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Abstract

The phenomenon of online dating via web and mobile phone applications involves several actors: graphical interfaces, developers, algorithmic systems for user matching, and users. These actors have been studied in parallel by the social sciences and by computer science. While computer science research focuses on the design of more efficient recommendation systems and on the analysis of behavioral patterns, research in the humanities and social sciences is interested in the effects of platforms and their computational practices on the formation of affective relationships.

This thesis explores how the mediation relations between the different actors of dating help to commonly establish the human-machine communication. Every actor learns in his-her own way a new conception of dating, mirroring the machine's algorithmic efficiency. The study of these new dynamics of communication is bound to become key to software and algorithmic studies, for which the human-machine relationship has hitherto remained invisible in the study of dating platforms, or incomplete when it comes to analyzing developers' practices or algorithmic systems without taking into account the final uses of the platforms.

Using a combination of qualitative and quantitative concepts and methodologies from sociology and data science, this thesis contributes to the comparative analysis of four actors who have a profound impact on the experience of online dating: graphical interfaces, developers, algorithmic matchmaking systems, and users. This is a study of more than 320 variables collected in more than 20 dating applications, both English and French, used in Switzerland and around the world. These variables mediate between the design of profile recommendation systems and their final use for dating. A case study is conducted on the massively-adopted dating application Tinder, which acts as an industry innovator, capable of establishing design conventions (e.g., swiping). This thesis further investigates, on the one hand, the development practices of nine founders and developers working in the industry, and on the other hand, the practices of 40 users of 26 different dating platforms.

The results show that the interaction with dating platforms involves a collective learning process of experimentation that allows for communication between humans and machines. This fast-paced communication favors trial-and-error practices: actors either learn to adapt to the machine, or on the contrary to overcome it by accepting the mutual tolerance stemming from the uncertainty of actions. Learning is possible through the supposed social conventions of the actors, some of which are made explicit and quantifiable through graphical interfaces. First, the interfaces present a conceptual model of use that makes explicit how to present the attractiveness of oneself, how to capture attention, and how to measure the performance of this attractiveness that is constantly updated according to the dynamics of the reputation economy. Secondly, the practices of developers are guided by the economic interests of dating companies. Dating is made quantifiable by imitating other successful applications, exploiting the developers' personal experiences, and by taking into account the machine's capabilities. This produces a reduction and a heteronormative standardization of the conceptual models of dating. Thirdly, the Tinder application case study shows how it favors an average ideal match modeled on sociodemographic factors through the swipe-imposed reduction of individual preferences. Finally, users learn to systematize their actions by mirroring the machine in order to fit into the reactive and competitive view they have of an application. However, there is also a personal reclaiming of the dating experience that allows individuals to step outside the machine-like framework of the application to foster other practices inherent in human capacities.

This thesis contributes to the described research field with a theoretical framework and empirical data which can guide future research on online sociability at the intersection of computer and social sciences, like in the digital humanities.

Keywords: online dating, development practices, matching algorithmic systems, self-description variables, user practices

Résumé

Le phénomène de la rencontre en ligne via des applications web et mobile met à contribution plusieurs actants: interfaces graphiques, développeurs, systèmes algorithmiques de mise en relation, utilisateurs et utilisatrices. Ces actants ont été étudiés en parallèle de manière distincte par les sciences sociales et l'informatique. Alors que la recherche en informatique s'intéresse à la conception de systèmes de recommandation plus performants et à l'analyse des traces comportementales, la recherche en sciences humaines et sociales s'intéresse quant à elle aux effets des plateformes et de leurs pratiques computationnelles sur les usages dans la formation des relations affectives.

Cette thèse explore comment les relations de médiations entre les différents actants de la rencontre permettent d'établir collectivement une communication humain-machine. Chacun apprend à sa manière une nouvelle conception de la rencontre à l'image de l'efficacité algorithmique de la machine. La question de ces nouvelles dynamiques de communication est appelée à devenir centrale aux software studies et algorithmic studies, pour qui la relation humain-machine est restée jusqu'à présent invisible dans l'étude des plateformes de rencontres, ou clivée lorsqu'il s'agit d'analyser des pratiques de développeurs ou des systèmes algorithmiques sans prendre en compte les utilisations finales des plateformes.

À partir d'une combinaison de concepts et de méthodologies qualitatives et quantitatives issus de la sociologie et de la science des données, cette thèse contribue à l'analyse comparative de quatre actants ayant un pouvoir d'agir sur la rencontre en ligne: les interfaces graphiques, les développeurs, les systèmes algorithmiques de mise en relation, et les utilisateurs et utilisatrices. Il s'agit d'une étude de plus de 300 variables collectées dans plus de 20 applications de rencontres, anglophones and francophones utilisées en Suisse et dans le monde. Ces variables font la médiation entre la conception des systèmes de recommandation de profils et leur utilisation finale pour faire une rencontre. Une étude de cas est réalisée sur l'application de rencontres Tinder, laquelle est massivement adoptée par les individus, tout en représentant un modèle d'innovation dans l'industrie, établissant des conventions de design (e.g., le swipe). Cette thèse explore aussi d'un côté les pratiques de développement de neuf fondateurs et développeurs travaillant dans l'industrie, et de l'autre les pratiques de 40 utilisateurs et utilisatrices de 26 plateformes de rencontres différentes.

Les résultats montrent que dans les plateformes de rencontres, il existe un processus d'apprentissage collectif d'expérimentation qui permet d'établir une communication entre les humains et la machine. Cette communication fonctionne sur un rythme accéléré et qui favorise des pratiques d'essai-erreurs: les acteurs peuvent apprendre soit à s'adapter à la machine, soit à la dépasser en acceptant une tolérance mutuelle sur la base de l'incertitude des actions. L'apprentissage est possible grâce aux conventions sociales supposées partagées des acteurs dont certaines sont rendues explicites et quantifiables au moyen des interfaces graphiques. En premier lieu, les interfaces présentent un modèle conceptuel d'utilisation qui rend explicite comment augmenter l'attractivité de soi-même, comment capturer l'attention, et comment mesurer la performance de cette attractivité qui s'actualise en permanence selon les dynamiques de l'économie de la réputation. En deuxième lieu, les pratiques de développeurs sont guidés par les intérêts économiques des entreprises de rencontre. La rencontre est rendue calculable en imitant les autres applications réputées, en exploitant l'expérience personnelle des développeurs, et en tenant compte des capacités de la machine. Cela conduit à une réduction et à une standardisation hétéro-normative des modèles de la rencontre. En troisième lieu, l'étude de l'application Tinder montre comment elle favorise un idéal moyen stéréotypé de la rencontre, modélisée à partir de variables sociodémographiques, en réduisant les préférences individuelles grâce au swipe. Enfin, les utilisateurs et utilisatrices apprennent à systématiser leurs actions à l'image de la machine afin de se conformer aux injonctions du design de réactivité et de compétition d'une application. Cependant, les individus parviennent à reprendre et à réviser leur expérience de la rencontre et à sortir du cadre machinique mis en place par l'application en mobilisant leurs compétences communicationnelles.

Cette thèse propose un cadre de référence théorique et un ensemble de données empiriques qui peut orienter de futures recherches sur la sociabilité en ligne à l'intersection de l'informatique et des sciences sociales, comme dans les humanités numériques.

Mots clés: rencontres en ligne, pratiques de développement, systèmes algorithmiques d'appariement, variables d'auto-description, pratiques d'utilisation.

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INTRODUCTION

Modern practices for finding a date online evolved with the development and adoption of technologies, as well as through the establishment of the dating industry. There are more than 9,000 mobile dating applications (apps), such as Parship, Bumble, and Hinge, in the mobile stores. Some apps are listed on the stock exchange under the corporate agglomeration of brands (e.g., The Match Group) (Bergström, 2019). Although it is claimed (Bergström, 2019) that these companies do not have expertise in couple formation, machine learning techniques are being developed to improve the performance of automatic recommendations on platforms (Xia et al., 2016 ; Yu, Zhang and Kreager, 2016). Predicting reciprocated preferences in order to match users is an active research area in computational recommender systems. In contrast to other platforms, dating apps are conceived as "reciprocal recommendation systems" (Pizzato et al., 2010) that measure mutual interest based on messaging interactions, behavioral traces, and user profile characteristics (Tu et al., 2014 ; Xia et al., 2016). In parallel, users are increasingly adopting dating apps like Tinder for multiple motives, including entertainment, curiosity, ego-boosting, meeting, and sexual experience (Timmermans and De Caluwé, 2017a). In Switzerland, dating platforms are the second most frequent means of finding a partner, the most frequent one being through friends (Potarca, 2020). According to the Swiss national survey about couples and families in 2018, 20% of Swiss adults are in a relationship of five years or more with somebody they met online. More broadly, scholars have identified two main transformations in online dating. On the one hand, dating apps foster couples with a stronger desire to settle down and have children, than partners who meet offline (Potarca, 2020). On the other, user practices in dating apps are regulated by the development of a "scopic capitalism" (Illouz, 2020). This scopic capitalism, mainly dominated by men, is based on the visual consumption of women's sexuality that is reduced to their bodies through images. Consequently, dating apps create evaluative and comparative dynamics of sexuality that lead to a "non-engagement" in romantic relationships.

The main purpose of this thesis is to understand the processes by which such transformations in dating practices come about in an ecosystem of human and non-human actors who build and shape its shared conventions. Previous research by social scientists and computer scientists into online dating phenomenon has analyzed single actors as isolated case studies. Hence, the current literature is limited to a partial view of this ecosystem, where Graphical User Interfaces (GUIs), matching algorithmic systems, developers and users have different agencies on the practice of dating. By the means of the relevant sociological theories, I provide a more comprehensive and holistic account of the interactions and interdependencies implied between these actors.

To briefly summarize the studies on the four types of actors, first, according to (MacLeod and McArthur, 2019), GUIs, in the dating apps Bumble and Tinder, convey the representation of heteronormative relationships with binary values (male/female) for describing the self and researching another person through the design of affordances like declaring gender identity. In addition, GUIs present profile forms that enable users to create a detailed self-description, both physical and psychological for establishing quantitative evaluations for both users and matching algorithmic systems (Fiore and Donath, 2004 ; Kessous, 2011 ; Zytko, Grandhi and Jones, 2016a). Second, few studies have been conducted about developers in dating companies. The studies that exist show that developers inscribe not only the company's branding strategy into the design of dating services, but also their personal ideas of relationships (Bergström, 2019 ; Churchill and Goodman, 2008). Third, algorithms in apps like CoffeeMeetsBagel and OkCupid ignore certain preferences declared by the users via GUIs, and provide recommendations that discriminate specific users (Hutson et al., 2018). Finally, it is argued that users believe in the algorithms' ability for finding the best possible date: users' perception of the algorithms seems more important than knowing how they work (Sharabi, 2020). According to their design, algorithmic outputs presented on the GUI guide users' attention via the information that is

displayed (Tong, Hancock and Slatcher, 2016). Such separate findings, however, can be integrated into one comprehensive framework in order to shed light on the processes by which the aforementioned actors pragmatically bring forth transformations in online dating such as the ones mentioned above.

This thesis studies the learning of communication processes (Livet, 1994) by which online dating techniques and practices are established in a situation involving combined relations between human (developers, users) and non-human actors (GUI, matching algorithmic systems). Based on the actor-network theory adopted from sciences and technology studies, I account for the agency of both humans and non-humans producing effects within a network of "translations"; i.e. transformations or changes that produce relations between one actor and another (Akrich, Callon and Latour, 2006). Complementary to that, I use the pragmatic approach (Boltanski and Thévenot, 2006), taken from the social sciences, to study online dating as a situated practice, with an emphasis on human reflexivity and capacity for action. This approach is particularly effective for analyzing the forms of knowledge that users engage with and that are produced throughout their practices to understand the social world. More specifically, I investigate the conventions of online dating and how these are developed by taking into account—with the same level of importance—human and technical practices, as well as the materiality that mediates them. Conventions are defined by Boltanski and Thévenot (2006) as common benchmarks that enable actors to participate in a collective action. These common benchmarks, that can be explicit or implicit, enable actors to understand each other and to cooperate based on principles and values that guide the coordination of their actions without the necessity of verifying such conventions. In this sense, conventions act as "supposed shared references" for reviewing actions (Livet, 1994). Conventions can also be formalized as tools and "methods for defining and coding the object, the individual, or the phenomenon, to be measured. Measures result from these conventions, and they are by definition normative as they seek to put in equivalence qualities for the quantification and comparison." (Desrosières, 2014, p. 38). In that sense, they play a crucial role for the quantification of user behavior in a standardized way, but also for the design of the graphical layout and behavior of apps according to the "conceptual model" (Norman, 1999) of the intended end-user's perception. This thesis analyses two conventions in particular; first, *affordances*, defined as the perceived range of possible actions that an app offers to users in relational interactions (Gibson, 2015 ; Norman, 1988). The second type of convention is *variables*. A variable (e.g., body shape) enables users' self-description by presenting different categories as input values (e.g., slim; athletic). These two conventions are a common link between different actors. They establish a communication between the machine and humans. Matching algorithmic systems require variables to be able to compute user behavior. These affordances and variables are defined and implemented by developers in a software program, and later offered to users via the GUI. In addition, GUIs contribute to the apps' commercialization. In the "reputation economy", a term coined by André Orléan, GUIs serve to attract and retain users on the platform by capturing their attention within multiple "regimes", i.e., within multiple processes, characterized by specific features, that engage the users' attention in predetermined ways (Boullier, 2009, 2019a). The principles of the reputation economy, also called the "attention economy", enables the companies developing dating apps "to attract sponsors and advertisers" (Illouz, 2020) through on the grounds of the collected personal data (Albury et al., 2017). In addition, the quantification tools explicit in GUIs enable users to seduce other users and influence the evaluations that are being produced about them, as has been observed in the case of social media platforms (Boullier and Lohard, 2015 ; Gerlitz and Lury, 2014). As a first contribution of this dissertation, I extend that literature by providing initial comparative empirical evidence on the conventions that build the reputation economy in the dating industry and the underlying processes that define and shape those conventions.

To computer science and social sciences, this thesis contributes an understanding of the way in which actors influence each other within a common process. Actors co-construct dating as an experience and expertise where material technologies and human affect are entangled. On the one hand, developers influence what machines and users learn as practices through the initial conceptual choices made in the development of a

software program. On the other hand, users influence what the app collects via GUIs and what developers learn as user behavior throughout daily connections on the platforms. The social sciences literature on software studies (Manovich, 2013) creates a fertile common ground for interdisciplinary research; this literature, is particularly interested in the analysis of Artificial Intelligence (machine learning techniques), and human-expert practices. Although scholars distinguish between human reasoning and machine thinking (Burrell, 2016 ; Pasquinelli, 2019), they show how the conventions of machines and developers create specific sociotechnical arrangements that influence the social world that they produce. These arrangements have a broader impact on the way in which humans learn to reason with computers (Houdé, 2019a, 2019b) and to explore the social realities experienced within online platforms in a pragmatic manner (Auray, 2016). Based on ethnomethodology (Garfinkel, 1984), I analyze how actors learn to build common-sense knowledge of their realities through situated practices. Knowledge is thus pragmatically based on specific pieces of information, "a stock of knowledge at hand", that are used in collective actions with objects and other humans according to their appropriateness *in situ* (Leiter, 1980). More specifically, as a second contribution of this thesis, I extend the literature by conceptualizing a human-machine communication process that enables various actors to learn, from the readjustment of collective actions, to build an expertise in online dating. The results shed light on the design and the uses of dating platforms that shape the possibilities of finding a date or a partner, and that lead to innovations that stay in the market.

The thesis is structured around four actors: GUIs, developers, matching algorithmic systems, and users. Every actor—each analyzed in a separate chapter—provides a different standpoint on the communication process with their respective mediations. Given the diversity of actors analyzed in this thesis, each chapter answers different research questions in relation to previous research. Moreover, each chapter begins with a small introduction and summary that establishes the links and relations between the various actors.

In Chapter I, I introduce the conceptual framework and the methods of inquiry. A variety of approaches and concepts from social sciences are presented, as well as this thesis' roots in the field of digital humanities. The framework provides a structure through which to understand each actor that is analyzed in the thesis and serves as a common background guiding the reader through the multiple perspectives discussed in the individual chapters. Combining theories and methodologies issued from data science *and* sociology, it constitutes a contribution to bringing the two domains together in the study of dating platforms. The first chapter also presents a general overview of the underlying datasets and the research ethics. More detailed descriptions are then presented in each chapter.

In Chapter II, I analyze the online dating experience from the perspective of three conventions of GUIs: affordances, variables, and input values. I carry out a systematic and comparative analysis of the materiality embedded in more than 20 dating platforms that shape the perception and interactions of users. I do not claim exhaustivity, rather I provide a comparative analysis of apps that present contrasting experiences in the dating market. This bottom-up approach is grounded in a qualitative and quantitative analysis of GUIs and provides an external perspective on the ways in which the app shapes the user experience. The results provide an understanding of the dating profile structure, and the means and semantics offered to users in order to describe themselves and to find a date. The results also provide a partial view of the computing variables defined for matching algorithmic systems. Other variables are taken into account by the systems that are, however, protected by intellectual property laws. The mentioned GUI conventions are influenced by the choices of development practices analyzed in the third chapter.

In Chapter III, I investigate typical practices in developing dating apps based on an interview study with nine founders and developers from ten dating app companies. The first part of the chapter is an analysis of practices used for building a software program. The second part is an analysis of economic and sociotechnical factors that, in the dating industry, guide the definition of variables when developing and releasing a

dating app. The results explain how communication is established between humans and the machine in order for the app to function, and the similarities and differences of variables observed across platforms in the previous chapter. This qualitative analysis provides a novel perspective on the online dating phenomenon: a view of the app in development. It is also a link to a better understanding of the matching algorithms that are necessary for recommendation systems, as analyzed in the following chapter.

In Chapter IV, I contrast the analysis of dating apps' technological expertise to human matchmaking expertise. More specifically, I study the matching algorithmic system of the dating app Tinder, based on a qualitative analysis of technical documentation, to identify the mathematical procedures of machine learning methods – so widespread today in different platforms – which enable measuring and matching users. The results show that Tinder defines the way profiles are ranked and recommended based on constructed variables and a principle of asymmetry according to sex, which transforms the probability of finding a date. Finally, I present the analysis of matchmaking expertise in a Swiss matrimonial agency based on an ethnographic study. The results show that matchmakers foster a common definition of dating that is negotiated through a process of continuous learning with members of the agency. The results are discussed, in contrast to the service provided by dating apps. The constrasted analysis contributes to understanding the possibilities and limitations of modern matching techniques. The chapter provides a view of the app from the inside, which is invisible to users of the GUI. Matching algorithmic systems are the core functionality of the service provided to users in the app; therefore, this chapter provides a link to the analysis of users, the final actor to be analyzed.

In Chapter V, I analyze user practices on dating platforms based on an interview study with 40 participants. Participants were invited to discuss their interactions on the app, and to use the dating platforms during the interview, in order to observe the users in action. The results provide an external analysis of the app functionalities in interaction with users, a situation that is distinct from analyzing user behavioral traces online. User behavior analysis reveals the limitations to the understanding of the dynamics of actors that cannot be captured, e.g., moments of hesitation before taking an action in the app, a dysfunction encountered with the app. The results shed light on a human-communication process that enables users to engage with the app, evaluate and interact with others; this process ultimately influences the actors' dating practices – both on the online platform, and offline.

The Conclusion summarizes the contributions of this thesis, presents a reflection on the empirical findings, and discusses possible areas for future research. Parts of the work presented in this thesis have been published in the references presented below.

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CHAPTER I. CONCEPTUAL FRAMEWORK AND METHODS OF INQUIRY

1.1. Introduction

In Chapter I, I present a conceptual framework drawn from sociology that is crucial to understand how I, as a researcher, engage empirically and theoretically to study the online-dating phenomenon. The multiplicity of concepts is relevant for knowing what and how to observe within a social world with different stakeholders, each one entangled with different techniques and objects, and each with its proper relational dynamics. The definitions might seem evident to human and social scientists. However, it is necessary to clarify them for engineering and data scientists who are also the readers of this thesis. Overall, the conceptual framework helps me to be coherent and to justify my observations, without preventing the data (qualitative and quantitative) from speaking for itself yet giving it a social sense, as experienced by the actors. The framework serves the reader as a guide to the research questions and to the standpoint adopted according to each actor. It is therefore worth reading this chapter, so as to be able to follow the actors within their own dynamics, in the same way as I did throughout the four years of this thesis research. The concepts are coming from different approaches which enriched my conclusions through the understanding of different social realities and their associations in online dating, as they are often ignored by one discipline or another. The enriching conceptual framework embraces science and technology studies (STS), media studies, the economy of conventions, attentional regimes, pragmatic sociology, and ethnomethodology. After discussing the related concepts to these approaches, I will present the methods of inquiry according to this framework. Finally, the thesis corpora and ethics are detailed.

1.2. Conceptual Framework

1.2.1. Science and Technology Studies

In this thesis, I analyze different actors that, together, produce the online-dating phenomenon: interfaces, affordances, self-description variables, sociotechnical choices of developers, and users' methods for finding a date. Not every scientific discipline and approach take in consideration all these elements, but the first sociological approach adopted in this thesis does. The science and technology studies (STS) consider equally both human and non-human elements as actors within a network. This idea comes from three main writers Michel Callon, Bruno Latour and John Law that formulated in the 80's the "Actor Network Theory" (ANT),[1] also called the sociology of translation (Akrich, Callon and Latour, 2006). Law (2009, p. 141) defines it as follows:

[1] ANT is spread across disciplines in social and human sciences, as well as in engineering, both in French and English-speaking countries, see (Asdal, Brenna and Moser, 2007).

"Actor network theory is a disparate family of material-semiotic tools, sensibilities, and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. It assumes that nothing has reality or form outside the enactment of those relations. Its studies explore and characterize the webs and the practices that carry them. Like other material-semiotic approaches, the actor network approach thus describes the enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, "nature", ideas, organizations, inequalities, scale and sizes, and geographical arrangements."

All these elements are considered in the ANT as "actants"[2] in order to avoid the divide between humans and non-humans. In this sense, actants are treated in a "principle of symmetry" and are accounted by the role they have in a network. Here, network does not consist in mapping interactions and links between actors. Instead, the interest is to observe the actants that produce effects within a network of connections made of "translations", i.e. transformations or changes that produce relations between the actants themselves. This principle leads me to look for the network *in the making* as a process in continuous transformation. For instance, when analyzing user profiles on social-network platforms, such as Facebook or LinkedIn, it is relevant to observe not the user profile as an individual, or "the whole", but the networks built by the "likes" in association with other elements of transformation, e.g., a metric. Following the translations of the likes is "to deploy its actor-network" that ultimately enables "encountering people or exploring communities without ever changing level [of analysis]." (Latour et al., 2012).

A critique (Boullier, 2017a, 2018a) to this approach is that when the researcher is following the network in the making, the variety of elements to account for can be endless. Consequently, comparison across case studies is not possible. This creates a limitation for analyzing current social phenomena produced on digital platforms. In STS, there is a prevalence for producing qualitative analysis based on a fine description of observations (i.e., ethnographic methods). In Law's words: "the actor network approach is not a theory. Theories usually try to explain why something happens, but actor network theory is descriptive rather than foundational in explanatory terms, which means that it is a disappointment for those seeking strong accounts. Instead, it tells stories about "how" relations assemble or do not. As a form, one of several, of material semiotics, it is better understood as a toolkit for telling interesting stories about, and interfering in, those relations. More profoundly, it is a sensibility to the messy practices of relationality and materiality of the world. Along with this sensibility comes a wariness of the large-scale claims common in social theory: these usually seem too simple." (2009, p. 142). The fact that ANT is descriptive and favours storytelling to reveal associations does not diminish its contribution. This qualitative work, grounded in empirical case studies, is where its main contribution relies in order to show how processes, often taken for granted, are produced. This method separates ANT from other sociological approaches based on general theories that do not cover the actors' pragmatic reality. However, digital phenomena require other methods. This is acknowledged in ANT; several projects attempted to combine qualitative and quantitative methods but they presented limitations. There are two main limitations raised: First, there is a focus on the combination of methods that ends up favouring one method over another. This is a common pitfall of studies using mixed-methods that can be traced back to the beginning of twentieth century, as feminist research has shown (Turcotte, 2016).

[2] The concept of actants was originally used by A. Greimas (1966) when analyzing semiotic structures in popular stories. The author used actants to refer to heros by the roles they play and not to the human as an actor. Bruno Latour and Michel Callon took over this concept and made it a fundamental entity in STS to refer to humans and non-humans and their capability of transforming the social order, see Latour (1987), *Science in Action.*

Second, quantitative methods are often privileged and focus on rebuilding networks. The resulting topologies present static positions and structures, but not processes and relational dynamics as the ANT originally proposed (Boullier, 2018a).

Boullier (2018a) insists on developing new methods for social phenomena in digital platforms by exploring the way the reality is produced and by using the possibilities of "traceability" that these platforms offer. More specifically, data are produced and actors multiply (e.g., content type, data formats, machine-learning algorithms, metrics) on a different scale. This constitutes, for Boullier (2018a), a new quantification era from which the social sciences can benefit. More specifically, he suggests putting aside the networks and creating a new "digital ANT framework". At the center of this new framework is the idea of "accounting for processes of replication". To account for processes of replication requires following entities, like a tag; a title that has the particular agency to produce replications in time by circulating from one actant to another. Boullier (2018a) gives the example of memes that have the ability -via specific features of an image or a semiotic material- to replicate ideas across platforms and actors. "The agency of these entities becomes the purpose of the investigation, and it must be demonstrated comparatively, possibly using machine learning methods based on the huge amounts of digital traces now available." (Boullier, 2018a, p. 10). In this sense, the symmetry principle is crucial, as Donna Haraway earlier highlighted: scholars should "confer a voice to entities that are active co-creators in the knowledge process." (Haraway, 2007). If I summarise Boullier's (2018a) proposal based on the analysis of the limits and advantages of ANT, digital practices require new methods of "systematic restitution of observations, for their control, validation and comparison". The methods should enable "the hypothesis to be tested in a robust way". This idea insists on the opportunity of quantifying the social aspect. However, in one passage by Boullier (2018a), he highlights that qualitative analysis from ethnographic methods reinforce digital methods with the condition that they enable comparisons to go beyond fine-grained descriptions. Indeed, from this standpoint, it is relevant to understand what holds the social aspect and to not deploy its network. This idea of replications is relevant to online dating, whereas scholars highlight the recurrent agency of specific actors. For instance, the body and the profile picture (Illouz, 2020 ; Miller, 2018, 2019 ; Strubel and Petrie, 2017)(Illouz, 2020 ; Miller, 2018, 2020 ; Strubel and Petrie, 2017); the swipe design gesture to evaluate profiles on the dating app Tinder (David and Cambre, 2016 ; LeFebvre, 2018 ; Potarca, 2020 ; Rochat et al., 2019 ; Rodgers et al., 2019). However, these studies shift away from those actants to focus on the user and to analyze psychological behavior or socialization practices.

Why is STS important? It provides a situated view and enables the deconstruction of the terms generally called "society" or "context" through actants, human and non-human; we can *describe* and *deconstruct* these terms to understand the specific processes used in producing practical knowledge in social realities and in research.

A popular reasoning about technologies is that they have pervasive effects on society. For instance, dating-app algorithms diminish actors' romantic feelings, and video games make players addictive, thus favouring a technological determinism. Whereas another popular reasoning is that technologies do not have such effects, as it is what humans do with them that produces consequences for society. For instance, users of dating apps only register for sex consumerism, and developers create algorithms that discriminate some users in recommendation results, thus favouring anthropocentrism. The cleavage is also present in research. For instance, scholars in software studies pay attention to algorithms as things that can be known. "In doing so, they posit 'the algorithm' as an epistemic object that produces social consequences" (Ziewitz, 2017). Scholars can also pay attention to developers implementing machine-learning algorithms as "a human nexus in the work process that can result in counterproductive outputs for democratic societies and their shared human values." (Bechmann and Bowker, 2019). The resulting cleavage can be beneficial for reflecting on different realities, according to the standpoint adopted; but it fundamentally ignores entities that have agency on holding the network. Tracing the actor network is undoubtedly hard work and time consuming for one

single researcher, and as Boullier (2018a) highlighted, it could be endless. This has been further rendered difficult today, as technologies, such as dating apps or social-media platforms are produced within competing private companies that protect their inventions with commercial trade (Pasquale, 2015). This conditions what can be observed. Nevertheless, some researchers endeavor to capture multiple standpoints in platforms and to connect the network while conducting comparisons across entities. Some studies focus on only one platform; for instance, on the analysis of Facebook. Yet, they analyze the network from user traces that are compared statistically. They also analyze qualitatively advertisement-technical documentation, and interfaces (Cotter et al., 2021). In the study of dating apps, a sociologist conducts also quantitative and qualitative analyses. Bergström (2019) interviews webmasters and users, and conducts surveys and data analysis on the dating app Meetic (Bergström, 2019). However, she focuses on the analysis of social structures, see her typology of dating-app structures based on socio-economic criteria (Bergström, 2011), and she is not interested in the actors' dynamics or in their power of replication across platforms.

In this thesis, I study three different standpoints: Graphical User Interfaces (GUI), developers, and users. For each standpoint, I retain the relevance of replications, as Boullier (2018a) suggests. This enables me to focus on specific entities for each standpoint (e.g., variables on interfaces) that have agency over replicating online-dating practices across platforms. I abandon the interest on deploying a network on one case study to favour comparison instead. Through a comparative analysis, I identify the entities that become conventional across platforms. This way, I focus on comparing the plurality of possibilities that online dating creates for every actor, beyond the cleavage of the negative and positive effects of technologies. To build the comparisons, I use both quantitative and qualitative methods, chosen accordingly for every standpoint adopted. I do not focus on taking advantage of the traceability that online platforms offer. Instead, I focus on the analysis of how such traceability is built, because it shows how the social aspect is shaped and what I can observe of it. Hence, I do not privilege one type of analysis over another. Although qualitative analysis enables me to have a situated view on what matters to actors, the quantitative analysis enables commensurability of entities. The methods of inquiry for each standpoint are presented in section 2 of this chapter. To my knowledge, this type of analysis is not common in STS. The main originality of this thesis lies in the conceptual framework exposed here and in its combination of traditional sociological methods of inquiries with data analysis due to my integration in an engineering school. This can contribute more broadly to the field of digital humanities, as I discuss later. Yet, it is important to remember that this thesis is anchored in the STS conceptual framework by its relevance to accounting for the materiality of online dating. My entry point to this materiality is the GUIs due to their crucial role. They mediate developers' practices of collecting data necessary for defining algorithms and of user interactions for finding a date, a partner, or for establishing at least a contact online.

1.2.2. Media Studies and Human-Computer Interaction (HCI)

Although STS pays attention to actants' relational dynamics, media studies and the HCI literature helps to understand that these relations are also perceptual dynamics constructed by design. They shed light on how interfaces are designed with "affordances" that program what is perceived and what can be performed by the user. The concept of affordances is at the core of the ecological approach developed by James Gibson [1979] (2015); it was adapted and applied later in the design practices of computational objects by Don Norman (1988). These two authors have, however, distinguished definitions (McGrenere and Ho, 2000). Gibson recognizes the agency of both the environment and the actors, and their relations (as in STS), to perceive the world. According to Gibson, the world is objective and perceived in the environment. Norman assigns more agency to conceptual models of actors that can be translated onto an object that reflects the world to be perceived. Affordances are considered in this case as "the means for communicating a design model to the user." (McGrenere and Ho, 2000). If I focus on Norman's concept when analyzing platforms, I study the

designer's general conceptual model of perceptions. Whereas, if I focus on Gibson's concept, I study platforms as the perceived relations of actors, and the environment that can be renewed according to each actor's perspective.

Originally, according to James Gibson [1979] (2015), affordances allow humans to act. They are "action possibilities" or "offerings" (McGrenere and Ho, 2000), they are the result of the interactions between a human being and the environment and make sense to each other in order to be perceived: "to perceive them is to perceive what they afford. This is a radical hypothesis, for it implies that the "values" and "meanings" of things in the environment can be directly perceived. Moreover, it would explain the sense in which values and meanings are external to the perceiver." (Gibson, 2015, p. 120). Gibson affirms that perception is not in the mind or on the properties of something, but it is on the changes that can be perceived from the ecological relations (Gibson, 2015). According to Gibson, "there are three fundamental properties of an affordance:

1. An affordance exists relative to the action capabilities of a particular actor.

2. The existence of an affordance is independent of the actor's ability to perceive it.

3. An affordance does not change as the needs and goals of the actor change (McGrenere and Ho, 2000).

In this sense, "Gibson's affordances introduce the idea of actor-environment mutuality" (McGrenere and Ho, 2000), whereas affordances are a singular, actionable, situated, and perceived (property 1); and they are stable with an independent existence (properties 2 and 3). Indeed, Gibson's ecological approach is focused on "direct perceptions" that "depend on the actor's 'picking up' the information that specifies the affordance and depends on the actor's experiences and culture. Let me be clear, the existence of the affordance is independent of the actor's experiences and culture, whereas the ability to perceive the affordance may be dependent on these." (McGrenere and Ho, 2000). Finally, another implied key element in Gibson's theory is "that affordances can be nested when an action possibility is composed of one or more action possibilities" that McGrenere et al. (2000) describe as a nesting of information that specifies affordances.

According to Norman (1988), affordances are perceived suggestions; he "deviates from Gibson in that perception by an individual may be involved in characterizing the existence of the affordance. Furthermore, Norman indicates that an affordance refers primarily to the fundamental properties of an object." (McGrenere and Ho, 2000). The study of dating-app interfaces illustrates how this concept is applied (MacLeod and McArthur, 2019). MacLeod and McArthur (2019) analyze more specifically the user's gender identity definition in the profile page designed by the apps Tinder and Bumble: Gender is coded as a setting button with which the user can set a binary heteronormative identity by choosing from a two-option list: male or female. In this sense, "affordances represent a way of understanding the role of the apps' interface in providing cues through which performances of identity are made intelligible to users of the app and to the apps' algorithms. The concept of affordances [...] applied to designed objects by Donald A. Norman ([1988] 2002), refers to the cues provided by an object that suggest its functions and operation. These clues and constraints reduce the number of alternatives from which we must chose, and so reduce the amount of specific knowledge required (Norman [1988] 2002, 55)." (MacLeod and McArthur, 2019, p. 826).

In a short article, Norman (1999) clarifies that his formulation of the concept affordances as "perceived affordances", in contrast to physical affordances in the environment. Whereas, he acknowledges that perceived affordances are made conventional by design (Norman, 1999). Norman states that "in graphical, screen-based interfaces, the designer primarily can control only perceived affordances. The computer system already comes with built-in physical affordances. The computer, with its keyboard, display screen, pointing device, and selection buttons (e.g., mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the screen" (Norman, 1999, p. 39). In contrast to physical affordances, Norman builds a two-fold concept

of perceived affordances that puts conventions at the centre: it is a design practice that integrates cultural conventions of a certain group. Otherwise they are not understood, and this later creates new ones in the environment to be learned. "When designing a graphical screen layout, designers greatly rely on conventional interpretations of the symbols and placement. Much of the discussion about the use of affordances is really addressing conventions" (Norman, 1999, p. 40).

The perceived affordances are created based on a "conceptual model" that is the design of the possibilities of user interactions. The model is relevant as it makes explicit to the designer a type of logical reasoning based on constraints that the user has to adopt. It follows the assumption that the user reasons in a certain way, therefore the social world is logically translated into the app:

"Logical constraints use reasoning to determine the alternatives. Thus, if we ask the user to click on five locations and only four are immediately visible, the person knows, logically, that there is one location off the screen. Logical constraints are valuable in guiding behavior. It is how the user knows to scroll down and see the rest of the page. It is how users know when they have finished a task. By making the fundamental design model visible, users can readily (logically) deduce what actions are required. Logical constraints go hand in hand with a good conceptual model. Cultural constraints are conventions shared by a cultural group. The fact that the graphic on the right-hand side of a display is a "scroll bar" and that one should move the cursor to it, hold down a mouse button, and "drag" it downward in order to see objects located below the current visible set (thus causing the image itself to appear to move upwards) is a cultural, learned convention." (Norman, 1999, p. 40).

Therefore, conventions -as embedded in the object- are used in design for defining in advance a conceptual model of the intended end-user's perception that is, in principle, a generalizable logic for the user. Norman's logical reasoning assumption is centred on the objects' properties that build a specific limited knowledge. This marks a clear abandonment of the ecological approach of Gibson's perception as direct affordances that are in the environment, relational, situated, and pragmatic (affordances have the frame of reference of action capabilities of the actors and not their perceptual capabilities, as Norman expresses). Although affordances designed in online platforms require the interaction between the interface and the user (otherwise they are not affordances in Norman's concept, but they are in Gibson's concept), the relation here is limited to what is preconceived as relational within the conceptual model and its affordances by design. The HCI scholar Gaver suggests talking about "the design that suggests an affordance." (McGrenere and Ho, 2000).

In this thesis, the study of perceived affordances, as conventions, provides an understanding on the perceptual dimension (that is operational and cognitive) of interfaces by design. GUIs have agency over users that are not in direct contact with designers but with these actants. However, I will not abandon Gibson's ecological approach for the study of user interactions, as each author elucidates that there is a type of learning required –or expected- by the actors to engage with a platform. Following Norman's concept means that actors have to learn a limited and logical constructed knowledge via perceived affordances or "new" conventions, as translated by the designers from the subject's cultural conventions. In other words, users learn to follow a logical user path. On the contrary, from Gibson's perspective, knowledge is directly available to learn in the environment. Based on "direct perceptions" in the environment, which depend on the actor's action capabilities, "an actor may need to learn to discriminate the information in order to perceive directly. In this way learning can be seen as a process of discriminating patterns in the world, rather than one of supplementing sensory information with past experience." (McGrenere and Ho, 2000).

1.2.3. Economy of Conventions

As the study of dating-app GUIs highlighted earlier, the design of affordances are a necessary mediation between users and algorithms (MacLeod and McArthur, 2019). This is a new logical-mathematical mediation that is added to the previous logical-conceptual model between designers and users. More specifically, affordances enable the collection of input values (e.g., male, female) via the definition of variables (e.g., gender identity) that are fed into a function necessary for algorithms to solve a problem. Hence, affordances are translated as quantification conventions more broadly necessary to statistics.

According to Alain Desrosières (2014), conventions are objects and methods to put in numeric values, qualities for statistical equivalency, i.e., characterizing in an homogenous way as to enable comparability. Users do not have access to upstream processes and agreements proper to the company's internal practices for establishing these conventions (this is what *software studies* aim to study in the analysis of algorithm developing practices). Instead, users have access to the resulting measures created by the app. The conventions enable programming interactions that users can perceive and computers can compute, and that the company can measure afterwards. Conventions are framed in terms of quantification for two reasons. First, the definition of GUIs is powered by the implementation of algorithms that facilitate data processing for the app functioning, and by the drive to automatically analyze data that provides a feedback about the app adoption. User traces are integrated into business metrics to evaluate platform performances and are examined by developers (Schermann, 2017). Second, their definition makes it possible for users in dating apps to declare and to evaluate their personal qualities (e.g., height, physical attractiveness) via a GUI to be comparable to the other users in the platform.

One study illustrates the use of dating-app quantification practices for both users and algorithms. The scholars present a relational situation online where one user browses the profile of another user anonymously (Bapna et al., 2016).

On the user side, anonymous browsing is a common market affordance on dating apps that the authors call "weak signal" as it enables users to make "an implicit move through viewing, without making a definitive explicit move by sending a message" (Ibid., p. 3102). The user who browses can either show or hide the profile visit, through affordances with a premium subscription. However, the user who is being "browsed" can also pay and access personal statistics that provide the number of times the profile was visited. Hence, the affordances as quantification conventions enable the user to measure the profile visibility resulting from the interactions between users. If the user does not have at disposal an affordance, such as a button that shows the action of seeing profile visits, performing the action is indeed not possible. Nevertheless, if the button is there but users do not choose to visit another profile because they are aware that the visit is not anonymous, no affordance will be identified by the other users in order to potentially make a contact.

On the algorithmic side, these interactions enable applying statistics for the app to function. It also enables performance analysis by companies, as the same study puts forward in the following concept: "while defining our [the researchers] outcome of interest, a match […] we define 'success' in online dating as a successful online communication […] More specifically, we define the communication of user *i* with user *j* as a match if there is a sequence of three or more messages exchanged between user *i* and user *j*. Communication theorists call this measure a double interact (Weick and Kiesler 1979), and it is considered a sensemaking process that people use when they organize in a variety of contexts […] Our [the researchers] conversations with the senior executives revealed that they strongly believe that the double-interact measure of a match is an accurate predictor of an off-line date and that it is used as an industry standard measure of success. Indeed, despite knowing the content of users' messages, monCherie.com [the dating app given pseudonym] uses

this double-interact metric as a measure of matching for their own internal recommendation engine, a key component of their value proposition to the users." (Bapna et al., 2016, p. 3107).

From this study, one can observe that statistical indicators result from conventions established and that actors rely on them to measure a certain performance (Desrosières, 2014), whether these actants are researchers, companies, algorithms or users. In online dating, these quantification conventions act as prior knowledge about seduction: personal qualities and events to be measured, as they are assumed to have value for a desired outcome that is, in principle, computable. It is important to note that the variables defined and presented via affordances do not have, in terms of computing, only a perceptual dimension but also a material-mechanical dimension. This constitutes one dimension of the "scale of complexity" (Boullier and El Mhamdi, 2020) of algorithm problems that influence development choices. The scale of complexity includes expressiveness (i.e., semantic precision for the computer to understand), computing time (i.e., the number of times a statement is executed, which influences the efficiency of the program), a dataset sample (i.e., how many observations, input values, to compute), and memory space (i.e., the amount of memory's computer used by the algorithm and its input values for executing and producing an output). In practice, the machine allocates a physical place in its memory for each of the variables whose values are coded by a sequence of 0's and 1's, the basic alphabet of the computer. Their values are successively modified by the execution of programs that are the transcriptions of the algorithms in a language interpretable by the computer. Variables, therefore, have a materiality in the memory of machines (computers, mobile phones, etc.) that conditions, by design, what to collect for calculating and producing a desired outcome.

Finally, Desrosières (2014) highlights that these conventions organize a social order while it produces a new one, as actors act upon it. As it was shown, these conventions have a perceptual dimension preconfigured in advance for an intended end-user. However, the conventions might be perceived differently by each person, according to their corresponding situations; which are fundamentally singular, that comforts Gibson's concept of affordances as action possibilities. The dating-app study above shows that men and women react differently to the affordances, as quantified and tracked by the app. When enabling anonymous browsing, heterosexual women tend to visit more women's profiles, and white women browse other races. Whereas, men browse less other men and do not browse other races. Moreover, anonymity does not increase the number of matches, and this convention is used only as a short-term practice. "Users revert to their original behavior in month three immediately once anonymity expires[3] demonstrating no observable learning effects." (Bapna et al., 2016, p. 3116). These observations show that the apps' conventions do not necessarily respond to the user's own conventions. The affordances –suggested by design- in the case above are not perceived, but only tested by users for a certain time for other purposes, which results, according to the authors, as a failure in learning from the platform perspective. Interestingly, this case elucidates that users do not learn as apps expect them to learn. It also shows that apps, with their algorithms, also learn about users. Quantification conventions, along with their related affordances, offer an opportunity to study relational dynamics as produced, accounted, perceived, and shaped differently by interfaces, their algorithms, and users.

1.2.4. Attentional Regimes

To study dating relational dynamics with their corresponding perceptual dimension, one cannot ignore how these dynamics are entangled with the apps' "reputation economy" (Boullier, 2009), currently called more

[3] i.e. paid subscription offered for a limited time to conduct the research

extensively the "attention economy" (Kessous, 2012). Indeed, to study how users perceive their online dating social world, it is key to understand in which ways their attention is captured. For instance, in the study below, I observe that the user attention was intended to be captured via the affordance for browsing anonymously, whereas the platform's interests were to increase user matches and retain them with a paid subscription. Other studies show that app structures can vary according to the community targeted (Bergström, 2011), the quantity of variables (Diminescu et al., 2010) and the type of variable categories (Zytko, Grandhi and Jones, 2016b), which means that each platform captures the user's attention differently. These studies do not describe the structures in detail, hence I cannot conduct a comparison; but they show separately that the configuration of each dating-app structure produces a variety of social practices. For instance, the user's attention can be captured in a racialized and hetero-cisnormative manner in order to attract white men of Western-culture on dating websites dedicated to finding migrant women (Levayer, 2019). However, capturing their attention has another interest far beyond this. Boullier (2009) explains that if the attention is on the platforms' economy, this is because capturing users' attention serves the app in building a reputation. Far from being an activity specific to platforms, users also build their own reputations and those of others they interact with online. Eva Illouz (2020, p. 150) calls it the "symbolic reputation economy", which on dating apps enables the company attracting sponsors and advertisers. According to Illouz (2020), the reputation is based on the construction of the visual and sexualised body of women, which then turned into capital.

As originally developed by Goldhaber in 1989, within an informational abundance, attention becomes the rare commodity to be attracted or captured in the attention economy (Boullier, 2009). By providing actors with information that they have not necessarily requested and that they are no longer able to sort, evaluate, or to interpret, attention is - by definition - scarce (Boullier, 2009). However, for Boullier (2019b), this so-called attention economy is fundamentally an economy of reputation, in the sense of André Orléan [2011] (2015). And it is not only based on informational abundance, as will be explained later throughout the attentional regimes (Boullier, 2009). According to André Orléan [2011] (2015a, p. 294) the evaluation of the price of goods is no longer made according to the law of supply and demand, as Illouz (2012) expresses: the demand of women over men is higher, hence the attributes of women become scarce. Orléan states that the price of goods passes through the establishment of the actors' "collective beliefs". This is due to the "self-referential" nature of the market, which is caused by liquidity and the speculation that this makes possible. When the individual evaluates the price they are willing to pay for a good, they do not only take into account the utility that this good means to them but also the means of the market to obtain this good. Such market behavior is called "self-referential", because the behavior of participants in the market is influenced by the market itself. These actors not only aim at exchanging goods, but also at acquiring purchasing power. This behavior gives rise to speculation[4].

How does this apply to the current "platformization"[5] of social interactions? Platforms collect user behavioral traces and compute probabilistic calculations on these traces. To Boullier (2019b), these calculations

[4] To establish these reflections, the author uses the Keynesian beauty contest that also illustrates the dating market. In this contest, the aim was to "choose the six prettiest faces from among a hundred photographs, with the prize going to the one whose preferences most closely resembled the average selection made by all the competitors." In this way, jury members choose not the faces they think are prettier but those they believe will win the majority of votes (Keynes, 1971 in Orléan, 2015, p. 317).

[5] "Following research in software studies, business studies, and political economy, [...] platformisation [is] the penetration of the infrastructures, economic processes, and governmental frameworks of platforms in different economic sectors and spheres of life. And in the tradition of cultural studies, […] this process [is] the reorganisation of cultural practices and imaginations around platforms (Poell, Nieborg and Dijck, 2019). The definition enables a sociotechnical analysis of platforms, based on their institutional dimensions (data, market, governance) and in correspondence with their shifting cultural practices (Ibid.).

serve to model a reputation based on the aggregation of traces, which builds the reputation in a self-referential way for both users and algorithms. This can be illustrated with a case study of the "Klout Score"[6] (Gerlitz and Lury, 2014). Gerlitz et al. (2014) explain this is a metric of influence in social media, created by the company and platform called Klout. It enables users to evaluate themselves and to modify their influence. The score considers "more than 400 variables" of engagement on multiple social networks. "The majority of signals used to calculate the Klout Score are derived from a combination of attributes": "Klout takes records of activities pre-structured by a number of social-media platforms, including tweets, retweets, and replies on Twitter, comments, wall posts, and likes on Facebook, and comments, re-shares and +1 s on Google+ as data (Klout 2012), and puts these continuously updated data-points in various kinds of recursive relations with each other to calculate a Klout Score for each Klout user. The Score is a number between 1 and 100." (Gerlitz and Lury, 2014). As explained by Gerlitz et al. (2014), Klout is a *participative metric of value* and not an individual rating as the values of the score are relative to collective dynamics. These dynamics are predesigned by the app, as relevant and measured in real time. The user measures their activities of influence in respect to others, through comparison. The user also has the ability to modify their evaluation, permanently through different actions. This is in alignment with the Klout score's design that affords *reactivity.* This is why, instead of referring to the term performance, Gerlitz et al. suggest calling the metric 'participative', as it relates to the dynamics of reactivity designed and afforded by the company: "The measurements they produce are not designed to capture a separate reality, but rather are deliberately designed to modify the activity that they themselves invite. They expect and exploit reactivity. Indeed, it is for this reason that we suggest that these tools provide not simply measures of participation but rather participative metrics of value." (Gerlitz and Lury, 2014, p. 180).

This influence measure contributes to building a reputation. The score serves "self-valuation" practices -as Gerlitz et al. (2014) name it- to be seen by others. These practices are visible with a score that qualifies the value of the user's actions in the social-media market that the company has created according to what they speculate as valuable. What Gerlitz et al. (2014) call "a participative score" is in the reputation economy dynamics based on collective beliefs. These beliefs drive speculation. In this economy, this means that users' take actions with respect to the value they think they have to others in the market. "The reputation-forming process creates value on itself by anticipating the preferences of others and speculating on them. It is then a collective process of the assumed evaluations of others." (Boullier, 2019b, p. 190). In this economy, the signals transmitted by actors must alter the evaluations being built by others; for instance, by traders that decide to invest in digital platforms, by advertisers buying real-time for ad placements, and by users themselves when socializing with others. The operations of speculation, or as Boullier (2019b) calls it "manipulation of signals", are not dematerialised, they rely on technical devices that hold as support indicators (i.e., a metric, a ranking like the Klout Score) which allow the aggregation of traces both to build a reputation and to attract the right person. Far from being an exclusive practice of traders or advertisers, there is a "collective learning" on social networks or even on dating platforms on how to attract, how to seduce. Hence, users cultivate a reputation by means of traces that give the right signals where competition between peers does not cease to increase (Boullier, 2019b, p. 193). This process is in permanent evolution; changes are tracked in real time and made public on dedicated platforms such as Klout, with dashboards and analytic tools. One main point of interest to this thesis is that when digital platforms seek to capture attention, they actually *produce* it and *direct* it while appearing to satisfy actors. Indeed, platforms create the tools for data analysis and user-behavior tracking, and platforms claim to know user preferences better than the users themselves (Ibid., p. 196). In parallel, users produce their own practices in order to build their reputation and capture attention. This

[6] Note that this platform was deleted by the company that bought it to the initial founders

reputation-formation process was empirically tested on a comparative study (Boullier and Lohard, 2015) of 280 opinion-mining services that offer dashboards for measuring an audience. The results show that there is a pragmatic co-construction of knowledge with devices in order to support the reflexivity of the actors. Companies build the dashboard conventions to be the bearers of the actors' reputation measurement. These conventions enable actors to modify their own exposure or their own targeted and labelled qualities, which provides feedback that companies believe they will measure (Boullier and Lohard, 2015).

As I see it, this is a two-fold reputation-formation process that involves a collective learning phase that is under-explored on dating apps and has not been yet qualified in detail. Online dating is a particular field of study as the dynamics that take place on the platform have, in principle, affective purposes. Emmanuel Kessous (2012) apprehends the process of seducing in online dating within the attention economy that blocks the development of romantic feelings. Although he quotes André Orléan to refer to the speculation process, he does not refer to the reputation economy. Instead, he uses it to describing the way the market works, how it "reveals" and affects, via profile forms, the actor's intimate sphere. This exposition of personal data ultimately affects the user's attention when engaging in a relationship. Kessous's argument tends towards a Marxist analysis of emotions, in alignment with Illouz (2012). Kessous (2012) refers to Illouz (2012) to highlight that there is a commodification of feelings on dating apps, and through a pragmatic analysis of the attention he explains seduction is equipped for calculation.

In Kessous's (2011) dedicated study to dating apps, he shows that users' affectional relations are approached as a *project,* in alignment with the new liberal capitalism that Boltanski et Chiappello (2011) have developed. Dating apps are constructed as markets. Consequently, actors construct self-presentation practices that provide the good signals in order to appear as the ideal candidate to others. As this market is based on speculations, choices are made based on the anticipation of the other choices, attracting another person's attention to one's self becomes homogenous and normative, which makes being unique (in French, "singularité") difficult. In a market logic, users seeking and selecting a potential partner are invited to apply benchmarking strategies, i.e., quantification practices for comparison and performances in order to attain the defined objectives. As a result, user interactions on dating apps are mainly rational strategies for Kessous (2011), due to the dating app design. These strategies are possible through GUI data-collection structures that the apps develop to guide users' attention. Kessous (2011) shows that, to objectify the self and the experience with the other, individual, physical, demographic, and psychological information, in particular, in the profile forms are accounted for in statistical equivalency by the platform. In turn, users use on this information to evaluate, to seduce and to go on a date with other users. Acccording to Kessous (2011), this objectivation guides the actors to a rational calculation of qualities, which blocks the development of romantic feelings. In opposition to rationalisation, Kessous (2011) finds that the idealisation and sublimation process about the other with incomplete information is necessary to develop romantic feelings. Moreover, the informational abundance to which actors are exposed to (i.e., comparing profiles, chatting with multiple persons at the same time) makes it difficult for them to focus their attention on only one person in order to build a relationship. Hence, learning online dating means acquiring "new seduction skills" that are "extracting oneself from a calculating logic and renouncing the abundance of possibilities proposed on the sites." (Kessous, 2011). These skills elucidate a learning process of distancing between the user and the platform's economy. Furthermore, Kessous (2011) highlights a relevant practice afforded by the app, without exploring it as part of the learning process: the conventional formatting of self-idealisation.

Kessous's (2011) general observations are limited to few dating apps in the market for long-term relationships, also called "generalists", and the study of user practices among actors who, registered in Meetic-France, declared the goal of desiring a long-term relationship. This focus on a specific goal is coherent with the author's analysis of love as a project. Consequently, Kessous's (2011) argument is framed by the possibility of choosing a partner and establishing a relationship, as sociologists in couple formation, to him framed

by the so-called attention economy. However, the results from Kessous' (2011) study do not cover multiple dating-app conventions that can coexist with multiple user practices. In the study of dating-app structures, Marie Bergström (2011) shows that the dating market is dominated by large American firms, such as the Match group, and that small and new players focus on a segmentation strategy by creating "niche" services to try to gain market share. They are, for example, sites dedicated to veganism, a specific religion or sexual orientation. Far from creating an original design or an image of their own, Bergström explains that companies, large and small, imitate by developing dating sites that take up existing concepts. More similar to the analysis of Kessous (2011), there is the study by Chaulet (2009b) about dating-app conventions. Surprisingly, Kessous (2011) mentions only Chaulet's doctoral thesis from 2007 in order to point out that profile-page construction builds statistical equivalency (Kessous, 2011, p. 210). However, Chaulet's (2009b) work, which is entirely dedicated to studying a pragmatic analysis of dating apps, goes further and in detail on dating-app conventions. Chaulet (2009b) qualifies the multiple forms of the process of evaluating others. Instead of attracting the other's attention for seducing and creating a reputation, Chaulet (2009b) explains that establishing *trust* is a first entry point to users in order to later consider the possibility of a relationship. I will cover this study in the following sections about subjects' engagements in platforms, after reviewing how multiple dating-app regimes can be created.

According to Boullier (2012), it is appropriate to speak of regimes of attention in the plural and in different degrees, as a device, its qualities, modes of capturing the attention, and the actors themselves are not in an absolute position. On the contrary, actors can navigate possible worlds in different temporalities and intensities. This plurality puts forward a social dimension present in apps; this plurality is entangled with the perceptual dimension constructed by design. It enables conceiving platforms as an ecosystem, or a social environment, and not merely as technological devices. This is how Boullier (2011) theorises experiences online. He provides a positive note to see both the potential and the constraints of the twenty-first century digital immersion, as ephemeral connections that constitute envelopes, or plural worlds called *pluriverses*. Boullier (2012) draws on Peter Sloterdijk's (2011) philosophical approach: Sloterdijk describes historical phases of envelopes in his trilogy on spheres that humans experience. In particular, he refers to the historical phase on globes as "our ability to round our world and integrate each other and to shape the world to our image in an assimilation process." (Boullier, 2019a).

Hence, he develops the theory of "habitele" (Boullier, 1999). The concept of habitele "is connected to the anthropological tradition of analysis of 'habit' (in French, [as a repeated behaviour] different from the technical devices called 'clothes'), 'habitat' (to be distinguished from the technical process of lodging since habitat involves a co-influence of the container and the inhabitant), and 'habitacle' in French; a personal bubble in which we inhabit." (Boullier, 2014a). The habitacle is far beyond a "personal-data ecosystem" or a media that captures our attention. Instead, he postulates to consider the digital world "as envelopes that we carry with us permanently and is mainly encapsulated in the smartphone, in which all access rights, all attachments, all affiliations, all transactional and provisional identities are stored and inhabited. From this point of view, the immersion of the twenty-first century looks exactly like what Sloterdijk (2004) refers to as foam, made of co-fragility, which allows extremely precise elective communities to constitute an envelope totally deterritorialized from the linguistic or national perspective." (Boullier, 2019a, p. 71). Indeed, today's actor's immersion in the Internet is *pluralistic,* which enable a smooth passage from one world to another, i.e., cross-platform but also within a platform. Being online, it is possible to experience heterogeneous worlds that capture a person's attention by surprise and with considerable timing. For Boullier, it is a new *envelope* that we *wear* (or bear) and *inhabit*, made of influences, of *neighbourhood* (or vicinity), and of *reterritorialization*

beyond geographic limitations (Boullier, 2014b, p. 15). However, the strategies of dominant platforms[7] recompose affinities and organise the circulation between social worlds, which provokes an *unified plurivers* (2012).

To understand how users' social worlds are programmed within different cognitive, perceptual, and relational dynamics, according to each platform's specific materiality, Boullier (2009) developed four "attentional regimes" that he considers distinctive envelopes (Boullier, 2019a). Before presenting these regimes, it is important to understand his definition of attention. Boullier (2009) defines attention mainly from Ribot's theory (1889) for whom the attention has at least two dimensions: duration and intensity. From these dimensions, Boullier (2012, 2014b, 2019a) progressively produces four regimes of attention, beginning with three regimes (2009) that present different degrees of each dimension. In the first regime of "loyalty", the duration prevails, and in the second regime of "alertness" it is the intensity that prevails. The third regime of "immersion" combines the two previous regimes, with a balance of duration and intensity (Boullier, 2009). The immersion "builds a cosmos capturing every sense", but it is also a shared experience. Finally, the fourth regime of "projection", in opposition to the immersion, is "holistic". It introduces "a single point of view and a universalist view of this world (universal means unique in this sense and is opposed to pluriverses)." The two regimes of projection and immersion "add a spatial dimension -the dimension of the topology of actants- to the one that connects the attention catcher and the caught one." (Boullier, 2019a).

First, the "loyalty regime" assumes duration, repetition, and stable bonding that provide well-defined conventions of perception that can be taught, transmitted, and inherited. Cognitivists make a distinction between this type of attention, described as automatic, and another one that is controlled. Attention is selective (a fundamental condition of attention) because it recognises habitual salient features in this regime. They can be memorised and produce habituation (Cowan, 1988). Boullier (2009) gives the example of religion that defines its members as faithful through repetitive rituals in church. Another example given is the packaging that by exposing specific qualities of the product, the packaging establishes loyalty between the brand and the customer (Cochoy, 2002). Karpik gives a more recent example in the digital-opinion economy, the so-called personalised advertising that enables adapting the offers of customers according to their singular tastes (Karpik, 2007).

Second, the "alertness regime" is characterised by intensity (Boullier, 2009). This destabilises the enduring attachment bonds of loyalty under reactivity. It works as a zapping modality, with exposure to events and stimulation interposed permanently. The intensity sets the attention on alert by means of devices and by its collective agency effect. In this regime, attention "is permanent excitement and maximum focus without reflexivity. It organises selectivity by eliminating context (and therefore habits) and it is active according to Cowan (1988)". This modality is called "priming" in cognitive psychology, and it explains the way attention is requested by small cues of stimuli, briefly and permanently (Boullier, 2009). Its perverse effect, according to Lahlou (2000), is the "cognitive overflow syndrome" that does not allow for hierarchy, orientation, memorization, or reflexivity (Boullier, 2009). A user's attention is captured in the platform by a state of alert, in "reactivity". This alertness is based more particularly on the reaction to *novelty* and *saliences* (Boullier, 2019a). This alert regime is currently largely adopted by platforms to produce excitement in users by liberating dopamine so that they are captivated by the app. This enables, in general, qualifying the current econ-

[7] i.e. the GAFAMT: Google, Amazon, Facebook, Apple, Microsoft and Twitter.

omy with other dimensions, in addition to its related informational abundance. The economy takes advantage of the attention design, according to the quantity and the shrinking length of information available, to the acceleration of its production, and according to its cognitive effects (Boullier, 2019a).

Third, the "immersion regime" (Boullier, 2009), particularly developed in the video game industry, mixes duration and intensity for sustained attentional effects. In this regime, the qualities of an object or experience are shaped through aesthetics, narrative, and multi-sensoriality in such a way that the qualities become captivating to actors for long durations of time while they receive continual satisfaction or excitement: for example, with prizes and other rewards. Thus, the player immersed becomes a producer of events, and the game becomes the reference for capturing users' attention in a different way. In particular, as this way of capturing attention is very much a shared experience with other players, who are faithful or loyal to a world that they build and are far from being individualistic and isolated. In the case of immersion, external influences are accepted (seemingly because they are appropriate) in order to produce a multifocal and integrated attention, centred and peripheral at the same time.

Finally, the "projection regime". Here the attention is captured "around a 'program', focusing on the 'project' (projection) to turn the mind towards the future (a promise), avoiding any influence and any feedback from environments and even by making the environments bend to this project." (Boullier, 2019a, p. 70). Projection has a projected and desirable vision of the world by means of cues and saliences that correspond to widely diffused expectations. In this regime, influences and signals are avoided as they can affect the plan. It is a strategy that, with a focus on the future, has to abandon to some degree the world of immersion in order to coordinate everyone around the program. This is a necessary strategy for moving forward and for focusing the attention of everyone on a single viewpoint (Boullier, 2014b, p. 12). "Desires of immersion mean 'to be had', 'to be caught' (passive mode) while the projection inspires the desire 'to have' (which are, according to [Gabriel] Tarde, both much better definitions of social entities, because 'having' is intrinsically relational unlike 'being')." (Boullier, 2019a, p. 71).

These four attentional regimes are relevant to this thesis in order to study first, the way dating apps produce the envelopes for capturing users' attention, and second, the way users capture other users' attention. Online dating is a particular environment, similar to social networks, where interactions are multi-partite and bi-directional. I illustrate these interactions below, based on the patents of the dating app Tinder (Rad et al., 2014), (Figures 1 and 2). The app, or the machine, is in interaction simultaneously with all users and individually with each users. A user is also in interaction with the machine, with all the other users, and one user at a time.

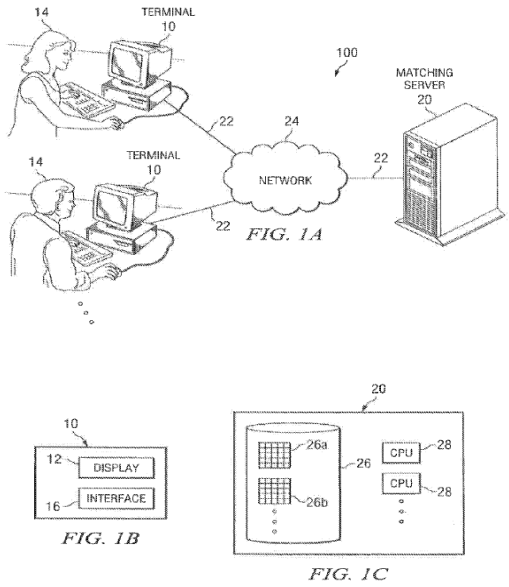

FIGURE 1 – DRAWINGS EXTRACTED FROM TINDER'S PATENT

FIG. 1A IS AN OVERVIEW OF THE MATCHING SYSTEM BETWEEN USERS AND THE MACHINE BUILDING A NETWORK, FIG. 1B IS THE PRESENTATION OF SEARCH RESULTS TO A USER BY THE MACHINE, FIG. 1C SHOWS HOW THE MACHINE, THE CPU, STORES, IN A SERVER, THE USERS WITH THEIR DATA WITHIN A TABLE OF VALUES.

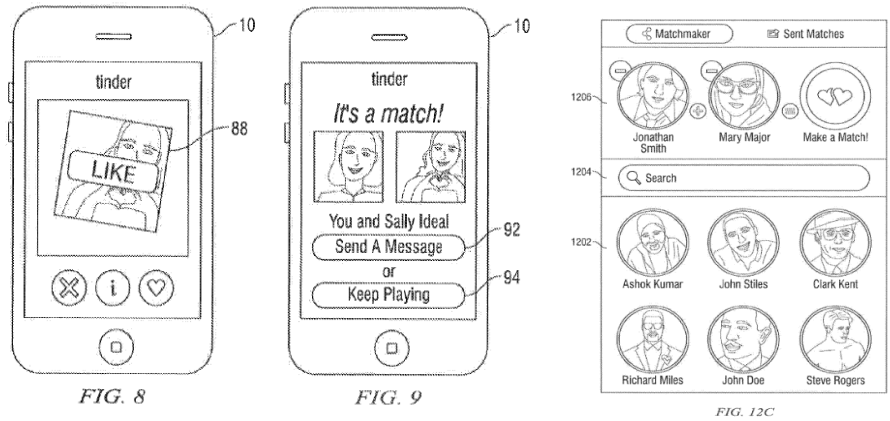

FIGURE 2 – DRAWINGS EXTRACTED FROM TINDER'S PATENT

FIG. 8, 9, 12C PRESENT THE DIFFERENT PAGES OF THE MOBILE DATING APP WHERE A USER SEES ONE PROFILE AND MANY.

1.2.5. Pragmatic Sociology

The way researchers engage with the reality they observe is related, in part, to their disciplines and their schools of thoughts, with their corresponding methods[8]. It provides guidance as a "compass". Indeed, Isabelle Stengers (2010), considers uncertainty as constitutive of scientific activity, but also of all contemporary human activities (Boullier, 2019a). For instance, I have shown earlier in this chapter how STS scholars analyse, based on the principle of symmetry, sociotechnical arrangements. This marks a disruption with previous studies about innovation. "Michel Callon and Bruno Latour propose to consider scientific activity as a collective work, linking multiple actors negotiating compromises and whose result is largely dependent on the cooperation and rules that organize them. This is in contrast to other scholars that see scientific activity as the fruit of an inspired individual, with a clear beginning and end and a clear sequence of steps (from invention to industrialization)." (Collin, Livian and Thivant, 2016). This is the reason I adopted an STS approach to entering the online-dating phenomenon, from the agency of its materiality. This entry point enables me to focus, up to this point, on the app structures, its design, and its economy programming, at first glance user behavior and attention. When studying user practices in online dating, I also read about distinct types of realities, according to the researcher's discipline. Kessous (2012) who study dating-app user practices in combination with app conventions, and Boullier (Boullier and Lohard, 2015) who is focused on other type of platforms, are anchored in pragmatic sociology. I adopt this approach in this thesis as it enables me to reconstruct the mediations between the purposes of the platforms and the users while embracing its materiality as the STS. In the previous point, I have also shown that the regimes of attention, within the reputation economy, are multi-partite and bi-directional. The interactional schema presented in the drawings (Figures 1 and 2) gives agency back to users as actants that can shape their dating social world, along with apps.

From a pragmatic approach, online dating is a situated practice, with an emphasis on human agency, i.e., humans have reflexivity and a moral-political capacity for acting. In this approach, I am particularly interested in the forms of knowledge that users engage with and that are produced throughout their practices to understand the social world. In other words, within this approach, I should consider how users engage in the world and learn know-how. The pragmatic approach steers me away from the two main approaches currently adopted for the study of online dating. First, there is Pierre Bourdieu's critical sociology, which is a structuralist approach that seeks to reconstruct the inherited and unconscious common sense of individual behavior on the basis of socioeconomic and cultural capitals. The "habitus" structures (and is structured) by the subject's social world (Bourdieu, 1979), including when the user chooses a partner in online dating in different countries, as recent studies affirm (Bergström, 2017, 2019 ; Schmitz, 2012). The second is the Marxist approach that was extensively developed by Eva Illouz (2020) in the development of the sociology of emotions but was also adopted by other scholars (Dröge and Voirol, 2011) who study dating apps. Drawing from the Marxist approach, Illouz (2020) explains that modern sexuality is a new separate sphere of consumption. It alienates love into a new form of non-engagement, in online dating based on economic logic and mass culture. To her, a "scopic capitalism" is rising, whereas the sexualised body of women has an economic value due to its transformation to an assignable visual unit based on aesthetic and fashion canons (Illouz, 2020, p. 144). To observe a clear distinction between these approaches, we can read further Illouz (2020). She explains that the industry builds a type of attractiveness and sex-appeal; the body is transformed into a visual article of consumption with the ability to arouse sexual desire. Therefore, for sex-appeal, there is no distinction between classes due to the user's massive adoption of the same products that build it, despite the user origins. She considers sex-appeal a democratic practice, in opposition to the notion of "hexis" by Pierre

[8] See the three generations of social sciences. These are different "viewpoints on the social" (Boullier, 2017a).

Bourdieu, to whom social class affiliation is expressed *in* and *through* the body (Ibid., p. 145). Whereas Bourdieu (1979) and his succeeding scholars focus on the revealed tastes of actors through structures, Illouz (2020) focuses on how the capitalist economic logic influences actors' tastes and emotions.

There is no denying that there are social structure reproductions and economic logic influencing online dating (as I have also put forward with the reputation economy). However, I privilege a pragmatic approach that is attentive to the dynamics of action. In the approach taken in this thesis, I assume that the actors have a critical and reflexive capacity to make a judgment of reality, based on the coordination of their actions with the environment (Thévenot, 2006). This is, in my opinion, aligned with Gibson's (2015) ecological approach to whom the environment, as well as the subject, is a frame of reference for understanding how social reality is perceived according to a plurality of action possibilities. Luc Boltanski and Laurent Thévenot [1991] (2006) drove this pragmatic sociology with a model of conflicting "orders of worth", i.e., inspired, domestic, market, industrial, of opinion, and civic, as a "regime of justification" that Thévenot (2001) expanded to "a sociology of regimes of engagements"[9]. In a nutshell, the problematic of the justification is how social actors justify their choices, their behavior and propositions; the action that is "just" to them according to a given order of worth (Boltanski and Thévenot, 2006). This way, it is possible to have access to the social actors' reality, the way they evaluate it and orient it to obtain a "good". A good, in French; "un bien", is not necessarily a material object; it can be, for instance, the feeling of belonging to a community through pragmatic manners in the domestic order. (Ibid.). Indeed, actors do not engage in actions in the same way if they are at home, at work, or in a park where they seek distinctive goods. However, in the previous sections' litterature, when presenting the different actants involved in online dating, one can see that actors are hardly definable in a single order of worth. Actors engage in intimate actions of the *domestic* order of worth (looking for, and bonding with, a date) within market exchanges, and of efficiency in the *industrial* order of worth, a platform ruled by productivity. Although Dröge et Voirol (2011) considers it as a new separate sphere of sexuality, a study on user practices in online dating shows that actors find themselves in tension between calculation and romanticism (Dröge and Voirol, 2011). Dröge et Voirol (2011) explain this tension by distinguishing two poles: the market and love, based on normative values. First, love is based on the reciprocal recognition of affectivity between two individuals. Secondly, the market is based on a logic of isolation and selfishness, of using others to obtain a profit (2011, p. 340). They also note a series of fundamental changes in modern society; these changes shape the normative values, such as entrepreneurial logic or the reduction of institutional restrictions for the formation of couples or families. Dröge and Voirol (2011) highlight, on the one hand, the sentimental involvement of users in the relationships they establish through online platforms, and on the other hand, the way in which individuals try to maximize the sorting of profiles to consult and the time spent in conversation or dating (2011, p. 350). This is why Dröge and Voirol (2011) consider digital platforms as spaces of experimentation of "neoromanticism" where distinguishing romantic love from economic rationalization proves to be extremely difficult, as these two spheres are often found in tension (2011, p. 353). For our interest in studying user-practice plurality, there are three "regimes of engagements"[10] that are further developed by Laurent Thévenot, in his book originally in French "L'action au pluriel" (2006).

The first "regime of familiar engagement" is the way of acting[11] in an "intimate" setting. This regime is defined as intimate by illustrating it with the first singular personal pronoun "I". The actor here coordinates with convenient actions and body gestures, in their environment, including objects and other humans. It is

[9] Well-known in the Francophonie but also in the Anglophone countries (Welch, Mandich and Keller, 2020)
[10] The author focuses on the term of engagement as an action within dynamic relations experienced by actors, and because the term contains "gage" which in French means something put in someone's hands as a guarantee.
[11] In French, the author uses the word "se comporter" that by definition is related to act "agir" on something or on somebody, in relation to a justification.

an act of personalisation that avoids a generalization of the person's world to everybody. (Thévenot, 2006, p. 102) For instance, organizing *my* bedroom. "The localized good is feeling at ease, comfort and convenience [...] The cognitive format is tacit and pre-reflexive as commonly acknowledged" according to Thévenot (2007, p. 416) (Welch, Mandich and Keller, 2020). However, according to Thévenot the "habituation" by its stability presumption is not sufficient to describe this dynamic construction of intimacy at ease: "the reaction to failure brings out rearrangements that can lead to a modification of my actions as well as to a transformation of my environment. The discrepancy is resolved in an adaptation of people or things that come to be reconciled again."[12] (Thévenot, 2006, p. 104). If there is success in the interaction with the environment, the conventions comfort the action (Ibid., p. 105).

The second "regime of engagement in a plan" (in French, "régime du plan") is the way of acting in a less personal setting; this is translated as an "ordinary convenience" joined by a third-party. This is illustrated by Thévenot, with the second singular personal pronoun "you" (Thévenot, 2006, p. 106): for instance, reorganizing *my* bedroom so *you* can stay in for a few nights. "In the regime of the plan, reality is engaged functionally, through an instrumental capacity. The 'good' is the accomplishment of autonomous will; however the regime also affords the mutual engagement of the joint project or contract" according to Thévenot (2014) (Welch, Mandich and Keller, 2020).

The third "regime of justification" is the way of acting in a general and controlled manner, so as to provide guarantees that will be evaluated by others. In this regime, the "action in common" is extended to a "common world", where actors seek a "common justification mode" instead of common intentions. This is illustrated by the third singular personal pronoun in French "il"; it is sex neutral and is defined by Thévenot as a "generalized other", an "anonymous person" who I could replace in English by a human "it" in plural. For actors, "it is no longer a question of adapting places to make them suitable for normal actions, but of preparing the possibility of an agreed coordination [with others] avoiding costly speculation about the actions of [them]."[13] (Thévenot, 2006, p. 107).

These regimes of engagement offer an entry point to how online-dating users shape their reality in respect to how platforms create their a priori conventions to capture attention.

Illouz (2020) adds that interactions are guided by structural frameworks that are cognitive, perceptual, and social in the sense of Erving Goffmann. These frameworks enable users to understand the situation and to orient themselves in the situation. However, modern heterosexual relationships, fostered in part by dating apps, have caused the separation of three distinct spheres of actions: sexuality, affection, and marriage. According to the author, this installs uncertainty[14] about the framework and the definition of the interaction, specifically in the modern culture of 'hook-ups' that she analyses extensively. In the sense of Thévenot (2006), she calls these three spheres "regimes of actions" that introduce distinct practices that are mainly problematic for forming romantic relationships (Illouz, 2020, p. 108). Rather attached to a traditional definition of relationships, she explains as follows:

[12] "La réaction à l'échec fait apparaitre des réaménagements qui peuvent conduire aussi bien à une modification de mes gestes qu'à une transformation de mon environnement. L'écart se résout dans une adaptation des personnes ou des choses qui en viennent à s'épouser à nouveau." (Thévenot, 2006, p. 104)

[13] "Il n'est plus question d'aménager les lieux pour les rendre adaptés à des actions normales, mais de préparer la possibilité d'une coordination conventionnée évitant les spéculations coûteuses sur les actions des autres." (Thévenot, 2006, p. 107)

[14] From this idea of uncertainty, the author develops six types of certitude in respect to romantic feelings that are not relevant to this thesis. The types refer to social structures and furthers away from pragmatic.

"Tinder can offer a quick one-night stand as well as the possibility of meeting the "ideal woman", with, between these two extremes, a multifaceted and indefinite range of possibilities. At the same time, a "confusion of frames" and an "uncertainty of frames" emerge; it is difficult to know in which frame one is acting, to anticipate a predictable plan of action and to use adequate tools to follow a defined course of action. Whereas traditional dating and courtship practices followed very precise scenarios both cognitively and practically (a boy picks up a girl at her house, takes her out to dinner or a movie, walks her home, gives her a kiss, followed by some caress). This type of modern sexuality undoes the classic romantic scenario. Indeed, the sexual practice - which marked the end of the courtship narrative - is now the beginning of the story, making the purpose of the relationship uncertain."[15] (Illouz, 2020, p. 113). According to Illouz, the uncertainty comes from not knowing the reasons for the encounter but also from not understanding the multiple significations of words, or from knowing the non-transparent intentions of actors (Ibid., p. 107).

This structural and generalist analysis is flattening singularity and personal reflexivity over structures. What might be a reality experienced by some users in one app, might not be in another app that has different conventions. For instance, in the study of user practices and their related utterances, both qualitative and quantitative, psychologists highlight the plurality of behaviours and motivational goals on one dating app: Tinder (Rochat et al., 2019 ; Sumter, Vandenbosch and Ligtenberg, 2017). In Meetic, heterosexual users describe themselves and look for a partner who has common qualities such as sensitivity and humour: with the "abolition of gender expressiveness, man and woman desire the same relationship, the myth of the two-person relationship does not seem to take hold today in terms of gender stereotypes." (Lemeilleur, 2014a).

In another note, two users can find themselves in the same regimes without the same intentions. For instance, two users are in different degrees on the regimes of plans for family for example, two users are planning to form a relationship and have a family. Being in the same regimes does not guarantee that actors have the exact same intentions about how to form a family. It is important to know the reasons why a person wants to have a child (which is the only element of uncertainty, according to Illouz). Kessous (2011) sheds light on the problematic of intentions in online dating with a user's practice excerpt, but he does not develop it further as his attention is focused on understanding romanticism, instead of trust:

"The declarative fields, however detailed [they are on the profile's page], these are of no help: 'when women put on a plumpy figure, it is often because they are fat', [says a male interviewee]. This apprehension of investing time in an interaction with a woman who will ultimately not suit him leads him to be suspicious of profiles when the weight section is not filled in. But why did these women did not provide this information? Because they are vain and they feel that it is not conventional to ask such a question to ladies? Because they refuse this standardization of the body? Because they are indeed fat and want to hide it? Our interviewee will never know. And for a simple reason, highlighted by Livet (1994) in his analysis of Austin and speech acts: the intentions delivered by this information are "undecidable". In general, people take this informational incompleteness as something positive. The author even bases his conceptualisation of trust on it." (Kessous, 2011, p. 214)

[15] "Tinder peut proposer un rapide coup d'un soir comme la possibilité de rencontrer la "femme idéale", avec, entre ces deux extrêmes, un éventail multiforme et indéfini des possibilités. Du même coup, se profilent une "confusion de cadres" et une "incertitude des cadres", il est difficile de savoir dans quel cadre on agit, d'anticiper par conséquent un plan d'action prévisible et de recourir à des outils adéquats pour suivre une ligne de conduite définie. Alors que les rencontres et les pratiques de cour traditionnelles obéissaient à des scénarios très précis à la fois sur le plan cognitif et pratique (un garçon vient cherche une fille chez elle, l'amène danser ou voir un film, la raccompagne, lui donne un baiser, suivi par quelques caresses). Ce type de sexualité moderne défait le scénario romantique classique. En effet, le rapport sexuel -qui marquait la fin du récit de la cour amoureuse est aujourd'hui le début de l'histoire rendant ainsi le but de la relation incertain." (Illouz, 2020, p. 113)

There is a final element that has been so far ignored in the pragmatic sociology and the study of dating apps. How do machines engage in the online dating reality? More precisely, how do algorithms engage in online dating, as they are the machines accounting for the input values directly provided by users? Scholars and the media (Duportail, 2019 ; Hutson et al., 2018 ; Illouz, 2020) have alerted the public about their actions of intended discrimination bias in online dating. This is also the case with other platform algorithms such as Uber (Cardon and Crépel, 2019). I have shown earlier (with the attentional regimes) that interactions in online dating are multi-partite and bi-directional, which means that users not only interact with other users; they also interact with the machine to attract its attention in a retroactive dynamic (the machine also wants to get the user's attention). Kessous (2011) gives another example that provides a hint about how algorithms engage in the world: "The algorithms of the various sites puts forward the profiles of the last connected. Withdrawing from the site is a guarantee that [users] will never be contacted again (except occasionally, when the sites include them in the mailing of suggested profiles, with the aim of re-motivating [a user] by means of a new message)." (Kessous, 2011, p. 209). The author abandons right after this machine's standpoint without exploring it, as he stated: "But now let's put ourselves in the position of a new registrant on one of the above-mentioned sites to achieve his or her goal: to find a person with whom to share a lasting relationship." (Ibid.)

Objects, or machines, are actants that have agency over the world. However, from their standpoint; how do they engage with users? Are their process (and not only their outputs) aligned with the app conventions designed to attract the user's attention? Users and platforms do not have the same goal in online dating. Despite the user's goal of "finding a person for a lasting relationship", it is an assumption that the app, as a private company, establishes its position in the market by providing a standardized service for increasing the number of users registered (Musiani, 2015). This is illustrated by a business-model study on the dating app Tinder that ensures economic profit by retaining users (Afuah, 2018); this is a standard ruled out by Apple and Google with their respective app stores. A scholar (Duguay, 2017), who is not interested in these questions, enables me to implicitly see the emergence of a reciprocal regime of engagement between users and algorithms; she qualifies this regime as "expertise", where the value of good in this regime is "trust" and "knowledge" support. Furthermore, Duguay (2017) brings out new elements of the reputation economy, without developing it. "The definition of a type of algorithms, which ranks users, as it is advertised by the company, incentivizes users to perform strategically for generating a reputation-based authenticity" (Duguay, 2017). Together, users and algorithms "form expert systems (Giddens, 1991) as a multiplicity of authoritative sources of technical knowledge. Expert systems rely on trust: individuals make a leap of faith, depending upon information disseminated by expert systems to supplement their limited knowledge." (Duguay, 2017, p. 361).

Trust is therefore at the center of online dating, where uncertainty is particularly high concerning how algorithms work and what the other users' intentions are. The question of trust is transversal to scholars in different disciplines that analyze the online-dating phenomenon. According to some scholars, users rely on algorithms as a validating agent for choice making: they trust algorithms to find a convenient potential match (Tong, Hancock and Slatcher, 2016). However, users are also building trust with other users, throughout different practices (Chaulet, 2009a, 2009b). Increasing trust enables users to gain certainty about one person's identity when there are too many user options to evaluate online and in order to consider start building a relationship with (Gibbs, Ellison and Lai, 2011). This commonality of trust across app's actants and research offers a comparison point between multiple apps and users. This steers me away from specific individual goals and feelings observed in recent studies that are not of interest for this thesis. Instead, I study how actants (app interfaces with their algorithms and users) learn collectively to build trust as a pragmatic process, where attention and actions are influenced by design and quantification conventions.

As I highlighted earlier, Kessous (2011) follows Pierre Livet's reflections and explains that actors seeking to establish trust are seek to reduce uncertainty about the other's intentions, which is impossible to provide in a guaranteed way. Thévenot (2006) evades the question of speculating and interpreting other's intentions by explaining that actors privilege engaging in a regime plan. This type of engagement means that actors coordinate their actions to make an environment convenient for a third party. In online dating, interpreting another person's intentions via the app affordances is crucial, because there is uncertainty about the algorithms and the other users. Within this uncertainty, how does one seduce online, and more generally, how does one seduce the right person, in the convenient manner? Without guarantees of reciprocity about the other's intentions, pursuing the coordination of actions with another person might result in a "failure". For example, on a dating app, one female user with dark skin explains that she is always contacted by dark-skin men, despite the fact that she is interested in finding a white man. In general, women receive more messages than men in online dating, which leads men to send many of messages that are unread (Kessous, 2011). According to Pierre Livet (1994), these unread messages are not failures, nor are they errors of communication. On the contrary, through traceable benchmarks, such as conventions, actors can review their actions in order to learn to communicate without having guarantees about the others. I now present Livet's theory of communication; it sheds light on learning as a process, despite the singular orders of worth and singular engagements, where actors can find themselves in the social world. More specifically, in this thesis, I am interested in the way users and machines learn together and in establishing comparisons across platforms and usages that Thévenot's (2006) pragmatic approach does not offer. After presenting one pragmatic approach about learning, I will refer to the regimes of engagement in order to present a final one developed by another author, Nicolas Auray (2016). Auray's regime is more adapted to studying online platforms and the process of learning, within a comparative methodology.

1.2.6. Reviewing Actions to Communicate

Conventions structure and delimit social order, but they also create a new order for actors to act in it (Desrosières, 2014). To Livet (1994), in order to communicate effectively, actors learn to review these conventions in action. He developed, from different disciplines, the dynamics of a communication learning process. Throughout this process, to reduce uncertainty, users seek to stabilize in action the incomplete representations of other's intentions, because intentions do not provide any guarantee. Thus, reviewing and readjusting interpretations enable a "mutual tolerance" between actors about their intentional actions *in situ* but never a complete knowledge or proof of reality. Tolerance, in contrast, enables coordination and communication to achieve a pre-supposed collective goal.

Livet (1994) elucidates the process of learning to which human interpretation is key. Interpretation functions in combination with logical reasoning in order to identify decidable and finite conventions that enable an actor to pursue actions. To the best of my knowledge, Livet's contribution is recognized more for the definition of a presupposed or virtual community that is created in action, and less for the underlying learning process explicit in Chapter 4 of his book. In this thesis, to focus on how actors learn to communicate, I do not focus on the definition of community as this process will lead them to establish trust. Indeed, Livet's (1994) learning process is relevant to online dating where users find themselves within a computer-mediated communication. On the one hand, users are required to make logical actions via the app quantification conventions that measure behavior in a finite decidable language via input values. On the other hand, users constantly interpret these values to find a mutual tolerance with other users to pursue together an action based on trust. To understand Livet's theory, it is important to review first what interpretation is: a cognitive process at the core of his theory that is distinct from decidable actions. Then, how communication is achieved and, finally, what conventions are and how they enable learning.

"Interpretation is a series of inferences based on the principle of relevance (looking for the interpretation that gives us the most information - that gives us the most implications from the context - with the least amount of cognitive effort)."[16] (Livet, 1994, p. 226). Interpretation is crucial because it enables actors to restrict the countless linguistic possible meanings and to retain only those that seem relevant to the situation. More importantly, by testing these inferences in action, actors can coordinate with others in order to be able to cooperate, despite being in a situation where the other's intentions are impossible to verify.

Livet's (1994) thesis is anchored in the algorithmic logic of artificial intelligence and the economy of conventions, which explains his strong logical reading on human action. He explains, however, that he does not contend that this is how communication is fully operated by humans, which is why he gives an equal relevance to the parallel process of decidable and undecidable reasoning. From his enriching combination of mathematical formalism and pragmatic social interactions based on tests (in French; "épreuves"), two distinct mechanisms of communication are drawn that link individual and collective actions with their environment. The first individual mechanism is the capacity of identifying *decidable* and *finite* references that act as *conventions*. According to Livet (1994), individual intentions are impossible to access because they are *undecidable* and do not provide any guarantee of success in a collective action. Indeed, if a person tries to test if another person's initial intention is true, they enter into an infinite retrospective of interpretations that has a high cognitive load. Therefore, actors rely on the identification of conventions to interpret other users' actions in order to formulate a hypothesis about the goal to be achieved in the course of action. The second collective mechanism is that actors, to pursue the hypothetic collective goal, cooperate in action by "reviewing" individual actions and by "correcting" discontinuities. In other words, corrections are immediate behavior adaptations for testing the hypothesis and causing the collective goal in action to emerge. This process is applied when there is something not understood about the action. In previous theories, "errors" are considered as elements that block the process of coding and encoding a message. Livet (1994) considers them, instead, as crucial discontinuities at the center of the communication, in this way, he rejects the term 'errors'. The message does not stand alone without the environment, the interpretations, the intended effects to produce on actors, and the interactions between them; discontinuities are a constant element in the process of communicating in action. Most importantly, correcting discontinuities enables a person to learn when another person has not yet adopted habits (1994, p. 107). Due to the difficulty of accessing someone's individual intentions, communication is based on seeking a "mutual tolerance" (Livet, 1994, p. 209) from the combination of gestures (in French; "actes"), individual representations, and a collective coordination through the permanent correction of discontinuities. Livet illustrates the communication process with an example of a rowing activity. This example does not apply to common daily situations, but it serves to clarify the communication process:

"As soon as one of the rowers hears a discontinuity (they accidentally hit the oar at the same time), he aligns with it, assuming that it is the first stroke of a hypothetical cadence [the collective goal to achieve]. It is possible that [the oarsman] is still out of step. But he now has an initial point of reference [the discontinuity] and can therefore interpret his shift as a delay or an advance, and thus correct his movement. And if there are no random coincidences, either of them may mark a stroke more strongly [review the initial action], to

[16] "Une série d'inférences, une interprétation, fondée sur le principe de pertinence (rechercher l'interprétation qui nous rend accessible le plus d'informations - qui nous donne le plus d'implications à partir du contexte- et ce en dépensant le moins d'effort cognitif)" (Livet, 1994, p. 226).

give the other person a reference point. If everyone follows this process, they will manage to synchronise [the goal]. "[17] (Livet, 1994, p. 234).

In this process, it is important to specify the definition of 'references', as it is rather confusing in Livet's thesis. The term 'references' is interchangeable or combined with others, for instance "the discontinuities references" (Livet, 1994, p. 227). 'References', from French "repères", are to Livet (1994) *conventions* shared by others, thus forming a virtual community to which actors identify themselves. Unlike Desrosières (2014), Livet distinguishes "explicit conventions" from "implicit conventions", based on Hume's philosophy. Explicit conventions act as a *supposed* common framework, enabling the coordination between community members that can be at a distance (i.e., in different spaces or time, and distributed effects are not visible to everybody) without direct communication (1994, p. 237). Explicit conventions arise from established agreements, e.g., the writing or speech acts. But, they remain a *belief*, as each individual can produce different representations about their collective meanings. To this point, Livet agrees with Desrosières (2014) who refers, for instance, to the foundation of statistics as an explicit quantification convention across states and how some qualification indicators (e.g., socio-professional categories) might have different effects on actors.

Livet (1994) further contributes with his emphasis on implicit conventions that are often named in his thesis as "discontinuities", in the sense that they are not formalized although they are manifested as explicit. Discontinuities are relevant because they are capable of relaunching a collective undecidable dynamic that requires interpretation (i.e., the communicative intention of the other person). It is thus from implicit conventions that he builds his theory (p. 235): "Conventions are discontinuities immanent to collective action. Unlike rowers, [individuals] may not intend to mark these discontinuities. It is sufficient that they produce it through their interactions, perceive it and then intentionally use it as a reference for the evolution of collective action. These benchmarks are therefore the collective decidable substitutes for the individual intentions underlying collective action, intentions whose guarantees are however indeterminate. These references can only function if collective action continues."[18]

Adding a layer of complexity to his multidisciplinary thesis, Livet explains, based on cognition theories, about perception and how conventions are installed through "ostensive gestures" (Livet, 1994, p. 226). Ostensive gestures, as opposed to speech acts in linguistics, are signs for transmitting information *and* communicating with the body, in the environment, and in interaction with others. These gestures manifest the relevance of the communication and the way they attract others' attention to particular information by using bodily articulations that show how to reach a target. They serve to vehicle an action that is accessible and that claims to be an intention (because cognitive pathways are not accessible). As discontinuities have to be accessible, they gain value if they are recognized by others or if they are attached to a salience in the environment. The concept of salience is key to Livet, as well as to pragmatic sociology, as I have previously presented with the attentional regimes (Boullier, 2009), in order to observe the social reality as it is expressed in action in relation to a subject's physicality. I defined it previously as follows: Saliences are perceptual;

[17] "Dès qu'un des rameurs entend une telle discontinuité (ils ont par hasard donné un coup de rame en même temps), il se cale dessus, en supposant que c'est le premier coup d'une cadence hypothétique. Il se peut qu'il soit encore décalé. Mais il dispose désormais d'un repère initial et peut donc interpréter son décalage comme un retard ou une avance, et donc corriger son mouvement. Et si aucune coïncidence aléatoire ne se produit, l'un ou l'autre peut marquer plus fortement un coup de rame, pour donner un repère à l'autre. Si chacun suit ce processus, ils parviendront à se synchroniser." (Livet, 1994, p. 234).

[18] "Les conventions sont des discontinuités immanentes à des actions collectives. Contrairement aux rameurs, il se peut que [les individus] n'aient pas l'intention de marquer ces discontinuités. Il suffit qu'ils le produisent par leurs interactions, qu'ils le perçoivent et s'en servent ensuite intentionnellement comme repères de l'évolution de l'action collective. Ces repères sont donc les substituts collectifs décidables des intentions individuelles qui sous-tendent l'action collective, intentions dont les garanties sont pourtant indécidables. Ces repères ne peuvent fonctionner que si l'action collective se poursuit." (Livet, 1994, p. 235).

they are stimuli in the environment that cause a transitory effect, of short duration, to the subject's sensorial device according to Thom (1988) (Bessy and Chateauraynaud, 2014). Also from René Thom's theory, Livet explains that saliences have a property of forms, where there is a cognitive component to perceive; and this is linked to a component of attraction in experiences (in French; "composant conatif" or "pregnance") (Livet, 1994, p. 105). This enables Livet to state that saliences are the human motor and the perceptive coordination that, besides linguistic material, convey an intention of communication. He anchors mental "interpretations" into action. This is in contrast with Norman's notion that (1988) mental "representations" are translated to mean suppositions by the designers into *suggested* actionable affordances. Livet is interested in building meaning throughout collaborative "situated actions" with environmental cues, as in the study of human-machine specific sociotechnical arrangements by Lucy Suchman [1987] (2007). According to Suchman (2007), plans emerge as resources in action or as "an artefact for reasoning about action". Therefore, the courses of action can be observed according to their materiality and to the social circumstances of the actants, instead of observing "the plan" as a mental abstraction to accomplish a future goal. Livet further complements the concept of saliences as regularities, based on the work of Thomas Schelling (Livet, 1994, p. 162). Schelling suggests that the environment and behaviours contain saliences that can be *regular*. Therefore, through regularity they enable coordination (as the alignment of actions) in a collective. The saliences become then conventions, with the condition that members believe that this is a *shared* convention by everyone and that they test in action these beliefs. In this sense, discontinuities precede explicit conventions and contribute to establishing them or to testing existing ones.

By conceiving implicit conventions as "immanent discontinuities" (Livet, 1994, p. 235) for reviewing actions, Livet proposes a human "shared fallibility" (Ibid., p. 180). Rationality is, to him, a person's capability of recognising that all humans make errors and that this is not intended to be perceived as a failure in communication. Instead, making errors is at its core, and humans have the capacity to *learn* to review their actions. According to Livet, human rationality is an asymmetric coordination due to the uncertainty about others' intentions (undecidable property); it avoids categorizing humans as strategic calculating agents as this would be an exhaustive task to assume in every situation. Indeed, if actors as strategic calculators pretend to *predict* other people's *actions*, they introduce uncertainty in their own behavior without having the possibility of calculating it in a situation. The calculation would require applying probability with "observed frequencies of errors and to edify reasoning based only on empirical observations" (Livet, 1994, p. 181). The agents' intentions are not accessible for calculation. Instead, a subject requires an immediate valid type of reasoning that does not require a probability calculation and that does not pretend to guarantee others' intentions.

Livet (1994) first recognizes a human interpretative capability based on inferences and beliefs and, second, another capability of logical reasoning and immediate action. Within collective *dynamic interactions*, actors can identify decidable and finite conventions in both their environment and in human behaviour. Via these conventions, actors find their bearings for reviewing the course of an action until they achieving mutual tolerance, even if only for a moment, to build a virtual community.

1.2.7. Regime of Exploration

With this pragmatic process of learning to communicate, according to Livet (1994), actors learn to review their actions when identifying regular saliences. These are discontinuities expressed and perceived by the body in interaction with the environment. However, to Livet (1994) these saliences have to be identified by the actors as conventions, whether they are explicit, formal, or implicit, to pursue the collective action. It is possible to recognize these conventions under the condition that actors *believe* they are *shared* conventions. What happens if conventions are built by default to be shared, given the standardization of dating-app

forms? Does every user follow the same course of action and can they review it? This is particularly important, when actors enter a new environment, where affordances are, by design, built within logical constraints. However, according to the literature apps capture the attention in different manners, which influences what the user believes in. It is also argued in the literature that users interpret differently the app conventions, according to the way they are retaken by users to interact, which influences how users engage in the world.

All these socio-technical arrangements induce uncertainty about the environment and about others. That is why users attempt to build trust in online dating, as Chaulet (2009b) shows. Chaulet (2009b) studied user practices, in combination with conventions of the dating app Meetic. He highlights that, "While some [users] will rationalise their research enormously in an attempt to make it as effective and 'compliant' as possible - mobilising the objectivising potential of the systems for this purpose - others will on the contrary try to form a more vague and general idea of the Other. The elements to be qualified and the means to achieve this are therefore not the same in each case. This eminently personal dimension of judgment and the attribution of trust must be kept in mind in order to try to avoid the pitfall of over-generalising a phenomenon with many psychological and individual determinants." (Chaulet, 2009b, p. 160).

Chaulet (2009b) gives the following example about dating-app quantification conventions: "the activity monitoring and individual statistics such as number of visits, contact requests or 'flash' requests, shape the way users browse the website. It enables users to request attention from another user and enter the game of reciprocity by 'giving back' to the other the attention s-he has shown". (Chaulet, 2009b, p. 142). By structuring profiles, the dating app "facilitates cognitively but also guides, organizes, and hierarchizes" the online-dating experience. Research tools, images, text box, and personal criteria are used to reduce risks and "develop a sense of caution" (Chaulet, 2009a). For Chaulet (2009b), platforms play a major role in the process of selecting someone, of building sense, and enabling users to engage in a potential relationship. Personal information and the actions that can be performed by a user can be presented as "stabilized, objectified and embedded within the sociotechnical artefact" according to Callon et al. (2000, p. 218-219) (Chaulet, 2009b, p. 137). But, users can also avoid this objectifying framework to, instead, build a vague and general idea about the other user.

The critical theory of emotional capitalism (Illouz, 2012) puts forward the rationalization of the selection of a potential partner. This is assertive when analyzing the platforms' interfaces and the practices of users that master strategies based on the platform quantifiable conventions. Chaulet (2009b) highlights that this generalization, however, is problematic because there is a plurality of engagements with the platform, with the other user, and with the experience itself. This is the plurality I focus on in this thesis by means of a "regime of exploration" developed by Auray (2016) who studied, in particular an extreme situation of uncertainty in online dating: "romance scams"[19].

Users are confronted with the uncertainty of seduction, but also with other users' malicious behaviour, such as with romance scams (Auray, 2016). These scams illustrate an extreme situation of misusing the non-accessible intentions of users. The study of this type of practice in online dating, along with others such as hacking, video gaming, video folksonomy, Wikipedia negotiations, since 2007 lead Auray to develop a "regime of exploration" (2016). The regime applies to digital platforms in a broad sense. It proposes a renewed mode of conceiving action in online platform engagement where uncertainty is generally high given the

[19] i.e. "a confidence trick involving feigning romantic intentions towards a victim, gaining their affection, and then using that goodwill to get the victim to send money to the scammer" –Wikipedia

openness it provides. When online, a person *discovers* multiple worlds and information -a practice that involves uncertainty-but this can be also beneficial to actors, as Chaulet (2009b) shows: When dating, users do not systematically follow a rationalized strategy. Users want to meet new people, online dating is a way of expanding their networks. This objective can be traced back to other media, such as press ads and matrimonial agencies (Ahuvia and Adelman, 1992).

In an extension of Thévenot's (2006) sociology of regimes of engagements, and to understand online practices as an exploration driven by curiosity, Auray (2016) defines *attention* within *action*. Exploration has three main characteristics: "the floating alertness, divided attention, and the difficulty of restraining excitability"[20] (Auray, 2016, p. 45). These characteristics are related, as I will show, to the attentional regimes (Boullier, 2009) previously described (section 1.1.4).

The first characteristic of exploration, the "floating alertness", is defined by drawing on the concept of "strolling" (in French "flânerie") as a subject's "reactive attention to the decomposition of chain of actions and experiences into increasingly shorter sequences" by Hartmut Rosa (2010) (Auray, 2016, p. 33). Auray (2016) explains that, when a person strolls, the exploration is enacted by "de-focalisation", the person is able to be distracted and focused at the same time. A person can have the *objective* of discovering while being in a state of *freedom* to do so: "when attention is focused on one thing, this focalisation is only partial, and there is a fringe of attention that is perpetually on alert, that inquires (in French, "en enquête"),[21] in a large environment."[22] (Auray, 2016, p. 28). This definition of attention is in opposition to Ribot's (1889) concept -earlier used by Boullier (2009). As Ribot (1889) conceives the attention as merely a focalisation and the "inhibition of concurrent activities" (Auray, 2016, p. 28). Instead, Auray (2016) relies on the definition of Bergson from 1905: attention is "a natural dispersion of perception, a confusing state, vague, scattered (in French, "éparpillé"). Exploration is "a state of attentional efficiency that relies on the assumption of the dispersed character of the perceptive consciousness, while being attentive to novelty"[23]; Auray (2016) avoids negatively qualifying "attention to novelty" as "distraction" (Ibid., p. 29). The subject's underlying "curious attitude supposes a permanent displacement of attention forms, a lateral mobility of the gaze and focalisation." (Ibid.). Curiosity enables them to live in two distinct possible worlds and to shift between them, with excitement and danger (Auray, 2016). Boullier (2011, 2012) describes these possible worlds "pluriverses" in the habitele. He also focuses on saliences and novelty, like Auray (2016) does, to describe the regime of alertness. Boullier (2009) refers to Ribot (1889) to introduce, in the attentional regimes, the duration and intensity characterizing attention that enables people to live in multiple regimes of attention at different degrees, without necessarily taking the focalisation for granted, as I will show in the following characteristic of attention.

The second characteristic of exploration is the "divided attention". It enables a reflexive control that frames the attention as a "bi-sociation" for enabling the emergence of novelty. Thus, the subject can recreate a new situation by remaining vigilant to a future benefit and, at the same time, by letting go (in French, "lâcher prise"). There is an expectation (in French, "attente") of a future benefit that "can arise, among other possibilities, through the dissatisfaction with the prescribed information flow or with the intention of solving an enigma." (Auray, 2016, p. 34). This vigilance is possible, in part, due to pre-attentional neuronal detectors

[20] "Vigilance flottante, attention divisée et difficulté à réfréner l'excitabilité" (Auray, 2016, p. 45)
[21] In this sentence the author puts alert and enquiry on the same level, although the title of his book is "Alert OR enquiry". To us, the regime of exploration is both alter and enquiry by the author's definition of attention. In a nutshell, when exploring the subject is enquiring the social world by staying alert; at the same time focused and distracted.
[22] "Lorsque l'attention est focalisée sur une chose, cette focalisation n'est que partielle, et il y a une frange de l'attention qui reste perpétuellement en alerte, en enquête, sur un environnement le plus vaste possible" (Auray, 2016, p. 28).
[23] "L'engagement exploratoire qualifie cet état d'efficience attentionnelle qui repose sur l'assomption du caractère dispersé de la conscience perceptive, attentif à la nouveauté" (Ibid., p.29)

that enable humans to remian attentive to peripheral events, without being conscious. To develop this idea, Auray (2016) relies on James Gibson's (1979) perception theory that I already developed (section 1.1.2). Recall that, according to Gibson, his ecological approach states that perception can be explained in terms of the environment: there is enough information in the environment to make sense of the world in a direct and perceptive way. Auray (2016) explains that saliences, as an active perception, can be distinguished from "occluding edges" (in French, Auray calls it "arrêtes occlusives"); a non-active perception also developed by Gibson (2015). Auray (2016) does not sufficiently develop this concept because the relevancy is that this non-active perception, from pre-attention neurones, is not enough to explain a controlled attentional availability in the environment as a "de-focalisation". Briefly said, Gibson (2015) explains that as humans move we receive different inputs on our retina which provides us new information about our environment. In this movement, we can see both some revealed and occluded (deleted or hidden) textures at the edge of surfaces in the nature[24]. Instead of relying on the divide of active/non-active as a characteristic of attention, Auray (2016) suggests an "intermediary level of expectation" where "troubles" in a given situation experienced as "unpleasant" induce the exploration. He draws this idea of intermediary level to build a judgment about a situation from Tversky and Kahneman (1974). This intermediary level of expectation is non-voluntary and can be animated by a certain "repulsion". According to Tversky and Kahneman (1974) humans have two systems: System one is the "lazy controller" that privileges intuitive reasoning; it is automatic and fast, based on habituation and the association of ideas. "Familiarity is a machine for generating hasty conclusions that is tricky, but we can acknowledge that in a pre-reflexive state to switch to system 2." System two is "rational and based on the control of our impulsive reactions and emotions." (Auray, 2016, p. 32). Auray (2016) suggests that the exploration is based in that pre-reflexivity capacity, as an intermediary level of expectation, it is the shift between the two systems. He distinguishes it from the system two of rational reasoning, developed by Tversky and Kahneman (1974).

This regime of exploration complements Livet's (1994) theory, as Auray (2016) assigns to humans the capacity of perceptive control that is pre-reflexive. It is flexible: a person, on a non-voluntary basis, remains vigilant yet inattentive. To conclude on this important characteristic of attention, which is relevant to the process of learning, it can be said that this intermediary level precedes the interpretation process of Livet (1994). In this sense, when experiencing the environment, actors do not exclusively and permanently rely on conventions to move forward in the course of the action; there is also an intermediary level of expectation that makes it possible to discover novelty. Boullier (2009) defines, like Auray (2016), 'attention' as multifocal, centred and peripheral, especially in the attentional regime of immersion where video gamers can be found building their world, solving enigmas, and being rewarded for this. They are also, to a certain degree, in the regime of projection that enables an expectation in the future and collective coordination (Boullier, 2009). This coincides with Auray's (2016) idea of having a reflexive control and an intermediary level of expectation. This idea means that an actor receives information from their environment, both saliences and occluding edges, but later *chooses actively* the information that *matters* to them, within a plan that is built in the course of the action. This is in contrast to Gibson's theory that gives more agency to the environment. The environment has enough information to make sense; therefore, actors have to discriminate patterns only.

[24] "When surface texture is gradually revealed (accretion) or occluded (deletion) over time at the edge of another surface, there is unambiguous evidence that the former surface is farther away from the perceiver then the latter surface. Typically, occluding edges are revealed with movements of the perceiver, and relative movements of environmental features. There are several significant implications of this phenomenon. First, the occluding edge of closer surface is only visible over time. Second, for this reason, the occluding edge is a relational property of the environment- organism processes. In the absence of movement, the occluding edge is not present. Gibson is pointing to the often over looked ontology of relational properties, which comes to play a foundational role in the proposed ecological approach. Third, perceiving an occluding edge includes an awareness of the now- hidden surface and to- be-revealed surface of the farther object." (Gibson, 2015, p. 22)

Moreover, in an extreme degree of alertness, according to Boullier (2009) and in contrast with Auray[25] (2016), there is a complete focalisation on certain saliences; attention is by default selective, and there is no reflexivity possible, only reaction. A chain of human cognitive actions, as formulated by all the aforementioned authors, can be sketched as follows:

Pre-attention to the environment (Gibson, 2015) [1979] → **Intermediary level of expectation** (Auray, 2016) → **Affordance identification by logical constraints** (Norman, 1988) → **Interpretations to review actions** (Livet, 1994) → **Speculative actions to capture attention and to form a reputation** (Boullier, 2009)

Finally, in the regime of exploration the third characteristic is "the difficulty of restraining excitability". Excitability is also called, by Auray, "fascination"; it carries benefits or misdeeds (in French, "méfaits"). Auray writes that "expectations rely on emotional dynamics non-regulated under a nervous tension" because the subject is close in time and space to a surprise that challenges them to solve an enigma (Auray, 2016, p. 35). Objects triggering curiosity give openness while constraining accessibility and pleasure. Hence, exploration is a particular case of attachment that differs from satisfaction and fulfilment. There is a tension in the state of expectation that leaves the subject susceptible to the upcoming event. Curiosity is, in exploration, a balance that is maintained between revelation and mystery: to be perpetuated, the curiosity has to be fulfilled and maintained with the non-satisfaction (Auray, 2016, p. 36). The surprise has a role for transforming social order but can also be problematic, in the sense that it fosters being in the grip (in French, "emprise") via the excitability state. However, it enables at the same time a transitory awareness of the grip to get rid of it (Ibid.). Auray (2016) defines this excitement state in video game practices, but he also refers to the kind of excitement a user can experience when clicking on a feed news to stay up to date with current events. Boullier (2009) qualifies this as reactivity: when a person feels excitement with no possibility of reflection to avoid an action that might not be convenient in a certain situation, as it was presented in the attentional regime of alert. Auray (2013) also qualifies this reactivity as "opportunism". To explain it, he uses the case of online dating that, to my knowledge, he does not develop beyond the case of romance scams. According to him, "curious exploration is based on a double opposition, against *organised research* on the one hand, and against *opportunistic reactivity* on the other. In opposition to organised and planned research, curiosity invokes an openness to finding things, to discovering things by chance. The difference can be seen clearly in the sociological texts on the uses of dating clubs: Most users claim to calculate optimisation, whereas others insist on the valorisation of the role of "destiny" or "chance". They are looking for "love at first sight" in the face of the optimised apparatus of dating."[26] (Auray, 2013).

The multiplicity of regimes of engagements, intertwined with the regimes of attentions, merits clarification. On one hand, the regime of exploration of Auray uses alertness (as in *remaining attentive*) as its principal component for exploring the world with curious attention and through perception and experience. In a communication, the author even refers to it as "a new attentional regime: the curious exploration". (Auray, 2013). On the other hand, alertness can be a type of attentional regime as Boullier (2009) names it; but according to him, attention alertness is also at the center of inhabiting pluriverses, as with Auray (2016). Both

[25] Auray explains a complete focalisation is not possible, however, like Boullier, he also acknowledges reactivity as a low-level process of little reflexivity that can be particularly problematic in the case of anxiety, depression and addiction in online platform usage (Auray, n.d.).

[26] "L'exploration curieuse s'appuie sur une double opposition, contre la recherche organisée d'une part, contre la réactivité opportuniste d'autre part. Contre la recherche organisée, et planifiée, la curiosité invoque une disponibilité à la trouvaille, à la découverte au hasard. On voit bien la différence à travers les textes de la sociologie des usages des clubs de rencontre: la plupart des usagers dénoncent l'optimisation calculatrice et une valorisation du rôle du "destin" ou du "hasard". Ils sont à la recherche du "coup de foudre" face à l'appareillage optimisé de la rencontre." (Auray, n.d.).

authors contribute to further developing Thévenot's (2006) regimes of engagements that are not adapted to the current reality of actors within an environment that is both offline and online. Boullier (2009) and Auray (2016) contribute to the study of digital platforms where users' engagement in their realities passes mostly through attention. Therefore, I can conceive of the regime of exploration as a transversal engagement in online platforms for discovering novelty via curiosity. However, attention can be captured in different ways, according to app conventions. When analyzing online dating practices through the regime of exploration, I stand by Boullier's (2009) attentional regimes of loyalty, immersion, projection, and alertness.

The exploration regime gives a better resource to understand online-dating realities, where users, within an open market, constantly experience novelty in the environment with new profiles, as potential dates, to finally engage –or not- in pluriverses or in one regime (for instance, in the regime of attentional loyalty to establish a relationship). Here, it is not relevant to focus on the goal (the relationship), rather on the process of capturing the attention and the other person's interest is to potentially establish a relationship. I study online dating usage dynamics from two perspectives: (i) the GUIs', (ii) the users. Within the exploration, I seek, in particular, to identify what users and machines are learning to be able to date online: What is a shared convention to them in every actants' situation? What is the meaning of novelty to them?

1.2.8. Ethnomethodology

GUIs, as frameworks designed by dating app companies, structure how users learn to date online. In principle, the app conventions guide the attention of the users and help actors in reviewing their actions when exploring novelty. However, it is key to understand how users make sense of it with their own methods. Do they actually adopt the app conventions, do they reject them, or do they create new ones by other means? Making sense of the world is crucial to the ethnomethodology as developed by Harold Garfinkel (1984). Philippe Amiel (2010) revisits in depth Harold Garfinkel's works and gives the most concise definition of [Garfinkel's] research as being "task-oriented to learn how the actual ordinary activities of members consist of methods for making the actions practical, the circumstances practical, the knowledge of the common sense of social structures and sociological reasoning practical, - analysable. "[27] (Amiel, 2010, p. 23). Common sense knowledge is at the core of the ethnomethodology and is one of the contemporary challenges of artificial intelligence (AI) (Frenzel, 2019). To ethnomethodologists, this type of knowledge is social and it is acquired through factual experiences with others to objectify their world. It does not mean that the world is rationalized but that the world exists and has a meaning as actors experience it. The "practices of common sense reasoning are a set of methods for turning personal experience into experience of an objective reality". The methods enable knowing when to choose specific information and how to use it, without following instructions, as actors' reasoning has an "open structure". This means reasoning is heterogeneous, arguments do not necessarily follow a logical order and they can be often contradictory. Actors rely instead, on decisions of "appropriateness" to articulate a piece of information with a given situation, and to construct a situated meaning (Leiter, 1980, p. 11).

Ethnomethodology enables focusing on the capacity of individuals to explore in inventive manners the social world through interactions for reviewing their judgments (Garfinkel, 1984). The capacity of actors for producing their own methods enables the recognition and existence of a structure by the practical sense that

[27] Own translation, "orientées vers la tâche d'apprendre de quelle façon les activités ordinaires réelles des membres consistent en des méthodes pour rendre les actions pratiques, les circonstances pratiques [34], la connaissance de sens commun des structures sociales et les raisonnements sociologiques pratiques, — analysables" [35] in Amiel (2010, p.23).

actors give to it. The ethnomethodology recognizes an anti-essentialism and the dynamic evolution of the social world: "What really exists is not things made but things in the making." [1977] (James, 2008, p. 107). The STS approach follows this dynamic characteristic from the ethnomethodology, often referred in the STS literature with the phrase "in the making". It is relevant for knowing how actors build the meaning of shared conventions or the meaning of novelty when discovering it in exploration.

One of the main phenomenon studied by ethnomethodologists, that I will focus on, is "the sense of social structure" developed by Alfred Schutz (Leiter, 1980). The phenomenon "is glossed by the term *common sense knowledge* [which] is our knowledge and experience of the social world as a factual environment. Schutz constructed a characterization of the social world as it is encountered by people living in it. He termed his characterization the 'natural attitude of everyday life', where members of society encounter a social world with [four properties]." (Leiter, 1980, p. 7). The properties are "historical organization, intersubjectivity, acceptation (taking the world for granted), facticity" as explained by Leiter (1980):

First, the world is experienced by people as a place that is historically organized, prior to their arrival on the scene and as one that will continue to exist when they have left it. The social world is experienced as having a past, present, and future.

Second, people experience the world as an intersubjective world. That is to say, people assume that the social world is not just their private world but that it is 'out there' for all members of society to see.

Third, people accept the world and its objects as they are given through experience. The world, as a fact, is taken for granted and, although particular doubts are from time to time entertained, they are never global doubts of a solipsistic [egocentrism] nature" [...] According to Schutz, "we take the world for granted until counter proof imposes itself." Social actors trust their experiences as long as they obtain the desired results. This "socialized structure gives this kind of knowledge an objective and anonymous character" (Schutz, 1962:75) [...] Doubts might, and do arise, but they are resolved in such a way as to sustain the factual properties of the world (Poller, 1969; Schutz, 1962). As Gurwitsch (1966:xii) proposes, "Such questions, doubts, and corrections, however, always concern details within the world, in particular mundane existents, and never the world as such and as a whole." (Leiter, 1980, p. 9).

Fourth, people address the world and its objects pragmatically. People are interested only in the features of the world that are relevant to the project of the moment [...] The natural attitude is a description of the structure of the social world, as it is encountered and experienced by members of society. [It is] a factual, determinate world." This facticity builds up "the stock of knowledge at hand" for actors to dispose on; to apply it later in "concrete situations" (Leiter, 1980, p. 9).

Ethnomethodology gives this research an anchor to observe dating as an affective-pragmatic phenomenon. It helps researchers to avoid falling into the divide of calculative optimisation / emphasis on romanticism that leads to a sort of nostalgia about "traditional courting" (Illouz, 2012), mainly seen through an heteronormative gaze. This nostalgia, which accuses modern relationships of not developing engagement, leads to occluding other histories and biographies that were also part of the concept of romanticism, such marriage by obligation, marital rape, discrimination of gays and of women, in general. I do not reject the role of emotions as biological and psychological realities that scholars studied extensively. But from a sociological perspective, I take the deliberate position of putting aside romanticism. I focus on the empirical analysis of the conditions of possibilities that online dating offers as a practice where romanticism, among other experiences, could also emerge. Hence, dating emerges because it is experienced pragmatically with specific mediations, with other users, with objects, and in concrete situations that build a common-sense knowledge about affectivity that is factual. This position enables researchers to consider modern relationships in online dating with their multiple motives, "i.e., seeking a relationship, casual sex, friendships, [and] entertainment

seeking or ego-boosting", which can result in both positive and negative consequences (Timmermans and De Caluwé, 2017b). Recall that to some scholars in Europe, the reference to romantic love –an era that covers only one century- continues to be present today in the representations of online dating, despite the decline of romanticism that is nevertheless reconfigured (Marquet, 2009). Historians show that, throughout time, private individuals have made use of spaces and objects to perform seduction as a *technique:* for instance, courting someone next to a fountain, giving someone a flower, picking up a person in a car (Bologne, 2010), and when women adapt their aesthetics in order to seduce, in particular their hair style, length or color (Perrot, 2006). In my analysis, I consider that social actors actively contribute to the construction of the techniques that constitute dating as factual knowledge. Consistently, some sociologists (Kellerhals, Widmer and Levy, 2004) show through the study of couple *dynamics* that there are common actions that enable relationships to form. These actions are *built* by different means, material and symbolic, and are not merely given or chosen.

In summary, I consider online dating to be a *space* for exploration with material *techniques,* where *communication* between the machine and the users is necessary for attaining each actant's desired goals. Consequently, online dating produces the specific *sociotechnical arrangements* and *engagements* that I study here through different methods of inquiry.

1.3. Methods of Inquiry

Online dating presents a plurality of standpoints within which different mediations play a specific transformational role. The term 'mediations' refers to the reconstruction of a network in the actor-network theory (ANT), where each entity can become a mediation and not a simple intermediary, depending on the agency (or power to act) with which it is endowed (Boullier and Lohard, 2015). Therefore, I investigate dating apps, based on a precise description of the key mediations that make them different according to two standpoints that I define and based on the transformations they provoke.

The first standpoint I identify is the "dating app front-end" that contains a graphic design that acts as the perceptual environment offered to users by conventions. To deliver users a front-end interface, developers and experts with programming skills implement affordances as conceived by the designers. The front-end enables users to interact with the machine while interacting with other users who are connected.

The second standpoint is the "dating app back-end", accessible to developers and app producers but not to users. In the back-end, developers conceive technical infrastructures for the app function via software programming practices. The architecture of a software program contains several components, such as a server, a handler, a database (e.g., MySQL) and the Application Programming Interface (API). Therefore, for this standpoint, I limit my analysis to the implementation of algorithms for matching that enable computing profile recommendations; they take as input the values collected via the GUI.

These two standpoints are studied from three different methods of inquiry, in alignment with the conceptual framework presented. By anchoring my methodology in a STS approach, I study online-dating materiality: GUI conventions and a matching algorithmic system. I study the GUI conventions through a quantitative analysis of variables and affordances. I study the matching algorithmic system via technical documentation and a dating app's case study, as a methodology suggested by the media studies and the CHI community. The STS approach guides me first, with the front-end (GUI conventions), then with the back-end (matching algorithms).

Using pragmatic sociology and ethnomethodology, I study the developers' and users' actions, and their related methods for making sense of dating. Guided by these last approaches, I analyze how users engage in the front-end, then I analyze how developers engage in the back-end.

1.3.1. The Dating App Front-End: Functional Description of GUI Conventions

The first method of inquiry is related to the app interfaces and their conventions. More specifically, I analyze variables and affordances through a functional description, as proposed by the "compass method" (Boullier, 2003). To observe and compare the different realities conveyed, the method suggests focusing on opposite views of the phenomenon. Hence, I describe the platforms by opposition. The opposition criteria is fundamental to identifying multiple conventions, as it has been previously shown that innovators create products by replicating features of products already existing in the market or by distinguishing from it (Akrich, 1995). The methodology used is a quantitative analysis detailed in Chapter II.

To analyze interfaces and to reconstruct the observation setting as a lambda user, as a researcher, I adopted the role of a new user by registering in the apps. I specified in the profile that I was a researcher and that I provide information about the study (see more details about this thesis' ethics in section 1.2.5). I created an account by following the user-behavior path designed by each app: for instance, registering with an e-mail address, filling in a profile description, and browsing other profiles. Thus, I discovered the app that traces the apps' actor-network while I manually collected data about the app affordances. Tracing the apps' actor-network, in the sense of following the actants online, is possible through "the walkthrough method" (Light, Burgess and Duguay, 2016) that is also grounded in science, technology studies, and media studies. This method was applied in online dating "for examining mobile apps with attention to relations involved in their deployment, functioning, and everyday use." (Duguay, 2017). It is a "form of observation seeking to identify mediators, examine their associations, and account for translations resulting from these associations." The researcher is engaged in "activity flows", records apps' characteristics through screenshots with accompanying field notes and seeks additional material related to the app design (Ibid., p. 355). I conducted the method alone. Ideally, I should have compared and validate the observations with another person. However, this method was useful for keeping traces of the fieldwork because, in particular, online dating is a growing market with 9,000 dating apps worldwide in the app stores, according to 42matters'[28] database. Although some apps have been established in the market for 10 years (e.g. Grindr and Tinder), others are deleted quickly and leave the researcher without the possibility of making observations again. The walkthrough method is limited to the analysis of one, or few, case studies. To be able to establish a comparative analysis of multiple dating apps and websites, I performed a systematic data-extraction. I created a table in an Excel file to register the recurrence of the app affordances. This enabled me to the manually and systematically collect data across platforms while gaining an in-depth knowledge about the origins of the data and its meaning on each platform. Note that personal data were not collected, nor were other users contacted. The data collection served to have a general view of the dating-app market, beyond my previous personal experience and knowledge throughout acquaintance practices. It enabled me to see the existing diversity of app classes, along with their design, their branding strategy, and the type of clients the platforms address in Switzerland, as Marie Bergström (2011) did in France. Her study focuses, however, mainly on the design and marketing material. For instance, in Switzerland there are apps that, such as Tinder, advertise for young

[28] 42matters is a company and online service for analyzing and providing data about mobile apps' audience. The service provides a database of Google Play Store and Apple App Store apps, as well as the top charts. Retrieved from: https://42matters.com/ (account creation required).

users with minimal profile information requirements, and there are apps that, such as Parship, advertise for long-term relationships with a profile based on a psychological tests. This general view enabled me to further understand developers' and users' jargon, according to each platform (e.g., on the dating app, the user can see the count of "crushes"; in other words, how many users marked an interest in the other user's profile. In contrast, Adopteunmec names it "charms". Ultimately, this view helped me make the interviewees feel understood during the interviews.

This method of inquiry will contribute to the STS approach by enabling a discussion of actants in online dating: quantification conventions, affordances, and saliences. Indeed, apps are designed with different data formats and semantic material that perform particular agencies for the attentional perception and experiences. I provide empirical material to understand the way attentional regimes are built in online dating, and the way they shape the possibilities of practices.

1.3.2. The Dating App Back-End: a Case Study of Algorithms

Dating app algorithms are protected by "commercial trade" (Pasquale, 2015) and they communicate little about it. Although journalists put efforts in documenting the internal practices of dating app companies (Duportail, 2019), there is little research on algorithmic developing choices. This opacity of the dating industry renders difficult "algorithmic accountability" (Wieringa, 2020) as suggested in other type of institutions and companies. For instance, it is suggested conducting ethnographies in engineering labs to better understand their practices (Jaton, 2019). It is also proposed reverse engineering algorithms in online journals to gain insights into their working (Diakopoulos, 2014). Another approach is combining a technical documentation analysis with user interviews as suggested in HCI "to confront values between designers -embedded in algorithms- and users." (Diaz and Diakopoulos, 2019). I use this last method as an alternative entry point to proprietary algorithms. Moreover, it provides insights about the conception of platforms in alignment with the "digital methods" approach (Rogers, 2013). These methods seek to understand the opaque functioning of dominant commercial platforms, such as Google or Facebook, to repurpose their techniques for scientific research. Some scholars developed interesting methodologies for reverse engineering the dating-app algorithms while protecting user's privacy. They developed a dating app that replicates the functioning of Tinder and recruited participants to use it, with declared consent for collecting personal data within a controlled setting. The replication of the app tests the components of Tinder found in media material, such as profile ordering (Courtois and Timmermans, 2018). I do not intend, however, to create new tools for understanding app algorithms' functioning. The creation of tools carries to my opinion the problem of adding more socio-technical mediations to the scientific observation of the social reality, as perceived and experienced directly by actors. To study the algorithm design in relation with their usages, I avoid the proliferation of methodological toolboxes and rely on qualitative methods. A few scholars in the digital-methods tradition also analyze technical documentation (van der Vlist, 2016), but they do not consider the mediation of the implementation of quantification conventions with users.

I selected Tinder as a case study in order to study algorithms for two reasons. First, because it is the most popular dating app worldwide and the second one (after Grindr) to develop a mobile dating-app in the market, which means that the app contributes to the construction of the online-dating phenomenon. The app is present in 190 countries and is the most downloaded app in northern Europe and United States, with an estimated 57 million users with free and paid accounts worldwide[29]. By February 2021, Tinder counts 100M

[29] Tinder Revenue and Usage Statistics (2021). Retrieved from: https://www.businessofapps.com/data/tinder-statistics/\#2

downloads from the Google Playstore[30]. The average number of paid subscribers worldwide were 6.0 million in Q1 2020, as reported by the Match Group,[31] the largest dating-app brand agglomeration. An extensive literature is dedicated to its interface design, usages, psychological effects, privacy concerns, and the algorithm function, by recreating a similar app to Tinder (Cho, Kim and Sundar, 2020 ; Courtois and Timmermans, 2018 ; David and Cambre, 2016 ; Díaz Sánchez, 2016 ; Duguay, 2017 ; Jekel and Haftka, 2018 ; LeFebvre, 2018 ; Lutz and Ranzini, 2017 ; Rochat et al., 2019 ; Strubel and Petrie, 2017 ; Timmermans and De Caluwé, 2017). However, the studies do not analyze Tinder from the perspective of the company's internal technical choices. The second reason I chose Tinder is because it is known, from media material, to have a sophisticated matching system. Indeed, to provide automatic profile recommendations to users, Tinder applies neural networks, a pioneering technique in artificial intelligence. To protect the invention, the company filed a patent that is, by law, available publicly. I base the analysis on this patent by linking the way choices are developed influences the way users perceive their reality from the interface and by linking what they understand as an algorithmic behavior, without necessarily referring to "the algorithm". This method of inquiry complements software studies with another perspective on algorithms. It contributes more broadly to the discussion of algorithm opacity that is often addressed when transparency is claimed in academia, as well as in public debate. Although this type of analysis does not provide the elements a researcher could obtain by directly observing developing practices, it is still useful for contrasting different standpoints on algorithmic quantification practices in order to understand what companies say their algorithms do and, in practice, what they actually do and mean to users. The HCI study (Diaz and Diakopoulos, 2019) limits the analysis of algorithms and usages to interviews with users and does not follow the actors' practices *in situ*. I chose, however, to go beyond this limitation in order to see actors using the app *in situ*. Ziewitz (2017) suggests to analyze algorithms in interaction with users, through "practical reasoning". In order to develop ethnomethods from these interactions, he explains that "when 'algorithms' are increasingly invoked by researchers, policy-makers, and designers in public talks, reports, and briefings, it is important to get a grip on how this specific form of reasoning is implicated in and implicates our actions." (Ibid.). Therefore, in this approach, algorithms are not analyzed as stand-alone objects that can produce effects on actors and that can be collected from a traditional interview setting but as a process; an ongoing work that, as the author explains, occurs *in situ* with actors in a specific environment. In the following section, I base my development of the interview setting with users on this approach.

1.3.3. Interview Study: User and Developer Engagement *in situ*

My epistemological posture as a researcher in the field is to be part of the online-dating culture. Scholars have shown that dating-app users are particularly interested in knowing how the app works. They are especially active in online forums where they discuss ways to overcome the app limitations, to debug it, and to improve their chances. Some users collect data and conduct personal-data analysis. These practices form an "online daters' community" (Masden and Edwards, 2015). Therefore, I decided to remain familiar to user practices and their preoccupations, as a *learner* exploring dating app platforms and the ways the others use it. Indeed, learning together is a common practice among dating-app users (Masden and Edwards, 2015). In the past, I have used dating apps; I am therefore familiar with online dating as a culture, and I know the different apps that are popular in the market. I am 32 years old and, according to national statistics, I am part of the second largest group of the population that found a partner via dating apps and websites in

[30] Tinder (2021). Retrieved from: https://wiki.personaldata.io/wiki/Item:Q1022
[31] Match Group Reports First Quarter 2020 Results (2020). Retrieved from: https://s22.q4cdn.com/279430125/files/doc_financials/2020/q1/MTCH-1Q-2020-Earnings-Release_Final.pdf

Switzerland. Of the actors who use dating apps, those between 30 and 39 years old are the second group (34.1%) behind those between 18 and 29 years old (50.2%). I am also the second group that uses dating websites (33.5%) after the group of those over 40 years old (60.9%) (Potarca, 2020)[32]. I am currently registered in the apps on the research sample for reviewing their functioning but not for personal use. However, I am surrounded by people that use dating apps and, as soon as people know I conduct research on online dating, spontaneous conversations rise about the user's personal experiences online. A similar posture was adopted in the methodology of Danah Boyd; "hanging out" with the participants (Itō, Baumer and Bittanti, 2019) to observe and understand how young people socialize and to learn the new media. Hence, I do not limit myself to following the actants, instead I am immerged in the social world of the object of study, through participative observation. This has been a particular advantage to my research but it also presents some difficulties.

Being a female researcher and conducting the interview study with users is emotionally difficult. The interviewees feel at ease sharing their most intimate experiences online and offline, both positive and negative. Experiences such as the frustrations of not finding a partner, harassment, infidelity, unconsented sex, and sadomasochist sexual experiences were particularly hard to deal with. In general, the actors exposed their biographical stories (except for two actors particularly shy). Therefore, controlling the interview duration required particular skills. One female anthropologist experienced this when conducting a study on a matrimonial agency, she was implicitly given the role of an adviser or psychologist in the matters of personal relationships (Chwieduk, 2010). In this research, the situation was controlled by adopting the role of a learner: somebody who wanted that, above all, the other person guide the interviewer throughout their experience within the app, while using it. The actors were constantly taken back to perform actions with the app. This guidance was possible due to a particular interview setting put in place as Auray (2016) did to analyze explorations online. He refers to the grounded theory, but in my opinion, the author goes further. His method "consists of accessing the actors' reflexive discourse that, during the interview, verbalizes their actions. The accounts made *in situ* are combined with a work of empathy consisting of sampling, or recalling [the researcher's] own experience, by staying attentive to the distinction of expertise and previous social skills. Hence, we recompose an approximate analysis of how exploratory engagement courses are raised and experienced in reality." (Auray, 2016, p. 48).

To conduct the interviews with users and developers, I created a situation setting as a learner through storytelling and practice, as Lucy Suchman (2007) did to understand the use of the printer between colleagues. In this research, I became the "learning couple" of another user while they used the app during the interviews.

When conducting the interview study with users, during an introductory phase, participants are asked to recall an online experience they had with somebody in the app. In a second phase, participants are requested to open the dating app on their phones or computers. They are asked to show and explain the researcher, as a learner, how to use the app. Inspired by the study of TV viewers, I take "the interviewees' speeches literally by focusing precisely on their […] rhetorical procedures […] This approach [enables me] to observe declared practices [in contrast to] declared tastes and declared judgments justified by the actors themselves." (Boullier, 2004). In this research, the user practice is guided by questions about how to register, to create a profile, to browse other users, and to contact them. The situation in the form of tests becomes spontaneous, with

[32] See supplementary material of the article. Sociodemographic descriptive statistics describe a sample of N=3,245. The full descriptive statistics of the national survey's sample are not public yet, therefore one cannot see the Swiss representative sample by sex and age.

unexpected situations, such as app bugs, doubts and hesitations about what to do, and surprise when discovering a new profile. Hence, the setting enabled the researcher to distinguish pragmatic moments, like with TV viewers, from moral judgments and justifications in the user speech. This is a form of following the actants in action. I do not claim to have captured precise behavioral events, as another type of research design could enable (e.g., eye tracking). Instead, I benefit from this double setting, offline, online, and connected in the app, to see further than quantifiable user traces. The interviews were recorded and transcribed. From the transcriptions, the interactions between the users and the devices (mobile phones or computers) were identified using the software Nvivo 12, as I explain in more detail in each chapter.

When conducting the interview study with developers, I was thwarted in my effort to learn by having the participants share their practices, such as coding the app or formulating an algorithm due to trade secrets. They were not allowed to share their practices. Therefore, I constructed a setting with questions about their daily work, recalling an experience with a colleague when solving a problem, etc. (more information about the interview methodology is provided in Chapter III). As with users, I took again the position of a learner: learning about their practices and, later, by capturing actions on the transcriptions. This positioning was facilitated because I knew their jargon. I have a past professional experience in managing a team of developers in a private company. I also had an advantage of being a researcher in an engineering school.

This last inquiry contributed to a new perspective on the study of the online-dating phenomenon by combining a pragmatic sociology and ethnomethodology. Although grounded theory has been extensively used for studying user practices in one of few dating platforms, the observations can often appear as a list of singular practices, which makes it difficult to compare across actors and platforms. A description of their actions in relation to their general methods of common-sense reasoning, as I propose, sheds light on how online dating came to be a pragmatic technically mediated reality at the intersection of diverse actants. This inquiry contributes with empirical material to understanding of how, within an exploration regime, actors make sense of novelty for engaging, or not, in the different attentional regimes that apps produce for building a reputation to attract others.

1.3.4. Research Corpora

My thesis is based on different corpus that I introduce briefly in this section. The data collection and methods of analysis are detailed in each chapter.

The first quantitative corpus covers two datasets extracted from dating-app structures:

(i) 317 variables of 22 platforms collected from two pages: profile, browsing

(ii) 84 affordances of 29 platforms collected from all pages: registration, profile, browsing and messaging.

The second qualitative corpus covers Tinder's patents and technical documentation.

The last qualitative corpus based on interviews contains two participant samples:

(i) Nine developers of ten dating apps

(ii) 40 users of 26 dating apps.

In each chapter, I present a combination of quantitative and qualitative data, according to the research questions defined. In Chapter II, the study is focused on the first dataset and the first participant sample by combining the study of user representation variables and the development practices in relation to the definition of variables. In Chapter III, the study is focused on the second qualitative corpus of patents and the

technical documentation, with a subset of the second participant sample: interviews with users registered on Tinder. Here, I examine how users make sense of Tinder's matching system. In this chapter, users registered in other platforms such OkCupid were discarded. In Chapter IV, the study is focused on the second quantitative corpus; the dataset of app conventions, and the complete second's participant sample for analyzing user practices online in relation to dating-app conventions. In every chapter, I present in detail the chapter's own dataset, sample construction, interview methodology, and analysis.

1.3.5. Research Ethics

This study adhered to ethical procedures, and established a data management plan concerning personal data that was approved by the EPFL Human Research Ethics Committee (HREC), No. 007-2018 / 22.02.2018.

A main question driving the ethics of this research was how to analyze online dating practices without interfering the course of action and at the same time respecting actors' privacy. I answer this question by formulating a management plan for the data collection, processing and analysis, which minimizes the personal information available for use. This plan is the basis for my thorough reflection on the research questions and the ethics, while I navigated the dating apps and discussed informally with some dating app users. The benefit was that I reflected on the preoccupations of the actors, which led me to know what to observe and what to collect as data. These reflections steered me away from reverse-engineering algorithms that observe their outputs as the effects they could cause to users. Instead, I focused on the direct mediations with users: the variables presented in the interface for self-description and the browsing of others, as these variables ultimately influence algorithm outputs. This type of mediation also steered me away from collecting personal data from the dating platforms, without the user's consent to observe their behaviour. Instead, to understand the meanings they give to their practices, I focused on direct interaction with users, via our interviews. These meanings ultimately leave traces, but are also telling in the traces they do not leave. This is an occluded surface to algorithms, which is harder to capture with statistical analysis.

Reverse engineering is critical in dating apps, as it requires input data that is sensitive; but these data are considered informally "quasi public" for scraping user profiles (Birnholtz et al., 2014). This was possible when there was less awareness about data protection in society and in academia. Researchers protect the users' identities and do not use the data for other purposes than research. However, scraping user profiles is not privileged in this research to preserve the researcher's ethics, to respect recent European regulations (GDPR), and especially because this type of analysis provides a view of on online behavior via traces as shaped by the platform' design. For instance, one study of three platforms for gay men shows that the platforms have limited profile fields and that users adapt their self-description to it (Rodriguez, Huemmer and Blumell, 2016). On the contrary, I used the platform structure as a frame for understanding actants' multiple standpoints and, via interviews, the actors' situated choices of communication, i.e., those that matter to them.

More broadly, the ethics of my research is driven by a personal concern. In my opinion, the type of research conducted, via platform traces by psychologists, sociologists, and data scientists, is critical to the production of scientific knowledge. Dating platforms are used as "observatories of couple formation" to understand user tastes via profile forms (Bergström, 2019 ; Schmitz et al., 2009) in agreement with the companies. Without this agreement, scholars also use dating platforms for predicting and explaining psychological causalities between sexual orientation and facial features (Leuner, 2019 ; Wang and Kosinski, 2018), and for predicting attractiveness with profile pictures (Jekel and Haftka, 2018). An extreme case is a pseudo-scientific analysis conducted with OkCupid data for neo-nazi racist assumptions (Kirkegaard and Bjerrekær, 2016). Conducting this type of research violates the data-protection rights of actors when there is no agreement with the company, and no data management plan that requires a direct and clear user consent. Furthermore, it shapes

what researchers can observe as social reality. This is a reality that is induced by dominating commercial platforms; this reality is yet unknown to sociotechnical and economic mechanisms. Today, dominating platforms have become "the collectors of the social reality they produce". When these platforms are the observatories of social reality for collecting user behavioral traces, these apps become the new "ground-truth" (Jaton, 2020) of researchers. It affects knowledge production when scholars do not have full control and a view on how data structures are conceived and for what purposes. There is an increasing awareness about the production of personal data for commercial purposes and this remains to be investigated further. Data in online-dating platforms is mainly structured and collected for advertising purposes, as it is the main source of income for apps. This was recently confirmed by an investigation of the Norwegian Consumer Council, see their technical report "Out Of Control" https://fil.forbrukerradet.no/wp-content/uploads/2020/01/mnemonic-security-test-report-v1.0.pdf. The investigation resulted in a lawsuit, for a 10M Euro fine,[33] against the dating app Grindr (10% of the app's annual revenue) for sharing the sexual orientations and precise geolocations of their users to third-party advertisers, without clear user consent. This case illustrates the concrete consequences, of the way data structures and data processing are designed, on user's privacy, on companies' finances, and on reputations. Consequently, the commercial purposes of data structures, defined in advance, shape what is produced and observed as user behavior.

For an ultimate deliverable of this research, I engaged in building a wiki "Dating Privacy" as a collaborative project with other volunteers (see https://wiki.personaldata.io/wiki/Project:Dating_Privacy), where we present media material, patents, privacy policies, and other documents related to dating apps. We also contributed to a wikidata of dating apps with a cartography of personal-data structures as created by apps; see for instance Bumble's cartography[34]. It illustrates the extensiveness of variables collected, their limitations, and risks for privacy protection for both user practices and scientists building knowledge from it. To contribute with our dating wikidata, I enacted another resource, following the Swiss federal law of data protection (LPD), and EU's General Data Protection Regulation (GDPR) by making a Subject Access Request (SAR): the right of access allows an individual to obtain records of their personal information, held by an organisation. I thus obtained files with my personal data collected from different dating apps, which enabled me to confirm which variables are actually collected by the app. The file confirms the variables I study in this research and provides an additional view on other variables that feed algorithms that are not visible from the GUI to users and researchers scraping profiles.

1.3.6. General Legal Principles of the Research Ethics

My research focuses on dating-app structures with their conventions, as well as on users and developers with whom interviews are conducted. Consequently, it was required to first ensure the data protection of the actors participating in the interviews, according to the LPD and the GDPR for non-Swiss residents. Second, I had to ensure the respect of copyrights for dating apps in the research samples accessible worldwide but established administratively in specific countries (i.e., American, European, and Swiss private companies).

For the interview study, participants gave their written consent based on a predefined form, or oral consent when interviewed online (audios registered). Before conducting the interviews, participants were informed

[33] Historic victory for privacy as dating app receives gigantic fine (January 2021). Retrieved from: https://www.forbrukerradet.no/news-in-english/historic-victory-for-privacy-as-dating-app-receives-gigantic-fine/
[34] Wikidata query from personaldata.io as mapped by dating privacy (April 2021). Retrieved from: https://tinyurl.com/y4t5w48z

and received a printed information sheet about the research, the purpose of interviews, and the participants' rights. Their names, as well as the company names where developers and founders work, are pseudonymized in the file transcriptions and analysis. Their names are kept, however, in a printed list to retrieve their personal data or delete it if requested. For collecting the interface conventions -without collecting any personal data from user profiles- the study relies on different doctrines and regulations, according to the country where the company is legally registered.

First, for American companies such as OkCupid (URL: https://www.okcupid.com/legal/terms), the doctrine of "Fair use of Copyrighted works" is used (URL: https://www.copyright.gov/history/studies/study14.pdf). The American government stipulates that, according to sections 106 and 106A, the fair use of a copyrighted work for purposes such as "research, is not an infringement of copyright." (URL: https://www.copyright.gov/title17/title17.pdf).

Second, for European companies, the legislation on the harmonization of copyright in the information society stipulates that, "3. Member States may provide for exceptions or limitations to the rights provided for in Articles 2 and 3 in the following cases: (a) use for the sole purpose of illustration for teaching or scientific research, as long as the source, including the author's name, is indicated, unless this turns out to be impossible and to the extent justified by the non-commercial purpose to be achieved (URL:http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1525701238400&uri=CELEX:32001L0029).

Finally, for Swiss companies such as Celibataire (URL: https://www.celibataire.ch/info_legales.php) based in Vaud, the law allows research to be conducted, as long as it is not intended for the reproduction of work for commercial purposes. See Art. 3 and 21 on the Federal Act on Copyright and Related Rights (Copyright Act, CopA) of 9 October 1992 (Status as of 1 April 2020) (URL: https://www.fedlex.admin.ch/eli/cc/1993/1798_1798_1798/en#art_21). Detailed information can be found in the Data management plan approved by the Ethics committee.

1.4. Digital Humanities Contribution

Although digital humanities as a scientific field still lacks today from a clear definition (Vinck, 2017), its origins shows that the emerging field is primarily dedicated to the study of arts and literature by means of statistical and computational techniques (Vinck, 2016). These techniques increased the integration of computer scientists in the field, and the acquisition of computing skills of researchers in the humanities. The field has more recently shown openness to a variety of disciplines in other human sciences like musicology, as well as social sciences. My thesis is part of this opening with a focus on sociology. The creation of a digital humanities' section in an engineering school poses challenges to engineers that investigate for the first time an object of human and social sciences (Williams, Figueiredo and Trevelyan, 2013). It also poses challenges to social scientists like me confronted to the application of new methods for statistical analysis in computer science, and the requirement of programming skills, that comes along with a type of reasoning. I studied these techniques, the critics and its potential, the dynamics and the establishment of digital humanities' section. For instance, gender unbalance (Boyles, 2018), the challenges of collaboration and integration of DH scholars in the general structure of academia (Griffin and Hayler, 2018), the possibility and the limits of interdisciplinary transfer of knowledge (Oiva, n.d.), the influence of digital tools as objects of knowledge to the human and social sciences (Cocco et al., 2018).

Integrated in the dynamics of this emerging field at the EPFL, I learned the advantages of methods used in the digital humanities and more broadly in data science, such as hierarchical classification (or clustering) detailed in Chapter II, for the analysis of platforms. In particular, it offered me the possibility of building a systematic and comparative analysis to the study of dating app structures. In addition, I integrated to the

data analysis, methods and a conceptual framework from the social sciences to be able to know *what to collect* among so much data, and *how to observe*, to ultimately understand and analyze a phenomenon in new platforms that shape the construction of knowledge.

More specifically, the contribution of this thesis is the combination of a sociological conceptual framework and statistical methods applied in data science to build a comparative setting of dating apps. The comparative setting enables the analysis of replications across platforms in contrast to single case studies that contributes to a new generation of social scientists (Boullier, 2017a, 2018a) as well of data scientists that found themselves working together nowadays in digital humanities. In particular, I question the social meaning of digital structures through the analysis of conceptual choices for defining variables and designing those structures. This questioning is essential to the processing of data by the machine and its statistical methods by which humans try to make sense *a posteriori* of the results that are produced. A sense that is often transformed by the complexity of the technique itself, i.e., neural networks. The questioning of loss and recovery of the meaning of data constitutes one of the contributions of this thesis to digital humanities. For this purpose, this thesis seeks to deconstruct sociotechnical practices such as the definition of variables, the methods for developing a program and implementing an application, the mathematical modeling of matching algorithms, in order to finally reweave the chain of transformations along which the sense has been lost. It ultimately enables to gain control over the consequences of data collection, processing, and analysis that this loss provoke.

1.5. Conclusion

This chapter presented the key concepts and theories that guide my dissertation. In summary, I take into account humans and non-humans within a "network" of "translations" (Akrich, Callon and Latour, 2006) to study the relational dynamics between them. The "agency" of humans and non-humans is not mobilized in order to explain what humans do to machines, or what machines do to humans. Instead, I account for how these actors have a reciprocated agency over each other that make possible the phenomenon of online dating.

More specifically, in online dating, collective actions occur "in relation with the environment" through "affordances" (Gibson, 2015). These "affordances are perceived actions" in a GUI that are made conventional by design to communicate a conceptual model of the end-user (Norman, 1988), but they are also "quantification practices" (Desrosières, 2014). These quantification practices are key in online dating as they enable measuring and comparing users' qualities. They also constitute a mediation between GUIs and user behavior that provide algorithmic input values to compute profile recommendations in the app.

After identifying the actors in online dating and their relations, I will analyze the coordination of collective actions to make a judgment of their reality, *i.e.*, "regimes of engagement" (Thévenot, 2006). I will pay particular attention to the actions within online platforms that enable users to engage in an "exploration driven by curiosity", *i.e.*, a "regime of exploration" (Auray, 2016). More specifically, I aim to analyze whether actors establish a communication with others through a "continuous learning process for reviewing their actions by means of shared conventions" (Livet, 1994).

This pragmatic approach avoids falling into the pitfall of explaining mental representations of actors and their intentions. Instead, what matters here is how these actors engage in the world with others through "situated" practices that build a "practical common-sense knowledge for turning personal experience into a factual reality." (Garfinkel, 1984). In this sense, online dating is approached as an environment that is equipped with cognitive devices and shared conventions that actors presuppose and at the same time construct together.

The conceptual framework serves as a common ground for social and computer sciences in order to study online dating through the combination of quantitative and qualitative methods, thus allowing for a systematic and comparative analysis lead from a variety of perspectives. This comparison sheds light on the dynamics of structural "replications" (Boullier, 2018a) across apps that eventually turns dating into an industry within the "reputation economy" (Orléan, 2015b).

While this first chapter was theoretical, the following chapters will present empirical investigations discussed in light of the conceptual framework of the present chapter. Chapter II will show to what extent GUIs are structured around conventions—themselves influenced by choices made through the development practices analyzed in Chapter III. Chapter IV will pay attention to the matching techniques upon which developers build an application. These techniques make use of the variables embedded in the GUIs to collect data and mediate the user interactions analyzed in the last chapter. Together, these five chapters describe relations of actors that constitute the phenomenon of online dating through materiality, development techniques, and usages.

CHAPTER II. THE DATING MARKET OFFER: PROGRAMMING USER ATTENTION AND INTERACTION

2.1. Introduction

In Chapter II, I am interested in analyzing the online-dating experience from the Graphical User Interfaces (GUIs). The analysis provides an understanding of the structure and the means offered to users in order to find a date. The results shed light on the dating market's offer from a bottom-up approach. I contribute with a systematic and comparative analysis of the materiality embedded in the GUI that shapes the perception and interactions of users beyond the dating experience advertised by the companies.

In this chapter, I cover the analysis of dating platforms' GUIs, based on three types of entities. First, the affordances: They are the possibilities of actions offered to users on the different pages of dating applications (apps). They are designed to program the evaluation and research of a potential date. Second, the variables: I focus, in particular, on the variables for self-description that serve users for creating a profile in order to present themselves to others and to evaluate a potential date. The profile creation constitutes a mandatory entry point to dating apps and a framework of comparison between users. Third, the input values of variables: They delimit the information a user can enter for a given variable in the profile form. The scope of the input values is limited to the description of women's bodies. Each analysis, or standpoint, provides a different comprehension of the online-dating phenomenon: First, a general analysis of the navigation in two classes, the second is a landscape analysis of user representations, and the third is a detailed analysis of the body representation. I do not focus on a particular level of analysis. Instead, I am interested in deconstructing the phenomenon into entities that are persistent across platforms. These entities are replications that build and maintain the dating experience in a pragmatic way. Therefore, this deconstruction enables me to identify the possibilities and limitations of perception and interaction in online dating.

In this chapter, I seek to understand the way the dating market captures the user's attention via specific entities embedded in the GUI that become conventional across platforms. For every entity analysis, in each section, I present the research questions, the related state of the art, the methods of inquiry, and the results. This grounded analysis of GUIs provides an external perspective on the user experience. However, in parallel, it also provides a partial view on the insights of the machine: what it captures as user behavior. The GUI enables users to perceive and to interact with others, and it enables the data collection process for the machine. In the next chapters, I will study the machine's and users' perspectives. Some of the material presented in this chapter was originally published in CSCW, where (Pidoux, Kuntz and Gatica-Perez, 2021) is the corresponding reference.

2.2. The Study of Affordances

As shown in Chapter I, affordances are the possibilities of actions offered to users that are made conventional through design practices. These affordances embedded in the GUI are used for defining in advance a conceptual model of the intended end-user and, consequently, a model of the online-dating experience through specific actions. In this section, to understand the way the user's perception and interaction are guided, I study online-dating affordances across platforms. These affordances play a major role in finding a date, as they engage the user in multiple attentional regimes in order to capture their attention on the platform. The four attentional regimes, loyalty, projection, immersion, alertness (described in Chapter I) enable us, the researchers, to understanding more specifically the way a platform captures the user's attention in order to perceive others and to be perceived by others. Each regime drives user actions in a different manner. For instance, an attentional regime of alertness, favored in one app, captures the user in a reactive state of alertness to new messages and new profiles, instead of engaging them in discussion with a potential date to build an affective relationship. In this section, I address the following research question, based on an exploratory data analysis:

(**RQ1):** Given the affordances collected from a set of dating apps, which main affordance arrangements guide the dating experience within specific attentional regimes?

To address RQ1, I analyze 84 affordances collected from 29 dating platforms through a qualitative description of the most recurrent affordances of building online dating, and through a computed classification of the affordance set based on the presence/absence of shared affordances.

The distribution of affordances over platforms shows that the online-dating experience is generally equipped with a high number of affordances that are not mere possibilities of actions but also restrictions. Using a descriptive analysis of the main affordances highlighted in the state of the art (the profile page with the photo, the geolocation and the chat), I contribute to the deconstruction of their related actions. Indeed, *to see, to find,* and *to discuss* with somebody are based on multiple granular actions that give more or less freedom to the user. For instance, upon making a payment, a user can -or cannot- hide their geolocation, search in multiple locations, and share multimedia content when messaging. The user can discuss in groups or one-on-one via a video call, and they can limit the type of photos shared with others. There are two affordances that are conventions across platforms: the declaration of demographic information in the profile page and the upload of a profile photo. In contrast, there are four unique affordances in the dataset. Among those four affordances, the affordance "Feedback: we met" in the mobile app Hinge marks a shift in the evaluation of potential dates as a "post-rating experience", such as those currently observed in platforms for recommending restaurants and hotels.

The computed classification of the affordance set, based on the presence/absence of shared affordances, reveals two classes that reflect distinctive conventional dating experiences across platforms: "List-view dating by immediate availability" and "Match dating by reciprocated attractiveness". The first class of apps in *list-view dating* by immediate availability captures the attention of users in two attentional regimes: loyalty and immersion. The loyalty creates the habituation, with a higher degree of duration, of users in the app. Users have access to profiles and detailed information that can be browsed immediately with the scrolling affordance. The immersion provides excitement to users and combines degrees of duration and intensity for a collective narrative experience based on discussing and reacting to availability, via the online status affordance. The second class of *match dating* by reciprocated attractiveness captures the attention of users in two different attentional regimes: reactivity and projection. The reactivity provides a high degree of intensity, where users stay alert to fast and short events in browsing. This is possible via the affordances of photos, binary choices, and reciprocity. The attentional regime of projection combines intensity and duration in

order to maintain the user in the app, within a plan for searching someone via economic affordances; they buy a subscription and limit their profile research to socioeconomic status.

The results shed light on the way a user is enabled and limited to finding a potential date on dating platforms, at a given speed and quantity of browsing profiles, with temporality for contacting others and placements to discover others. The affordances do not simply suggest evaluating a profile and discussing with a potential date, but more specifically by which criteria a user can date. Dating is conditioned by *where*, *when* and *whom* users can date, following a specific ordering and timing.

In this chapter, I contribute with the systematic comparison of platforms, according to the possibilities and restrictions of perception and interaction. On one hand, to understand user experience from a bottom-up pragmatic approach, the results enable me to go beyond the categorization of platforms, as advertised by companies in their marketing speech. On the other hand, the results shed light on the construction of user behavior by the platform's affordances for the sociology of couples and of other disciplines that study the dynamics of couples formed, due to online dating and without considering the influence of the GUI's structure.

2.2.1. State of the Art: Dating-App Affordances

Affordances have been extensively analyzed by media studies, the Human-Computer Interaction community, and communication scholars. The state of the art related to dating apps presents two limitations to my research. First, the study of affordances is guided by its design and the effects on users but little by what users do in interaction with these affordances. Second, it lacks visibility of the affordances across platforms through a comparative analysis. The increasing creation and popularization of dating apps requires analyzing in detail their potential diversity of means to find a date. This visibility avoids generalizations about the online-dating experiences. In this state of the art, I present first the studies that conceive affordances as a two-way communication medium, between the platforms and the users. Then, in order to conduct a quantitative study, I present the studies by drawing on the main app affordances that guide the dating experience online and their relevance to users.

The study of social media platforms shows that affordances cause the "coevolution of users and platforms/environments" to emerge. (Bucher and Helmond, 2018). In alignment with this coevolution between actors, it is suggested to qualify affordances as "imagined affordances" (Nagy and Neff, 2015). Nagy and Neff (2015) make a theoretical contribution without empirical evidence that helps guide the observations on dating-app affordances. Although we can assume that affordances are, by default, imagined because they are perceived and projected by humans, the formulation of this new concept sheds light on the tension between the imagination of the designers and the imagination of the users. This divergence can be directly observed in the action that takes place on the GUIs and not in the traces of user behavior. Imagined affordances, as a concept, proposes the materiality of affordances and the way it mediates affective relationships. It captures the concretization of users' experiences in the qualities of media. The concept avoids seeing affordances exclusively as a result of designers' practices that are active and rational constraints guiding user practices. Imagined affordances are a process that shape sociality. This process enables us, the researchers, to capture the expectations of designers from the materiality of the media, in combination with users' own "perceptions, expectations and misperceptions." (Nagy and Neff, 2015). Nagy and Neff (2015) summarize the imagined affordances as a process with underlying tensions "between users' perceptions, attitudes, and expectations, between the materiality and functionality of technologies, and between the intentions and perceptions of designers." (Nagy and Neff, 2015). This two-way communication process is significant, as users do not always recognize the possibilities of actions designed by the platforms. One empirical study (Mannell, 2019)

focuses on "how the materiality of messaging technologies was implicated in [user] efforts to limit and reduce their social availability". The results establish five affordances that matter to users in their practices, in contrast to what the design expects of user behavior. The affordances are (i) "*disentanglement*, i.e., a loosening of attention, where the device and platform retreat into a person's field of awareness, along with their interlocutors, (ii) *jamming*, i.e., a disconnective action for jamming network signals like the transmission of messages, (iii) *modulation*, i.e., the opportunity to modulate availability to specific individuals, (iv) *delay*, i.e., being connected in the sense of being free to read a message but disconnected in the sense of being unwilling or unable to reply until later, and (v) *suggestiveness*, i.e., an increased expressive capacity in messaging that enables suggesting disinterest or unavailability, dissuading interlocutors from continuing an interaction". One limitation of the study (Mannell, 2019) is that it is focused on the affordance of availability when discussing in mobile dating apps. The study does not make a comparison across platforms, and the affordances are defined according to the user practices. From the user perspective, I do not have a full view on the possibilities of actions designed by the platform.

In this thesis, I am interested in conducting first a comparative analysis of dating affordances, and second, an analysis of user practices. The latter is presented in the final chapter of my thesis. My combined analysis sheds light on the tensions emerging between design and practice, as the concept of imagined affordances suggests. This new concept is not commonly adopted in research. The study of dating-app affordances is still focused on "what the technology does to user actions" (Nagy and Neff, 2015). This is one side of the cleavage I expose in Chapter I to explain the relevance of studying apps from a pragmatic approach. When comparative analyses of affordances are conducted, their relation to user practices is ignored (Wu and Ward, 2020). Indeed, research about the way the design influences user practices is abundant. The focus is on one or a few descriptive case studies with less attention on the design across platforms. For instance, Licoppe, Rivière, and Morel (2016) show that users' interactions on Grindr are based on the form of a checklist. They take the shape of a "hook-up" culture due to the possibility of exchanging pictures, displaying the geolocation, and declaring sexual preferences and goals with proximity and immediacy requests. However, an interview study shows that gay users explore and develop multiple affective relationships via the messaging affordances of dating apps. Although some users seeking sex conduct checklist conversations, others engage in different types of conversations (Wu and Ward, 2020). This diversity is also present in other apps, beyond the messaging affordance. Scholars (Lane et al., 2020) show that attraction can be influenced by the language, the website, the photograph and the sex of the profile owner. The analysis by Lane et al. (2020) is focused on three dating platforms and in-depth interviews with users. Using another methodology, scholars (Comunello, Parisi and Ieracitano, 2020) analyze gender scripts through focus groups, on a variety of users registered in dating apps. The sample was made of users of 39 different dating apps. The study is focused, however, on the practices more than on the affordances. The results show that heteronormative stereotypes are reinforced by the way the app categorizes sexual desires. Some users accept and adopt traditional gender scripts. The design also guides who has to initiate the interaction. However, some users (both men and women) make efforts to subvert the gender scripts in their conversations. Beyond the focus on heterosexual dating apps, queer studies have contributed to the understanding of "LGBTQ representations and receptions shaped by technological affordances and constraints" (Shaw and Sender, 2016). These studies do not analyze dating apps and are focused on specific social-media platforms. Shaw and Sender (2016) contribute more broadly to conduct affordance analysis by challenging the conventional binary oppositions that structures media research: gender vs. sex, and heterosexual vs. homosexual. A typology of dating-app structures in France shows this opposition is present in the design and marketing strategies of the dating industry (Bergström, 2011). In my quantitative and comparative analysis of dating-app affordances, this binary conventional design was the basis for providing empirical evidence on the similarities and differences across platforms. In order to have an overview, I do not ignore this binary convention in my data-sample construction,

which later enables me to explore transversal affordances despite that distinction of communities made by design.

Few studies provide comparative elements of dating-app affordances. Based on a literature review, a typology of affordances is suggested by Chan (2017). But a detailed study of affordances is not of interest to Chan (2017), as he uses to focus on the impact on the user's attitudes in relation to their relationship goals. According to Chan (2017), there are five main affordances "*mobility, proximity, immediacy, authenticity* and *visual dominance*"; they are helpful for distinguish mobile dating-apps from websites.

"First of all, in a traditional setting, people log onto dating websites from their computers. Because dating apps run on smartphones, users can use dating apps anywhere at any time, similar to making a phone call (Ling, 2004). Second, dating websites usually connect people who are in the same broad region, whereas dating apps connect people who are in the immediate vicinity. Third, Liccoppe, Rivière, and Morel (2016) also found that Grindr users believe that the app provides them with "fast sexual encounters" (p. 2545). Fourth, some dating apps offer a certain level of authenticity, as they require users to register with an existing Facebook account. Finally, dating apps are more visually driven than dating websites as the image takes up the whole screen of the phone. Fitzpatrick, Birnholtz, and Brubaker (2015) regarded face-pics on dating apps as personal disclosure because a face is unique enough to differentiate people." (Chan, 2017).

The dating shift from websites to mobile apps has interested scholars, thus highlighting the implications of mobile affordances to the practice of dating for different stakeholders (Albury et al., 2017). In particular, the geolocation is a main affordance analyzed on dating apps, which causes practices of surveillance but can also provide advantages for networking (Ma, Sun and Naaman, 2017). The focus on geolocation fosters the categorization of mobile apps in research as "geo-social dating apps" (Schreurs, Sumter and Vandenbosch, 2020). This observation shows the relevance of studying online interactions from a pragmatic approach. Sociologists of couple formation contrast dating before and after dating apps. When using dating apps, actors abandon social spaces such as local parties, and neighborhoods where future partners could meet. From this perspective, platforms are considered as a separate space that provokes the "privatization" of dating; a practice that is not embedded in socialization as before (Bergström, 2019). More broadly, other scholars consider that digital platforms are not communication tools. According to Boris Beaude, these platforms are spaces that have shifted from classic orientation schemes based on cartographies, to new orientations based on topologies (Auray, 2016, p. 49). However, from the study of affordances, I can analyze if apps have the same means for orientation and communication. The uniformity, or its contrary, the diversity, of apps influences how, when, and where a user interacts.

A literature review by Wu and Ward (2018) on gay dating-app studies shows there is abundant research on two main affordances: the profile page and the chat. These two affordances are studies that consider user practices of self-presentation and messaging. The same authors (Wu and Ward, 2020) contribute with an interview study of user practices linked to these two affordances. They introduce two main categories of browsing GUIs on dating apps that condition the messaging affordance: "One type has a grid view or a list view, presenting a range of nearby users' profiles in descending order of geographic proximity. This type includes the most popular gay-specific apps, such as Grindr and Blued. One can start a conversation with any user displayed on the screen. The other type presents one single profile at a time. Users need to swipe left or right on the profile to signal their dis/interest in establishing a connection. Private messaging is possible only when both users signal their interest. Representatives of this type are Tinder and the Chinese gay app Aloha." Their results contribute to the differences, in China, between dating apps and social-media platforms and show that dating apps are currently increasingly integrating social-media affordances. There are two main affordances of dating apps: "c*ommunicative synchronicity* and *user identifiability*". The first one is defined as the user's expectation of synchronized mediated communication. The user expectation on dating

apps is lower than on social media, because the use of foreign dating apps is limited by the Chinese government. The second affordance refers to the possibility that users have to create profiles with dedicated identity cues that are both individual and social. "Chinese dating apps have integrated many functionalities of mainstream social media, allowing users to post status updates, follow each other, react to content, and so on." Finally, Lutz and Ranzini (2017) highlight the predominance of linking social media accounts to the dating app profile. The state of the art shows that dating apps are platforms built as spaces and tools of communication, where geolocation plays an important role, among other components. In my quantitative study, to contribute to their characterization from a bottom-up approach, I explore dating-app affordances and extend the literature to the description and comparison of 29 dating platforms. This sheds light on which of the affordances that build dating apps as social spaces guide the user experience.

2.3. Data Collection I: Dating-App Affordances

A set X of p = 84 affordances were manually gathered from a set D of n = 29 online dating platforms, composed of 12 websites and 17 mobile dating-apps accessed and downloaded from smartphones in Switzerland. The app language depends on the IP address, mobile-phone language configuration and app version. In all cases, the default language was chosen. The data was collected between February and November 2019 (with the exception of Facebook Dating, data collection in January 2021), and the platform versions are described in Table 1. Two factors guided the selection of the dating apps. First, the diversity of the population was targeted. The diversity is based on the sex options available, when the users register to declare their sex, and the sex of other users they are interested in finding. The sex options have limited combination constraints, for example women seeking women (homo) AND men (bi) OR women seeking men (hetero). Second, a distinctive element of innovation was targeted. These elements are advertised in the app's website or in media coverage. The two factors are relevant, as it is shown in the state of the art that dating apps are created under a marketing logic. The marketing logic is based on population segmentation strategies driven by sexual orientation, whereas the vast majority of apps is defined for heterosexual persons (Bergström, 2019). More broadly, technological innovations are created by advertising a new improved component from another app or a distinctive one for market penetration (Akrich, 1995). To find the apps online, I used the digital methods tool "Search Engine Scraper"[35] to query the browser, without the influence of personal history and cookies, with the following keywords in English and French: "dating apps", "online dating", "sites de rencontres", "mobile hook-up apps", "apps de rencontres" and "rencontre en ligne". After consulting every link and clearing the list of unrelated websites, the most recurrent app names were retained, as well as those containing a distinctive component or message.

The affordances were extracted from GUIs and organized into five types of pages: registration, profile-editing, profile-view, research criteria or preferences, and messaging. I resorted to a manual extraction, with a preliminary registration and profile creation in each platform as a user. No personal data was collected, and no contact was made with the users. All the profiles created specifically mentioned that it was a "researcher" profile, and that it was possible to contact me for further information about the research. For dating apps targeting heterosexuals exclusively, and for generalized apps for heterosexuals, homosexuals, and bisexuals,[36] as well as for apps exclusively for women seeking women, a female profile was created for collecting

[35] Digital Methods' tools from the University of Amsterdam (December 2020). Retrieved from: https://tools.digitalmethods.net/beta/searchEngineScraper/

[36] I use these three categories because in a general manner dating apps target users via binary sex combinations (M-M, F-M, M-F, F-F or both F-M-F, M-F-M). It is a mandatory field on the registration page, despite the fact that some apps offer myriad sexual identities at later stages.

data. In dating apps exclusive for men seeking men, a male profile was created. It is worth noting that only two apps (OkCupid and Facebook dating) present multiple gender values when registering; four apps are exclusive to heterosexuals and eight to same-sex (female or male). The remaining 14 platforms include marking an interest for both the opposite and the same sex. Although the majority of apps (27/29) is guided by the binary conventional distinction between heterosexual and homosexual, there is a trend of platforms (14/27) that, including bisexuality, do not allow declaring a gender identity beyond cisnormativity. The inclusion of bisexuality could be in part driven by the interest of browsing same-sex profiles for the assessment of the market, as shown in a dating app study (Bapna et al., 2016). The binary predominance has effects on data analysis, as it excludes different gender identities and builds uniformness that requires further research. For the sake of analysis comparison, I created standard naming conventions in English for the affordances found in Figure 3.

TABLE 1 – LIST OF 29 DATING APPS AND WEBSITES. AFFORDANCE ANALYSIS

No.	Name	Platform	Population (sex/status options)	Version/ Access date	Language
1	AdopteunMec	website	hetero	feb 2019	FR
2	AdultFriendFinder-Aff	website	hetero/bi/homo/ single/couple	oct 2019	FR
3	AttractiveWorld	website	hetero/bi/homo/	oct 2019	FR
4	Badoo	android	hetero/bi/homo	v5.137.1	EN
5	Bearwww	android	homo (men only)	3.0.16	FR
6	Bumble	android	hetero/bi/homo	v5.139.1	EN
7	CasualLounge	website	hetero	nov 2019	FR
8	Celibataire.ch	website	hetero/homo	nov 2019	FR
9	Facebook dating	iOS	multiple gender values	312.0	FR
10	Feeld	android	hetero/bi/homo/ single/couple	v5.5.7 Build 364	FR
11	Fruitz	android	homo (men only)	2.4.4	FR
12	Grindr	iOS	homo (men only)	v5.20.0	FR
13	happn	android	hetero/bi/homo	v24.17.3 #633	FR
14	Her	iOS	homo (women only)	v6.5.14	EN
15	Hinge	android	hetero/bi/homo	v7.1.0	EN
16	Hornet	android	homo (men only)	7.0.7	FR
17	Lovoo	website	hetero/bi/homo	nov 2019	EN
18	Meetic	website	hetero	jul 2019	FR
19	neargroup	website	hetero/bi/homo	nov 2019	EN
20	OkCupid	website	multiple gender values	nov 2019	FR
21	Once	iOS	hetero/bi/homo	v2.8.10	FR
22	Parship	website	hetero	nov 2019	FR
23	Passions - Meet over 50	iOS	hetero/bi/homo	v2.1.1	FR
24	PlanetRomeo	website	homo (men only)	oct 2019	EN
25	Pure	android	hetero/homo	v2.19.33	FR
26	Scruff	android	homo (men only)	v6.0019	EN
27	Tinder	iOS	hetero/bi/homo	v11.2.1	FR

No.	Name	Platform	Population (sex/status options)	Version/ Access date	Language
28	Tomorrow	android	hetero/bi/homo	v1.0.8	FR
29	UnitedMen	website	homo (men only)	nov 2019	EN

2.4. Results I: Affordance Landscape

The distribution of the number of apps over the affordances, set D, is very heterogeneous (Figure 4), with a maximum for "demographic (age, sex, geolocation) (creation)[37]" equal to 28 and a minimum for "unlock features watching an ad" equal to 2. More precisely, the affordance set X can be partitioned into two subsets: subset X_1 that contains the $p_1 = 80$ affordances common to two or more apps of D, and subset X_2 that contains the $p_2 = 4$ affordances appearing in only one app. In the following subsections, to analyze the dating app similarities, I focus on the subset X_1. There are two affordances present in all apps: "demographic (age, sex, geoloc) (creation)" and "photo (creation)". Below, I discuss these two conventions on dating, in combination with other common affordances, as they play a major role of constructing the profile page. Four unique affordances are also found in the corpus: "escorts" (Planetromeo), "feedback: we met" (Hinge), "set calendar date" (Tomorrow), and "sexuality test" (AFF). They are not present in other apps. Therefore, their uniqueness merits an analysis.

First, the last affordance, "sexuality test" is more of an adaptation of psychological tests present in other apps that are advertised for long-term relationships. In contrast to long-term relationship apps, AFF builds a psychological test that is focused fully on sexuality.

The other two affordances "escorts" and "feedback: we met" qualify how the apps distinguish themselves from others by extending the interactions to experiences other than dating online. Indeed, on the one hand, the affordance of "escorts" in Planetromeo privileges paid sexual interactions offline. On the other hand, the affordance "feedback we met" on Hinge suggests a user to indicate on the profile of another user if they have already met in person or not. This unique affordance shows a precursor and major transformation in online dating. The affordance suggests that the users give the company feedback about their offline experiences. This promotes the process of data collection in platforms currently limited to the user behavior online. The match group that owns Hinge has patented[38] this affordance, which is already an indicator of its possible power of replication in the dating industry as it can be seen with the 'like' and 'swipe' gesture on Tinder, where both are patented affordances too. The "feedback we met" affordance merits further investigation, as it marks a shift on the evaluation of potential dates as the post-rating experience "like" that is observed nowadays in platforms for recommending restaurants and hotels.

[37] "(Creation)" means these variables are required to create a profile. It can also be requested for declaring a preference about a potential date. In that case, I added to the affordance "(preference)"

[38] Match Group. SYSTEM AND METHOD FOR USER COMMUNICATION IN A NETWORK (April 2020). Retrieved from: https://worldwide.espacenet.com/publicationDetails/biblio?CC=US&NR=2020137019A1&KC=A1&FT=D&DB=en.worldwide.espacenet.com&locale=en_EP&date=20200430&rss=true#

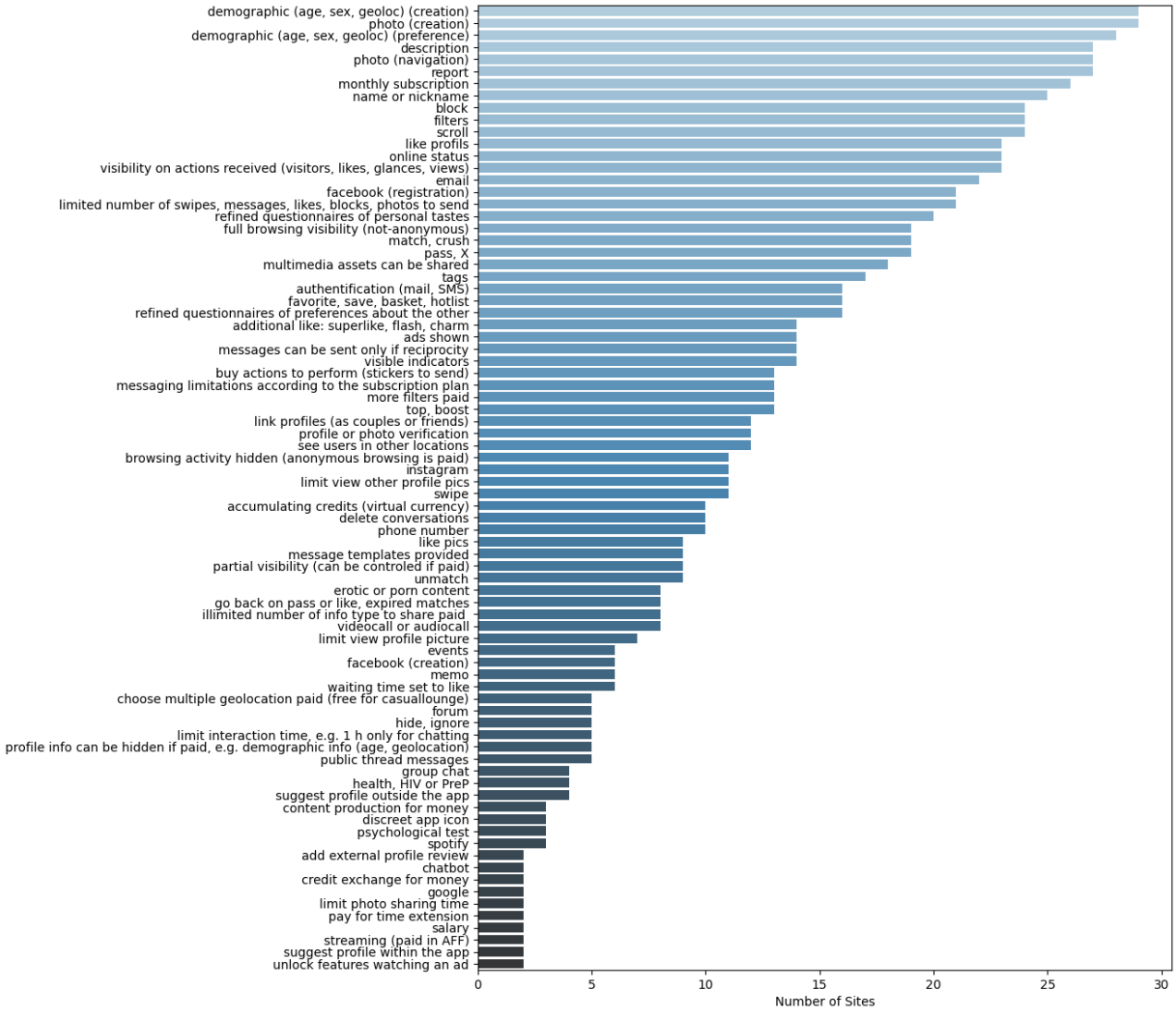

FIGURE 3 – DISTRIBUTION OF WEBSITES AND APPS OVER AFFORDANCES

The distribution of affordances over platforms in Figure 4 shows that the online-dating experience is equipped with a high number of affordances. This means the dating experience is highly programmed by "logical constraints of suggested actions" (Norman, 1988) far beyond the profile page, the profile picture, the geolocation, and the chat affordances often analyzed in previous research. I discuss these actions in detail, according to their relevance to the state of the art of affordances.

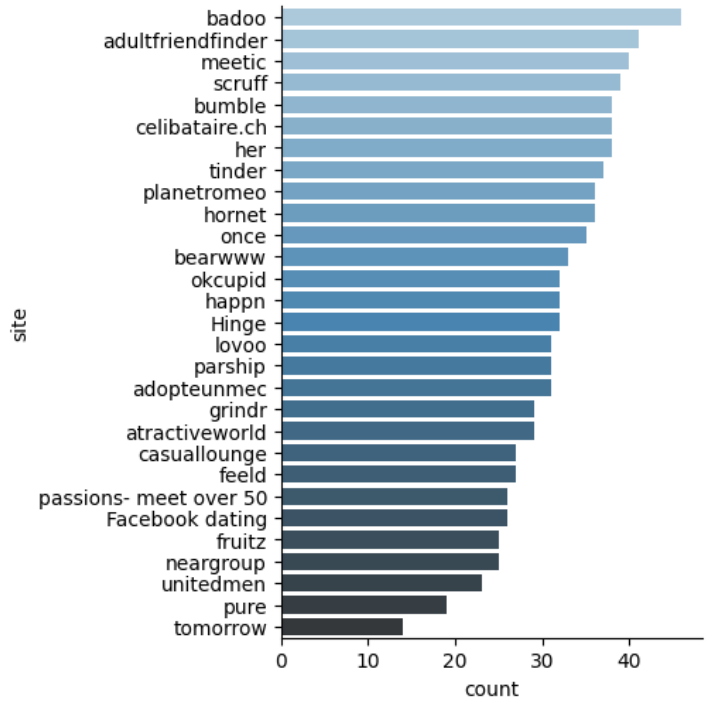

FIGURE 4 – DISTRIBUTION OF AFFORDANCES OVER WEBSITES AND APPS

First, my results confirm that the profile page and the chat are recurrent affordances, as previously observed (Wu and Ward, 2020). I provide a finer analysis of those affordances, by means of the specific possibilities of actions they offer. For instance, a profile page is constructed based on multiple actions, such as declaring information, uploading photos, sharing, and limiting the view on specific photos. In the profile page, the relevance of declaring specific demographic information is present in all apps, in particular the age, sex, and geolocation. My results confirm that dating apps are "geo-social" (Schreurs, Sumter and Vandenbosch, 2020). However, it is worth noting that geolocation serves for creating a profile and for finding another user by marking a specific distance range in kilometers or miles. This affordance limits the perimeter of the discovery of other users. Each app has a specific limit on the distance range. For instance, 160kms (i.e., Bumble) and 400 km (i.e., Feeld). Apps such as Adopteunmec or Meetic allow users to select a city, directly from an option list, instead of requiring them to activate their geolocation. The observations of couple formation on dating apps are related to this affordance, but results are contradictory, depending on the country and the platform. Some studies are based on observations made of one platform. A recent study (Potarca, 2020) in Switzerland claims that dating platforms favor, in general, the diversity of partners from different geographic locations. Whereas, other studies in France (Bergström, 2019) and the United States (Lin and Lundquist, 2013 ; Skopek, Schulz and Blossfeld, 2011) show that, in specific apps, couple formation is based on patterns of homophily that mainly depend on education, race, and sex. These studies do not explore the way the app favors trends of behaviors. My results also extend the literature by showing that geolocation is configured by different affordances that are both possibilities and restrictions: 12 apps allow seeing users in other locations (i.e., Hinge, Grindr); 6 apps condition searching in multiple locations upon payment (i.e., HER) -Casual Lounge allows it for free-; and 6 apps allow hiding the geolocation and other demographic information upon payment (i.e., Tinder).

Multiple apps offer the chat affordance. I deconstruct the chat affordance and show that communication, like geolocation, on dating apps is also conditioned by different possibilities for and restrictions to messaging: Only a limited number of messages can be sent; multimedia assets can be shared in addition to text

messaging; messages can be sent only if there is reciprocity between two profiles; messages are limited according to the subscription plan; message history is deleted; message templates are provided; video calls and audio calls are possible; a limited interaction time is set (e.g., one hour for messaging before the connection is deleted); and public message threads, forums, group chats, and chatbots are offered. The availability of public conversations, besides private one-on-one conversations, confirms the previous observation that some dating apps are becoming similar to social networks (Wu and Ward, 2020). Indeed, the affordance group chats is available in four apps, forums in five apps, and public thread messages in five apps. This similarity reconfigures the notion of intimacy on dating apps towards publicization. Communication is also dependent on the subscription plan of the user, which gives them more –or less– possibilities to communicate freely. In this sense, affordances are both possibilities and restrictions of actions.

Finally, in all apps there is the affordance of uploading a photo when creating a profile. This confirms the relevance of the study of dating, as interactions primarily based on in visual appearance. According to Illouz (2020) this is the core of modern "scopic capitalism". More pragmatically, my study shows that, as with a profile's sociodemographic description, the profile photo enables a user to find another via self-presentation and navigation. However, in relation with the profile photo, there are eight additional affordances that configure visual appearance on dating apps: limitations on number of photos that can be uploaded; photo verification; additional photos on Instagram; limitations on views of profile photos; likes allowed on multiple photos; permission of explicit erotic or porn content; limitations of views on the profile photo to certain users; and limitations of time to share a photo. However, the visual exposure is not limited to an individual online experience, as apps include affordances: suggest the profile to a person outside the app; suggest it inside the app; and add an external review of the profile, which is given by an acquaintance of the user outside the app. In general, these results show that dating apps are not limited to a visual experience based on photos: two apps afford streaming (live interactions) and base their business model on the metric of minutes of exposure on streaming (e.g., Badoo). More recently, due to COVID-19, apps have replicated the affordance of audio calls and video calls, in addition to messaging. This appears in Figure 3: eight apps in the corpus have implemented it. Together, these affordances equip the user's attentional regimes beyond a static visual perception. Attention is also based on interactions that involve affordances that are auditory, *in movement.* Furthermore, affordances create a clear distinction between online and offline experiences. Bergström (2019) explains that dating platforms have changed the temporality and modality of dating. Before dating apps, actors generally met physically first, then they got to know each other. With dating apps, actors now get to know each other in a textual form before meeting face-to-face. However, meeting physically happens quickly; one third of French users had a date after one week of their first contact online. Bergström (2019) explains that meeting physically is a secondary step that serves users to test their digital profiles and the compatibility between actors. My results show that platform affordances create a distinction of the two, online and offline, environments that enable the platforms to collect different types of data. Nevertheless, they are interrelated and users can live these experiences in parallel. Indeed, some affordances induce a permanent back-and-forth between the two environments. This dynamic movement is important for understanding the way users learn to date online. Users bring their offline experiences to the platform to finding someone.

The distribution of affordances in Figure 4 shows that platforms are not minimalistic in terms of what actions they allow for users. These observations contrast the analyses in the literature that reduce the online dating experience to one or a few affordances such as the profile picture. These analyses focus on either the alienation of sexuality in visual merchandise (Illouz, 2020) or on the positive potential of dating apps that carry possibilities of mixing socioeconomic origins of partners (Potarca, 2020). Furthermore, the study of affordances, as a bottom-up pragmatic approach, enables researchers to go beyond the categorization of plat-

forms, as advertised by companies in their marketing speech. For instance, the design and textual information of marketing strategies classify apps into user communities divided by their sociodemographic criteria; mainly by sexual orientation and type of relationship desired (Bergström, 2011).

2.4.1. Affordance Similarities: Two Conventional GUIs

In this subsection, I focus on dating app similarities by considering their description with the previously established variable set X_1 that includes affordances present in two platforms at least. From this dataset, I built a hierarchical classification of the dating app set D according to the variables X_1.

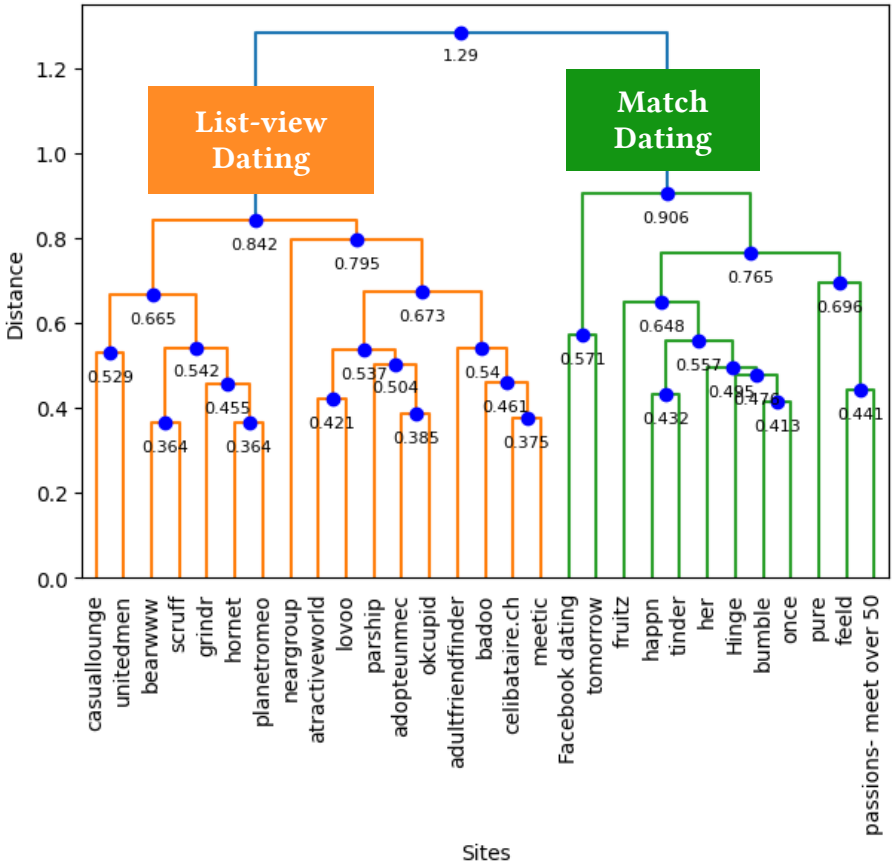

FIGURE 5 – TWO CLASSES OF AFFORDANCES EXTRACTED FROM A HIERARCHICAL CLASSIFICATION USING THE WARD INDEX

The presence/absence of each variable of X_1 in each dating app can be described by a matrix A_{nxp1} with binary entries, where an element a_{ik}= 1 (one), if the variable a_k is present in the i-th app, otherwise a_{ik}= 0 (zero). I denote the vector a_i = (a_{i1}, …, a_{ij}, … a_{ip1}) associated with the row of $A_{nxp}1$ that describes the i-th app. The classification of the apps depends on the choice of the function that measures the similarity between each pair of apps (a_i, a_j). Numerous functions are proposed in the literature and I retained one of them, the classic Jaccard index (Jaccard, 1901). There are over 70 dissimilarities that are defined on binary data (Hubálek, 1982). Their differences are based on the way information is taken into account (e.g., taking into account the common absence of characteristics). The Jaccard distance has two interests in this analysis framework. By construction, it takes into account the common presence of the

characteristics, without requiring weights (that I do not know how to justify here), and it normalizes this number by the sum of the observations. Moreover, there is theoretical work on the statistical distribution of this distance in the case of random data. These results, completed by simulations, enabled me to verify that, prior to the classification task, the distribution of the distance on the observations was different from one associated with a random distribution (Lerman, 2016). Therefore, I use the Jaccard Index to measure the proximity between two apps a_i and a_j:

$$s(a_i,a_j)=1-\left(\frac{n(a_i\&\overline{a_j})+n(\overline{a_i}\&a_j)}{n(a_i\&a_j)+n(a_i\&\overline{a_j})+n(\overline{a_i}\&a_j)}\right)$$

where $n(a_i,a_j)$ denotes the number of variables present in both apps, and where $n(a_i\&\overline{a_j})$ denotes the number of variables present in the app a_i and absent in the app a_j, and $n(\overline{a_i}\&a_j)$ the number of variables absent in a_i and present in a_j.

Two classes of affordances can be extracted from a hierarchical classification H(D) of the affordance set D with the Jaccard index and the standard Ward aggregation (Figure 5). In Hierarchical Ascending Classification, there are a variety of aggregation criteria (Gordon, 1999). Ward's criterion is one of the most used because, being based on an underlying criterion of inertia minimization, it limits the undesirable effects of rare atypical behaviors. Moreover, it is associated with interpretation criteria that guide the choice of the partitioning level to extract the classes. The two main classes of H(D) are the following.

2.4.2. List-View Dating by Immediate Availability (Orange Class)

The first class contains 12 websites and 5 mobile apps in the orange class. All the websites in the corpus are in this class. All together, they have in common the design of two affordances: the "scroll" and "online status" for browsing user profiles. My quantitative analysis confirms previous qualitative observations on dating apps that identify the list view as a main affordance that conditions communication: "the grid view or a list view, presents a range of nearby users' profiles in descending order of geographic proximity [...] One can start a conversation with any user displayed on the screen." (Wu and Ward, 2020). I further explain this type of dating, using my quantitative analysis and the combination of the scroll affordance with the online status.

Scroll Affordance enables the viewing of a GUI in a vertical way, from up to down and inversely. It is not trivial that all the websites of the corpus are in this class. The affordance is adapted to a website consulted from a desktop device, which shapes the way users perceive the online dating experience and what they can do to find a potential date. Some platforms, such as OkCupid, are available in both website and mobile-app form, but the scroll is a predominant affordance that act as a convention for accessing more profiles and more data about those profiles. Indeed, these platforms, with the scroll affordance, provide detailed information about the user (e.g., personality tests, match questions); this requires a particular affordance for navigating online. Consequently, the experience in a scrolling mode requires investing time to spend online, to read the information and browse the profiles. A common characteristic of the platforms in this class is that they offer, after registering in the app, immediate access to profiles in the form of a grid, or a list-view. Hence, the scrolling affords viewing profiles that are accessible immediately. Moreover, it enables the user to compare profiles side-by-side, according to a specific order. The profile ordering depends on the app that contrasts the previous generalization of geographic proximity ordering (Wu and Ward, 2020). For instance, Parship orders the profiles according to the decreasing personality test score between the two users (the one browsing and the one being presented), which means the profile with the highest score is presented first

(see Figure 6)[39]. Platforms, such as Celibataire.ch (see Figure 6) and Grindr, order profiles by distance, thus increasing kilometers between two users, which means the users nearest to each other are presented at the top of the list. In general, the platforms in this class enable users to find a date, similarly to choosing from a picture-based directory, like personal ads in the press (Cocks, 2015 ; DeSingly, 1984) except now with a picture and metrics for ordering. The dating experience in this class is also similar to the user experience in social networks; this requires more socialization time within the platform than by merely evaluating and selecting a potential partner. An example of this dating experience as a social network is the mobile app Hornet that includes a feed page like Facebook.

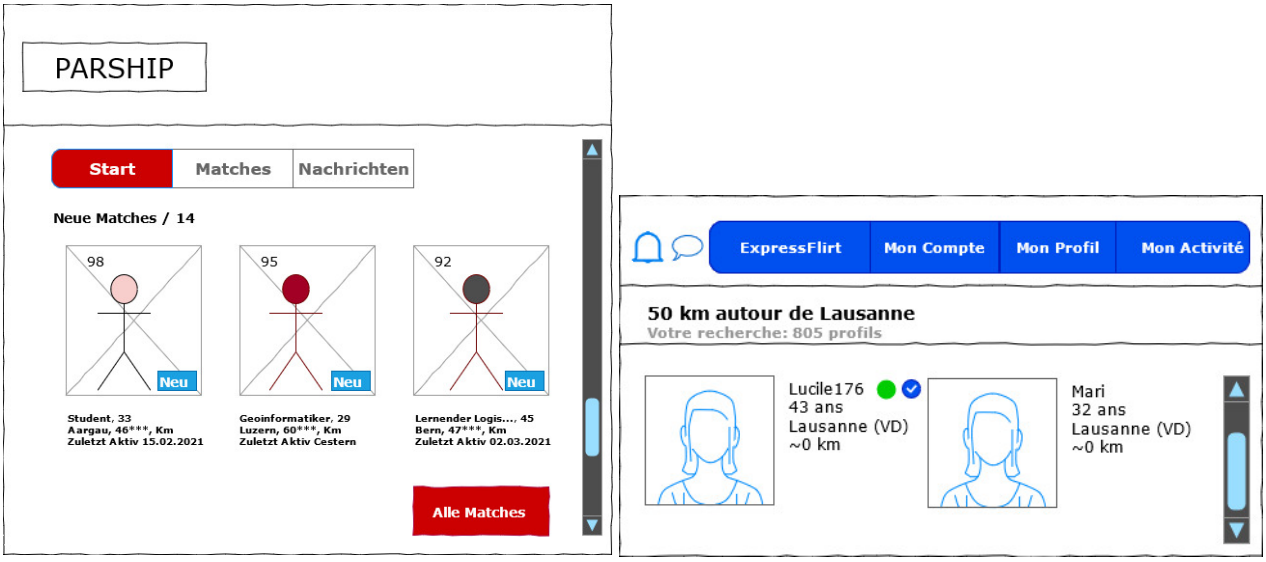

FIGURE 6 – PARSHIP (LEFT) AND CELIBATAIRE.CH (RIGHT)

Online status gives access to messaging. It suggests an availability for discussion. Indeed, the online status indicates with a green dot, for instance, if the profiles are online, or not (in this case the dot is not visible), and that the user can send a message to increase the probability of obtaining an answer. This affordance complements the previous 'scroll affordance', as it enables the user to manage a high quantity of information

[39] For illustration purposes, I copied images of dating apps. In the case of American apps, I rely on the doctrine of "Fair use of Copyrighted works" defined as follows "Fair use may be defined as a privilege in others than the owner of the copyright, to use the copyrighted material in a reasonable manner without his consent; now withstanding the monopoly granted to the owner by the copyright" (URL: https://www.copyright.gov/history/studies/study14.pdf). The U.S. government states that "Notwithstanding the provisions of sections 106 and 106A, the fair use of a copyrighted work, including such use by reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright." (URL: https://www.copyright.gov/title17/title17.pdf). For European apps, the legislation on the harmonization of copyright in the information society stipulates "3. Member States may provide for exceptions or limitations to the rights provided for in Articles 2 and 3 in the following cases: (a) use for the sole purpose of illustration for teaching or scientific research, as long as the source, including the author's name, is indicated, unless this turns out to be impossible and to the extent justified by the non-commercial purpose to be achieved." (URL: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1525701238400&uri=CELEX:32001L0029). Finally, concerning the only Swiss website identified as Celibataire (URL: https://www.celibataire.ch/info_legales.php) with headquarters in the canton of Vaud, I collect the structural data of the website with the sole purpose of doing research without any commercial interest : 231.1 Federal Act on Copyright and Related Rights (Copyright Act, CopA) of 9 October 1992 (Status as of 1 April 2020). According to the Art. 2 Definitions of Works: "Computer works are considered as literary and artistic intellectual creations with individual character, irrespective of their value or purpose." Following Art. 21 Decoding of computer programs, "Any person who has the right to use a computer program may obtain, either personally or through a third party, necessary information on the interfaces by decoding the program code using independently developed programs. The interface information obtained by decoding the program code may only be used for the development, maintenance and use of interoperable computer programs insofar as neither the normal exploitation of the program nor the legitimate interests of the owner of the rights are unreasonably prejudiced." (URL: https://www.admin.ch/opc/fr/classified-compilation/19920251/)

and profiles in order to evaluate while scrolling, as well as to reduce the time invested when browsing. Some apps present the online-status affordance with a free account, also called *freemium* account. In platforms, such as Hornet and OkCupid, online status is a paid option and affords the user to manually filter profiles. By paying, the user obtains in the result page those users who are connected, which reduces the effort when browsing (see Figure 7). The scroll and the online status are hence two conventional affordances in 17 platforms. Whereas the scroll gives visual accessibility to a large number of profiles for capturing the user's attention, the online status focuses their attention on the profiles with immediate availability for discussing. Together, the affordances organize the research and evaluation of profiles in a hierarchical order when browsing. Although the online status offers the browsing user a guarantee of interaction, the scroll enables them to acknowledge that to increase the probabilities of finding a potential date; they need to remain permanent available so as to appear on the top of the result list. In this sense, the affordances encourage users to learn how to be perceived and to find a date strategically.

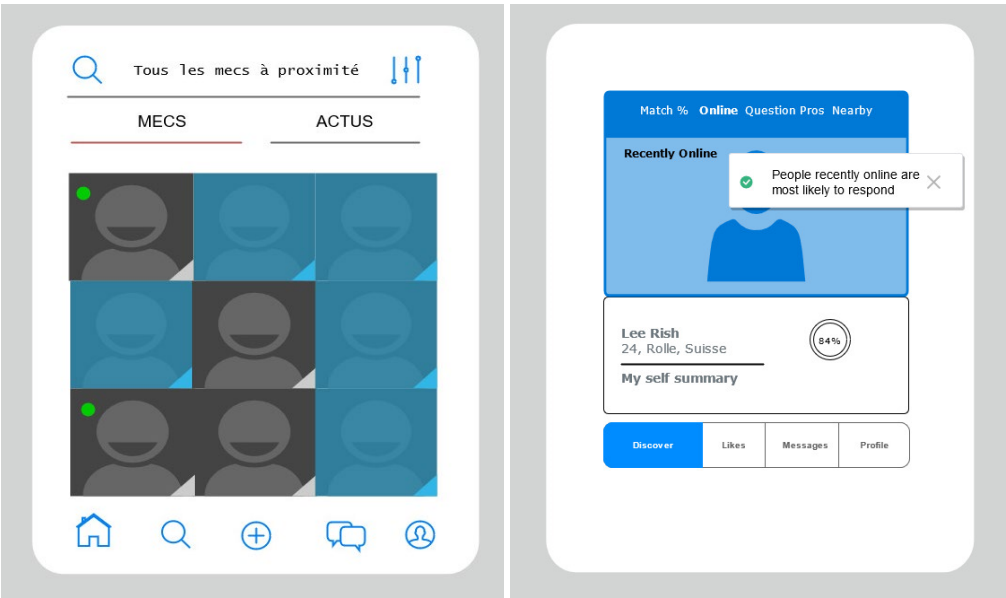

FIGURE 7 – HORNET (LEFT) AND OKCUPID (RIGHT)

Using these two affordances, I now identify the attentional regimes (Boullier, 2009) as programmed in these 17 platforms. These regimes contain particular possibilities of actions that are mainly immediate access and availability; they require time for browsing and discussing in the app. The user's attention is captured here, more through duration to become a regular user than through intensity to feel excitement. Although the immediate accessibility to a high quantity of profiles in the list-view can produce excitement, it becomes quickly a hard cognitive task to manage with the scroll affordance. On one hand, there is a certain degree of intensity programmed with the online status as a salience of immediate availability. On the other hand, the online status affords *staying* available and *discussing* in the app: these two actions require duration and a narrative experience. Discussion interactions are a main step in online dating and are used for establishing indicators to measure a choice mate, or a "successful" match, by app producers and scholars (Bapna et al., 2016 ; Bergström, 2017 ; Fiore et al., 2010 ; Skopek, Schulz and Blossfeld, 2011 ; Zhang and Yasseri, 2016 ; Zytko et al., 2018). Therefore, in this class, apps program a higher degree of duration to capture users in two main attentional regimes: loyalty and immersion (Boullier, 2009).

Loyalty Regime. This regime establishes bonding between the platform and the users via conventions that enable habituation in order to remain in the app. Users here can recognize habitual saliences, such as the

online status for knowing *when* to contact whom before searching other types of information about the profile. The salience is two-fold, as it requires users to be connected in order to be perceived, and to browse by availability in order to be able to interact in the app for a longer time. Otherwise, the user sends a message and can quit the app with the uncertainty of knowing when a reply will arrive, as with the mailbox dynamic. These affordances are more important in apps where the picture is not a salience. For instance, on Parship, the profile pictures are blurred before discussing with somebody; on celibataire.ch and Grindr, users do not necessarily present a picture. Only a few apps verify the profile picture before accepting the registration on the platform. Consequently, users are required to get to know the person via the conversation within a duration, before making a rapid visual evaluation. This pragmatic analysis is different from couple formation studies that focus on what demographic criteria matches users in online dating (Skopek, Schulz and Blossfeld, 2011). These studies do not cover the way platforms program the attention on certain profiles, based on a hierarchical order of time (immediate availability), which influences in advance who can select whom.

Immersion Regime. This regime is characterized by capturing the user, for a certain time and by using a type of continuous and collective excitement. The apps build a shared experience with the other, through the online status affordance; whereas the user can receive satisfaction when receiving one message, while remaining attentive to the next message. At the same time, this regime captures the attention in a multifocal manner: There is a multiplicity of profiles accessible on the app, and a reduced quantity of profiles that are available immediately. This double modality of attention provides the user the perception of having possibilities. The user can try reaching other users that are also available in the pool of profiles, in case some do not answer despite their immediate availability. This is mainly an immersion via the discussion so that the user attention is captured for a longer amount of time, but it is also a regime of reactivity to a certain degree. When the user browses with the scroll affordance, the immersion regime requires them to invest more time in the app to find somebody in a list-view, thus to be available for a discussion. However, it can also program attention in a state of reactivity in order to identify those who are available. A high degree of immersion online leads the user furthers away from a regime of projection offline, where the plan is to meet somebody face-to-face or to establish a couple. The projection is necessary, to a certain degree, so that the person can engage in a collective action with another user beyond the online experience.

2.4.3. Match Dating by Reciprocated Attractiveness (Green Class)

The second class, green, contains 12 platforms that have 6 common intertwined affordances. They are photos (navigation), 'like' profiles, passing X, sending of messages only if reciprocity, demographic (age, sex, geolocation) preferences, and monthly subscriptions. My quantitative analysis confirms that the second category of browsing affordance can be identified on previous qualitative observations that have an impact on communication. "The category presents one single profile at a time. Users need to swipe left or right on the profile to signal their dis/interest in establishing a connection. Private messaging is possible only when both users signal their interest." (Wu and Ward, 2020). The reciprocated action of signaling an interest (both users like each other), creates a *match:* a main characteristic of the dating experience in this class. I explain in detail this type of dating based on the combination of six affordances.

Photo. First, these platforms are differentiated from the apps in the previous orange class, as they do not provide access to profiles in a grid. Instead, the profiles are shown, one after another, in the form of cards. This enables an individual browsing of profiles, in contrast to the browsing in a list-view, which affords a comparison of profiles side by side. The apps in this class enable browsing profiles in a way that the experience is guided by a main profile photo. This type of dating experience does not provide direct visibility on how many profiles there are on the dating app, as in the previous class. It is a limitation of the view on the

dating market and it avoids memorizing the judgments built by every profile, as they disappear immediately, one by one, as they appeared at first.

Like or Pass. The second and third affordances are combined here as the profile browsing is framed by a binary choice. It enables the user to indicate an interest or a refusal for a profile: the 'like', also designed as a heart button, or pass, also designed as an x button (see Figure 8) to continue browsing. Marking a choice affords the user access to a new profile in the result page. As a result, browsing profiles is quicker on the apps of this class due to the individual browsing and the design of the binary choice. The binary choice is linked to the design of a swipe horizontal gesture with the thumb: swipe left to pass the profile, swipe right to like it. This design affords quick and short browsing. It is a contrasted experience to the vertical scroll browsing that requires more time.

FIGURE 8 – TINDER PROFILE PAGE

Reciprocity. The apps on this cluster do not afford sending messages to a profile directly. Users are required to obtain a reciprocated 'like' or sign of interest before being able to send a message. That is not the case on apps in the other class, for instance on Hornet, Grindr and OkCupid, users can send a message directly without receiving a reciprocated sign. This means apps in this class enable the user to send signs of interest and in a high quantity, while waiting to receive a 'like'. The binary choice mitigates the waiting time of the reciprocity condition of availability for discussion.

Demographic Preference. The apps in this class afford the user to ability to declare, mainly based on demographic criteria, their preferences for browsing. This affordance is designed more concretely as a "settings" icon or page. It affords declaring a range preference according to age, distance in kilometers or miles, and sex.

Monthly Subscription. Finally, all these apps present the affordance of buying a monthly subscription. Users can also buy a package of several months or a year. They differentiate from the apps in the orange class that afford buying virtual credits created by the app that can be exchanged for actions online, e.g., in Badoo a user can buy 100 credits for a 10 Euros and then exchange 5 credits for sending a sticker like a flower to another user. The affordance of buying a subscription in this class is designed in various forms: In

the form of a button (also called *call for actions)*, a dedicated page, or a pop-up window captures the user's attention in order to unlock other affordances that are only accessible to premium accounts. For instance, a user with a freemium account can filter profiles by only demographic preferences, whereas a user with a premium account can access a larger list of criteria for filtering profiles. This means users in this class can configure the granularity of preferences based on which they browse a date. The six affordances are established as conventions across 12 platforms, which characterizes the dating experience here as quicker and based on a certain guarantee -coded by the system- of reciprocated attractiveness. Indeed, users can browse profiles on a succession of photos with a binary choice, where the reciprocity condition for messaging provides a preliminary guarantee between two profiles in order that they invest in the interaction. Moreover, browsing profiles is guided by the user's type of subscription and the socioeconomic status, as declared on preferences.

Using these 6 intertwined affordances in these 12 platforms, I identify two attentional regimes: alertness and projection (Boullier, 2009). The affordances in this class contain particular possibilities of actions that are mainly quick browsing of photos, reciprocity based on a binary choice, subscription type, and socioeconomic status. They capture the user's attention during the preliminary step of evaluation, more when browsing than during the step of discussing.

Alertness regime. This regime captures the user's attention at a high degree of intensity, with quick and short possibilities of action; in particular, with the photo and the binary choice. The dating app Tinder is the best illustration for the regime of alertness described by Boullier (2009) as, "a zapping modality with exposure to events and stimulation, interposed permanently.". The apps in this class form the scopic capitalism described by Illouz (2020). She refers, in particular, to how users consume sexuality on Tinder and do not engage in relationships and experience dating with a high uncertainty about the other's affective expectations. Whereas I show, more specifically, that multiple apps in this class capture the user's attention via affordances that propose novelty by design. Before users learn to create value with their bodies, as Illouz (2020) shows, they learn to adopt the machine's dynamics. The design of the apps guide their attention by two particular affordances: browsing in succession individual photos and sending a binary choice as a signal to the system. By affording the user to view one new profile after another one and by enabling them to quickly mark an interest, the apps guide the user's excitement to discovering. This leads them further away from finding a potential date. Instead, they are captured by the novelty of browsing; in particular, via the affordance that conditions sending messages based on reciprocity. When there is reciprocity between users (both users mark an interest for each other), the app sends a notification of a "match". This salience produces permanent state of excitement, via ephemeral events that arrive between browsing one profile and another one. The attention in alertness does not enable memory and hierarchy of information (Boullier, 2009), as in the previous class of platforms designed for a form of loyalty. Here the attention is divided between different events of excitement: the picture, the binary choice, the reciprocity. When users enter these apps they are constrained to have a certain type of dating experience by the logically designed constraints. However, when users are captured in alertness with the app and not with other users, for instance, during the discussion, they can fall into a certain degree of the regime of immersion. When focused on discovering novelty, they can be retained by the app. Here the app uses this immersion as an opportunity to encourage the user to buy a subscription, which extends their experience for a longer period, according to the monthly or annual subscription paid. According to Boullier (2009), alertness blocks reflexivity due to a complete focalization on saliences, yet this is not the definition that Auray (2016) gives to attention. He highlights that attention has a "floating alertness" property when a user explores. Discovering novelty can be both exciting and threatening, and this duality enables users to experience excitement while continuing with the inquiry. As a result, users are on a state of freedom, letting novelty emerge, while still seeking to discover another profile. In this

class of dating apps, the subscription affordance guides the user's purpose to discover, through two dimensions: financial and temporal. These two affordances lead to the last regime of attention, predominant in its class.

Projection Regime. Attention is programmed mainly by the type of subscription and the demographic criteria for declaring preferences. These affordances guide the user's attention in order to organize their discovery research in the form of a plan. The planning is guided by browsing via a specific socioeconomic status. The planning is also dependent on the users' own economic status within the platform, which is based on their subscription type. Through these specific affordances, a user's attention is captured in a strategic position where the platform provides possibilities of actions, as resources, to follow a presupposed plan. It is a presupposed plan as programmed by the app via specific affordances, despite the individual's motivations for registering in the app. This creation of a presupposed plan via financial and temporal affordances enables capturing the user's attention for the long term.

According to Auray (2013), when platforms, such as these dating apps, program the exploration with a high degree of reactivity or projection, the environment is organized and it blocks openness to discover others. He qualifies, on one hand, reactivity as an "opportunism" where the "user is in automatic pilot" and the environment limits actions to a "mechanical grip of affordances" (in French, "saisie machinale des affordances"). On the other hand, he qualifies projection as an organized research where the user is a "prospector" focused on calculation, where the environment produces "intentions of maximization", and the engagement is the planning. As he was interested in developing the potentialities of digital platforms for transforming the social order, *curiosity* enables discovery in a fruitful pedagogical sense, where the environment enables "excitement throughout surprises", and the user can engage in the "anticipation of excitement" via an "inquiry". Auray (2013) highlights that "curious exploration is based on a double opposition, against *organized research* on the one hand, and against *opportunistic reactivity* on the other." However, I can see that in dating platforms, the type of actions and their related cognitive tasks are hard to distinguish, as the app learns to program them in combinations of affordances that capture the attention in different regimes within the same dating experience. In the first class of list-view dating, the browsing design on apps, such as Parship, affords over time scrolling, and within the excitement of availability for discussion with and discovery of the other. In the second class of match dating, the browsing design on apps, such as Tinder, affords feelings of excitement, and surprise, in order to discover novelty through short actions, e.g., marking an interest for a succession of pictures, while remaining attentive to an organized research based on a financial plan.

2.4.4. Methodological Contribution

Our study contributes more broadly to a new methodology for revisiting the "design of the visibility" on platforms, as defined by Cardon (2008). By describing, in a qualitative and quantitative manner, which specific arrangements of affordances will capture the user's attention within multiple platforms for dating, I show that online dating cannot be fully described and categorized as "classic sites with a search engine based solely on identity criteria", as Cardon (2008) highlights. According to Cardon (2008), dating platforms can be classified in a visibility type called "screen" (in French, "paravent"). Screen is defined as a flat, movable, often folding, covered framework for preventing a person from being seen. Dating apps in screen visibility "preserve the identity of users from excessive exposure by encoding identity into a category system that is only accessible through a search engine." (Cardon, 2008, p. 105). For Cardon (2008), this type of visibility design "encourages a rational research of the soul mate, based on a metric categorical matching of civil and bodily identity." (Ibid., p. 106). My study of affordance arrangements shows that the online dating experience is only partly based on categories of sociodemographic criteria. Other affordances shape what to look at, how to browse and find somebody. While the study of visibility is based mainly on what is visible on profile

pages, my study shows the full experience of online dating, via the study of affordances on different pages. However, given the importance of the profile page for presenting oneself in a dating app, I will apply the same methodology to the study of the profile pages in my corpus.

Now that I have exposed two distinctive conventional dating experiences with specific affordances and the combination of attentional regimes, in the next section, I study self-description variables, by focusing on the user profile page. Before browsing profiles or being available for discussions, users are obliged by platforms to create a profile for self-presentation. If the analysis of affordances sheds light on the way the user's attention is captured, and on the possibilities of actions by design, the analysis of variables contributes to the specific type of linguistic material that holds the agency of affordances to capture the attention of one user for another.

2.5. The Study of Phenotype Variables

Using an exploratory data analysis, I address the following research question:

(**RQ2):** Given the phenotype variables collected from a set of dating apps, which main variable arrangements structure the dating profiles in direct mediation with users?

To address RQ2, I computed two classifications: one of the variable set and one of the dating-app set, based on the presence/absence of shared variables. A preliminary observation of the distribution of the variables on the dating-app set shows that it is non-uniform: 34% of the variables are common to two or more apps, and the others appear in only one app. An in-depth analysis of the variable landscape led me to propose a new typology of the phenotype variables in nine categories that, supported by the literature, reflect the perimeter they cover, from "individual capital" to "relational dynamics". Additionally, the dating-app classification reveals four classes that reflect specific dating structures ("communitarian sex-driven", "quick dating", "full commitment", "diversity") that do not necessarily regroup apps with the same language or common brand agglomerations. My study provides insight into the variables for profiling users, according to platform interests that serve the mechanisms of filtering tools and recommendation systems.

2.5.1. State of the Art: Self-Description Variables

An algorithmic system design attracts the user's attention via the information that is displayed (Tong, Hancock and Slatcher, 2016). The information display is presented on the profile page of the dating apps and is often referred to in the literature as "self-description" variables that serve algorithmic purposes. Dating apps are conceived as "reciprocal recommendation systems" (Pizzato et al., 2010) that measure mutual interest, based on messaging interactions, behavioral traces, and user profile characteristics (Tu et al., 2014 ; Xia et al., 2016). A principal feature of these so-called "social-matching systems" is the profile creation, where users are required to create a personal portrait of themselves by specifying their interests, age, and gender, and by providing a photo (Hsiao and Dillahunt, 2017a). The volume (Diminescu et al., 2010) and content of profile pages can vary from system to system (Zytko, Freeman, et al., 2015). Various lists of characteristics can be extracted from the literature: 73 traits, preferences, lifestyles and future plans (Xia et al., 2014); and 9 variables (such as race, education, smoking, drinking, and quick match rating) are taken into account to create "community profiles" between old and new users; these profiles serve to solve the "cold-start" machine-learning problem, i.e., lack of information about the user when they first register in the app (Yu, Zhang and Kreager, 2016). A coarse-grained classification of self-description variables was compiled from a review of attraction literature; it contains five general trait categories that influence a person's attractiveness (Zytko, Grandhi and Jones, 2016b):

"Physical attractiveness: physical or visual appearance;

Demographic traits: height, weight, race, ethnicity, age, religious affiliation, income, education, marital status;

Lifestyle traits: attitudes, values, interests including lifestyle choices associated with demographic traits (e.g., how often one goes to church), attitudes about life (e.g., should women stay at home while men work), and other interests and activities (e.g., smoking habits, kayaking);

Personality traits: the psychological five-factor model of personality, intelligence, and sense of humor;

Relationship goal: perception of the person's preference for a long-term relationship or short-term casual encounter."

Some of these variables are not new to online dating and are etched in long-standing practices from traditional matchmakers to computer-readable questionnaires (Hashish and Peterson, 1999). These artifacts dispose and provide precise ways of organizing knowledge and expertise about matchmaking. In sociological studies, user-profile variables are roughly categorized into "sociodemographic", "geographic" and "psychological" (Kessous, 2011); these categories are often undescribed (Illouz, 2006) or are aggregated to construct "cultural and economic capitals" (Schmitz, 2012). The latter is inherited from Bourdieu's sociology of tastes (Bourdieu, 1979); he affirms that tastes concerning arts and food, and even potential mates, are practices defined by an individual's structured socio-spatial position. In these structural analyses, individual tastes regarding mate preferences depend on "socioeconomic" (e.g., education) and "sociodemographic" (e.g., age) characteristics that define a certain lifestyle (Schmitz et al., 2009). Bourdieu's capitals have also been classified in online dating as "social" (i.e., variables describing resources and benefits of social ties) and "cultural" (i.e., variables describing symbolic and incorporated resources) (Hsiao and Dillahunt, 2017a). Additionally, upon culmination of the present study, a comparative analysis of ten popular American dating apps was published (Olgado, Pei and Crooks, 2020), wherein 18 variable fields were common, and 65 were unique. Olgado et al. (2020) show that variables reflect market and power structures that rule intimate platforms. They highlight the fact that users have limited freedom when creating a profile, as they can choose only from predefined options, as the majority of these are fixed by the system. In this sense, variables serve for "self-representation and profit extraction" (Olgado, Pei and Crooks, 2020). Although the study is one of the first quantitative studies of variables, it is restricted to describing only the most commonly required fields.

I extend the state of the art with the analysis of self-description variables, which also contributes to the definition of user preferences: This is the most extensive quantitative and comparative study of dating app variables, extracted from an extended set of Anglophone and Francophone platforms. It complements online-dating research by providing insight into "what" constitutes user representation in the dating experience.

2.5.2. Definition: User's Phenotype Variables

To build a landscape about "user representations" (Akrich, 1995), two types of variables are distinguished here and called: *phenotype* and *genotype*. The definition of the type of variables contributes to assigning the relevance that these variables merit. The lack of ontologies in the literature makes it difficult to explore them in further comparative studies. Together, these variables define users from the platforms' perspective. As noted by M. Akrich (1995), innovators construct different representations about potential users when defining new technologies. These representations are objectified in technical choices. The first type of variable that I name phenotype refers to a user's observable characteristics or identifiable properties (e.g., hair color, geolocation), as defined by the app and declared by the user when creating a profile. Profile creation is often

a mandatory registration step in online dating (Zytko, Grandhi and Jones, 2016b). Both users and dating-app creators can use these variables via GUI forms: for self-description, filtering, or recommending profiles. The second type, genotype, refers to information or arrangements of information (e.g., date and time when a message was sent, total time spent on the app per day, number of times the app was opened) tracked during a user's navigation in the platform. The genotype is not declared by users via GUI forms and is collected without the users' knowledge. The information is invisible to users and researchers analyzing online dating (unless they have access to their databases). Furthermore, it is accessible only to the dating app creators who use it for different internal processes: to explain user behavior, to improve the system, and to sell it. The two variables enable the collection of user data from both the dating platforms and from exogenous integrated sources, such as social media. Together, they feed the input variable set of algorithms. Indeed, defining constrained descriptors enables companies to apply automatic searching and matching systems (Fiore and Donath, 2004).

My research is focused on phenotype variables for mapping the online daters' representations that are directly accessible from the GUI and that can be collected without affecting user privacy. These phenotype variables matter to users when performing the different possibilities of actions offered to them via affordances (e.g., settings for declaring a demographic preference), and they constitute a partial view on proprietary algorithms. More generally, in this thesis, my focus on variables re-establishes the importance of these entities in "algorithmic accountability" studies. A well-known author in this domain, N. Diakopoulos (2014), formulated the application of reverse engineering to proprietary algorithms in order to understand their outputs in data journalism. He initially pointed to the relevance of variables in the methodology "the journalists had to painstakingly reconstruct profiles that simulated inputs to the algorithm, and look to see if any of the variables in those profiles led to significant differences in output." (Diakopoulos, 2014, p. 19) He later abandoned variables to focus on input values. This focus is critical in online dating, where input values are sensitive data that some scholars scrape for the sake of research (Birnholtz et al., 2014). When researches in online dating focus on the analysis of these input values, their goal is to understand user behavior. I take a different position by analyzing, instead, dating structures, as they are created for capturing user attention. My position contributes to the way user behavior is produced and, in the same movement, is captured. It contributes, more broadly, to what researchers can observe and analyze as user behavior.

2.6. Data Collection II: Dating-App Phenotype Variables

In this second data-collection, I gathered a set of variables based on a subset of the previous data-collection of affordances. Although the data collection methodology remains the same with respect to the diversity of apps, according to sexual orientation and the elements of innovation, here I add a third factor for the data collection: the access to the whole set of variables available in the app's GUI. Indeed, some pages of apps are designed in a way that new variables appear and are updated constantly. The main reason for this is that the app crowdsources the variables from external resources and requests users to add new ones. This third factor leads me to exclude some apps hence reduce the number of apps in this sample to 22 platforms. Furthermore, in this dataset, to build the classifications and discuss my results, I account for the language of the platforms, as well as the differences between variables. I describe in this section the new data-collection and samples, whereas some elements are repetitive in respect to the previous section. Yet, for the sake of coherence and understanding of this section analysis, I keep them.

A set Y of p' = 317 variables were manually gathered from a set D of n = 22 dating platforms composed of 9 websites and 13 mobile dating apps (14 Francophone and 8 Anglophone). See previous section 2.1.2. for more details about the sampling. The list of variables is available in the Annex section. Three factors guided the selection of the dating apps: (1) the diversity of the population targeted according to the sex options available

when registering to describe oneself and to find another user. The sex options and their combination constraints, for example, women seeking women (homo) AND men (bi) OR women seeking men (hetero), are presented in Table 2, see "Population (sex or status options)"; (2) a distinctive element of innovation advertised in the app's website or in media coverage; and (3) the accessibility to a finite number of variables.

TABLE 2 – LIST OF 22 DATING APPS AND WEBSITES. VARIABLE ANALYSIS.

No.	Name	Platform	Population (sex/status options)	Version/ Access date	Language
1	AdopteunMec	website	hetero	feb 2019	FR
2	AdultFriendFinder-Aff	website	hetero/bi/homo/ single/couple	oct 2019	FR
3	Badoo	android	hetero/bi/homo	v5.137.1	EN
4	Bumble	android	hetero/bi/homo	v5.139.1	EN
5	CasualLounge	website	hetero	nov 2019	FR
6	Feeld	android	hetero/bi/homo/ single/couple	v5.5.7 Build 364	FR
7	Grindr	iOS	homo (men only)	v5.20.0	FR
8	happn	android	hetero/bi/homo	v24.17.3 #633	FR
9	Her	iOS	homo (women only)	v6.5.14	EN
10	Hinge	android	hetero/bi/homo	v7.1.0	EN
11	Lovoo	website	hetero/bi/homo	nov 2019	EN
12	Meetic	website	hetero	jul 2019	FR
13	MeeticAffiny	website	hetero	jul 2019	FR
14	Once	iOS	hetero/bi/homo	v2.8.10	FR
15	Parship	website	hetero	nov 2019	FR
16	Passions - Meet over 50	iOS	hetero/bi/homo	v2.1.1	FR
17	PlanetRomeo	website	homo (men only)	oct 2019	EN
18	Pure	android	hetero/homo	v2.19.33	FR
19	Scruff	android	homo (men only)	v6.0019	EN
20	Tinder	iOS	hetero/bi/homo	v11.2.1	FR
21	Tomorrow	android	hetero/bi/homo	v1.0.8	FR
22	UnitedMen	website	homo (men only)	nov 2019	EN

The last selection condition (a finite number of variables) led me to exclude apps from the first dataset, such as OkCupid, as the profile page is organized on sliders, where a few variables are visible, but not all are previewed by default. Instead, a user can continue to perpetually add new variables, thus leading to the appearance of a new profile section. These sections are organized according to different topics, and each topic has between five and eight predefined variables that can be chosen from a list. For instance, in the section "About me", a user can choose among, for example, my self-summary, my favorite thing about the place I live, and me-a Haiku. Moreover, OkCupid crowdsourced the match questions, which led to the creation of more than 460,000 questions, hence they were intractable for my analytical framework. Including such websites, while limiting them to only a few pages such as "Basics" where sexual orientation is presented, would lead to an unbalanced proportion of number of pages for some apps. The p' variables were extracted from GUIs, where they were then organized into four families of pages: registration, profile-edit-

ing, profile-view, and research criteria or preferences. Together, these pages form the declarative user identity and the ideal date; this is often a compulsory process for accessing the online-dating service, which acts as the first mediation between the system and the user.

The diversity of programming languages, design formats, and dynamic contents did not afford an efficient use of automated scrapping methods. Therefore, I, as a user, resorted to a manual extraction with a preliminary registration and profile creation on each platform. The various pages of the apps were browsed so as to understand the whole system, and for every page where an online form with questions was found, all variables were collected. No personal data was collected, and no contact was made with other users. All the profiles created specifically mentioned that it was a "researcher" profile, and that it was possible to contact me for further information about the research. For dating apps exclusively targeting heterosexuals, and for generalized apps for heterosexuals, homosexuals, and bisexuals,[40] as well as for apps for women seeking women, a female profile was created when collecting data. In dating apps for men seeking men, a male profile was created.

Variables were collected using their original names and later translated into English for Francophone apps. For the sake of comparison, the diversity of the naming conventions was standardized in the following way: Long sentences were shortened and coded into a more general description; and variables that had an ambiguous name (mainly because they were using jargon) were labeled by a specific variable that reflected their meaning, after their usages were browsed on the platform. This data pre-processing avoids redundancy with variables that refer to similar questions. Note that one major difficulty I faced was labeling variables from the extensive questionnaires (about sexual preferences, social life and psychology) that were integrated in the following four apps: AdultFriendFinder, Hinge, Parship, and MeeticAffiny. These are very specific, often building scenarios to capture the users' behavior in precise situations.

2.7. Results: Phenotype-Variable Typology and Dating-App Classification

The distribution of the number of phenotype variables over the dating app, set D, is heterogeneous (Figure 9), with a maximum for Aff, equal to 123, and a minimum for Pure, equal to 5. Note that the nine apps containing less than 20 variables are geared towards a practice of immediate matching, through the minimization of variables presented to users. The main variables common to these minimalistic apps are demographic (binary sex, age), socioeconomic capital (occupation, university name) and online sociocultural capital (cross-platform connectivity), and they are also present in the other apps. More precisely, the variable set Y can be partitioned into two subsets: subset Y_1, which contains the $p'_1 = 109$ variables common to two or more apps of D, and subset Y_2 which contains the $p'_2 = 208$ variables appearing in only one app. In the following subsections, I first created a typology of the phenotype variables, and then I analyzed the dating app similarities and identify their differences. As shown in Subsection 2.1, the lack of ontologies upon which to base my analysis made it difficult to draw *a priori* assumptions. Consequently, I followed an exploratory data analysis approach.

[40] I use these three categories because in a general manner dating apps target users via binary sex combinations (M-M, F-M, M-F, F-F or both F-M-F, M-F-M). It is a mandatory field on the registration page, despite the fact that some apps offer myriad sexual identities at later stages.

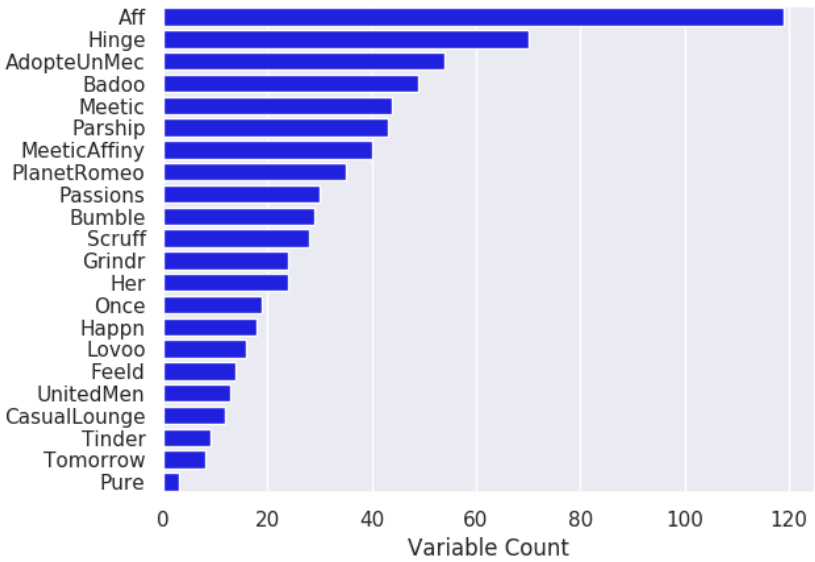

FIGURE 9 – DISTRIBUTION OF 317 PHENOTYPE VARIABLES OVER 22 DATING APPS

2.7.1. Phenotype Variable Typology

The new typology of the variable set Y, in nine categories, is deduced from an inductive approach based on three criteria: (i) who the variable refers to (user, ideal partner, couple, interaction itself), (ii) which tense is used (past, present, future), and (iii) whether the app already presented a category (myself description, personality, lifestyle, etc.). The observations of the empirical data were compared to previous sub-classifications published in the psychological and sociological literature. As reflected in the state of the art, part of this literature focuses on the evaluation attractiveness in terms of the user's demographic, physical, psychological, and social characteristics (Fiore et al., 2008 ; Fiore and Donath, 2004 ; Zytko, Grandhi and Jones, 2016b). Another complementary part focuses on what constitutes a person's capital in a social context, drawing on Bourdieu's theory (Hsiao and Dillahunt, 2017a ; Schmitz et al., 2009). In a process of self-description, these variables address mainly one initial stage of the encounter; this includes both the description of oneself (to be chosen) and the description of another person (to choose). The first subset of my empirical data covers this initial choice stage. The second one, however, concerns the description of the online and offline encounters between two users (e.g., relational goals, daily organization as a couple, importance of sexuality). The dynamics of relationships was studied in the in-depth literature review on couple formation by Kellerhals et al. (2004). They identify certain dimensions distinguishing that which refers to the individual from that which refers to the couple. Specifically, they establish four dimensions: (1) psychological characteristics, (2) socio-cultural heritage, (3) relational dynamics, and (4) problem solving or "coping". Using these indicators, in combination with previous literature on online dating, I drew a new typology T(Y) of Y in nine categories, described in Table 3 (variable details are sent via e-mail upon request). Note that these concepts are defined and measured differently across disciplines. Therefore, the new categories are defined according to three dichotomous criteria: (i) individual/couple, (ii) personal patrimony/behavioral dynamics, and (iii) offline/online environment.

The three categories most representative of the variable corpus are individual capital (32%), relational dynamics (27%) and sociocultural capital (13%). Online dating is, in general, formed by personal history, the users' representation of their own capital and behavior, and what can be built *in situ* on dating apps, as a

socializing space on its own. Collectively, these dimensions characterize the user, or "cast a mold" of intimate platforms (Olgado, Pei and Crooks, 2020). The heat map in Figure 10 displays a variety of category combinations for each given platform. The dating apps on the x axis are organized by a decreasing number of variables. For instance, in first position, Aff (AdultFriendFinder) possesses numerous variables relating to individual capital (30%) and relational dynamics (26%). In last position, Pure has mainly demographic variables (60%). In the middle, Her focuses on the demographic (29%) and sociocultural capitals (25%). Overall, the least exploited variables are those that concern coping and online relational-dynamics. The statistical distribution of the different categories of the typology T(Y) is given in Figure 12: For each category of T(Y), the value presented in the heat map corresponds to a rounded percentage of variables per category, divided by the total number of variables per app.

2.7.2. Dating App Similarities and Differences

In this subsection, I focus on dating-app similarities and differences by successively considering their description with the two previously established variable sets, namely Y_1 and Y_2. First, I built a hierarchical classification of the dating app set D from Y_1, where the previous typology T(Y) explains the obtained classes. Then, I manually analyzed the role played by the unique variables of Y_2 in the 14 apps that contain at least one of them.

TABLE 3 – CATEGORY DEFINITIONS AND REFERENCES

Category	Definition	References
Demographic:	Individual characteristics within the population, e.g. nationality, civil status, sex.	Kessous (2011), Zytko et al. (2016b), Macleod and McArthur (2019), Sumter and Vandenbosch (2019), Fernandez and Biltholtz (2019)
Individual capital:	Individual's psychological, morphological and health factors, e.g. dreams, skills, body parts of sexual excitation, sexually transmitted diseases.	DeSingly (1984), Fiore et al. (2004), Zytko et al. (2016b), Hutson et al. (2018), Kessous (2011), Zytko et al. (2016b), Schwartz (2012)
Sociocultural capital:	Individual's material and symbolic possessions, e.g. tastes in music, arts, transportation means.	Bourdieu (1979), Schmitz et al. (2012 ; 2009), Hsiao et al. (2017a)
Socioeconomic capital:	Individual's professional and financial position or projection, e.g. income, level of education, company name.	Bourdieu (1979)
Relational dynamics:	Behavior referring to boundary setting between the couple and the outside world (family, friends), including goals, sharing and work organization, e.g. common dreams, family exchanges, dirty talk preferences.	Kellerhals et al. (2004, p. 49). Sumter and Vandenbosch (2019), Zytko et al. (2016b)
Coping:	Behavior in problem solving, alone or with a partner, e.g. heartbreak reactions, behavior when disliking physical appearance.	Kellerhals et al. (2004, p. 143)

Category	Definition	References
Online individual capital:	User's descriptors within online platforms, e.g. login status (last connection time).	Derived from Individual capital
Online sociocultural capital:	User's possessions in relation to others within online platforms, e.g. PlayStation Network, Instagram login.	Derived from Sociocultural capital and Albury et al. (2017)
Online relational dynamics:	User interactions with others within online platforms, e.g. cybersex experience.	Derived from Relational dynamics

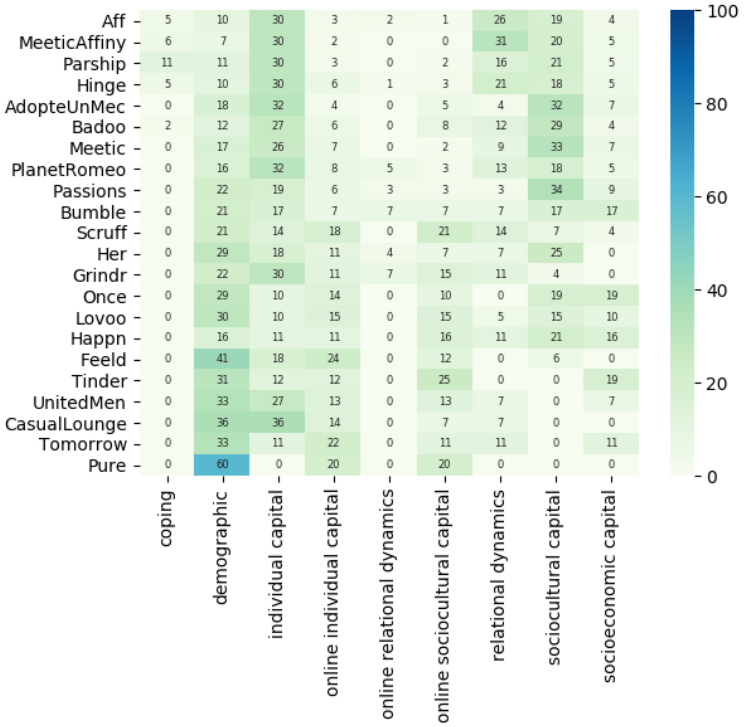

FIGURE 10 – HEAT MAP OF VARIABLE DISTRIBUTION PERCENTAGES BY CATEGORY FOR EACH APP.

2.7.3. App Classification by Similarities

The presence/absence of each variable of Y_1 in each dating app can be described by a binary matrix. As I presented in section 2.1.3.1., the classic Jaccard index (Jaccard, 1901), is used to measure the proximity between two apps.

A preliminary comparison, of the observed distribution of the s values on A_{nxp1}[41] with the distribution of the Jaccard index for randomized data, revealed substantial differences and highlighted that the set D is structurally heterogeneous, with some apps being similar and some being different. More precisely, four classes of dating apps can be extracted from a hierarchical classification H(D) of the dating-app set D, with the Jaccard index and the standard Ward aggregation (Figure 11). The classification H(D) is robust with respect

[41] Here I use the same notation for the binary matrix A as the one used in section 2.1.3.1. These are different matrixes but the same notation is used to improve the readability.

to potential minor coding errors in the construction of the matrix A_{nxp1}: To remove them from $A_{nxp1,}$ I randomly selected 5% of the Y_1 variables then re-computed the classification; and the result remains stable for 50 trials. The four main classes of H(D) are the following:

Class 1 (green) "communitarian sex-driven" contains five Anglophone and Francophone apps that share the following categories: relational dynamics (e.g., sex position, sex protection, sexual activities), individual capital (e.g., male hairiness), demographic (e.g., birthdate), and online sociocultural or online individual capital (e.g., Twitter, login status). The app class is characterized by the granularity required to describe sexuality and physicality, thus conveying mainly sexual encounters; and it contains all apps exclusive to male users, as well as CasualLounge for heterosexuals,.

Class 2 (red) "quick dating" contains four Francophone apps, which share the following categories: online sociocultural capital (e.g., Spotify songs, link partner's profile), and socioeconomic (e.g., university and company name). The class conveys a minimalistic portrait of the user in order to speed up interactions, thus leaving more room for uncertainty about the encounter and the other person's identity.

Class 3 (blue) "full commitment" contains six apps (only one being Anglophone), which share the following categories: socioeconomic capital (e.g., revenues), demographic (e.g., nationality), sociocultural capital (e.g., smoking, diet, instruments, underwear), individual capital (e.g., hair length, look satisfaction, ambitions), and relational dynamics (e.g., ease of communication). This class is characterized by a large amount and variety of detailed variables in comparison to other classes. It conveys committed relationships, for which a holistic view of the user is required.

Class 4 (purple) "diversity" contains seven Anglophone and Francophone apps that share the following categories: sociocultural capital (e.g., gendered pronouns), demographic (e.g., gender identity), online sociocultural or online individual capital (e.g., Instagram, Google connect, login status), relational dynamics (e.g., looking for), socioeconomic (e.g., university and company name), and individual capital (e.g., political leanings, mysticism). This class presents an experience balancing quick dating with full commitment. It adds social segregation but with more inclusiveness.

Note that the distribution of Anglophone and Francophone apps per category, shows that the contribution of the language to the app similarity is low: for example, the Anglophone apps, Badoo and PlanetRomeo, closely resemble the Francophone apps Adopteunmec and CasualLounge, respectively. Only the "quick dating" class exclusively contains Francophone apps but, except for Tomorrow, these apps are also available in English and other languages. Despite the language, the categories reveal a homogenization of online-dating profile structures, which suggests that apps reuse variables from companies outside their origin country. For instance, Tomorrow, Meetic, Adopteunmec, happn and Once, were founded in France and closely resemble, respectively, Tinder (United States), Parship (Germany), Badoo (UK), Lovoo (Germany), and Bumble (United States).

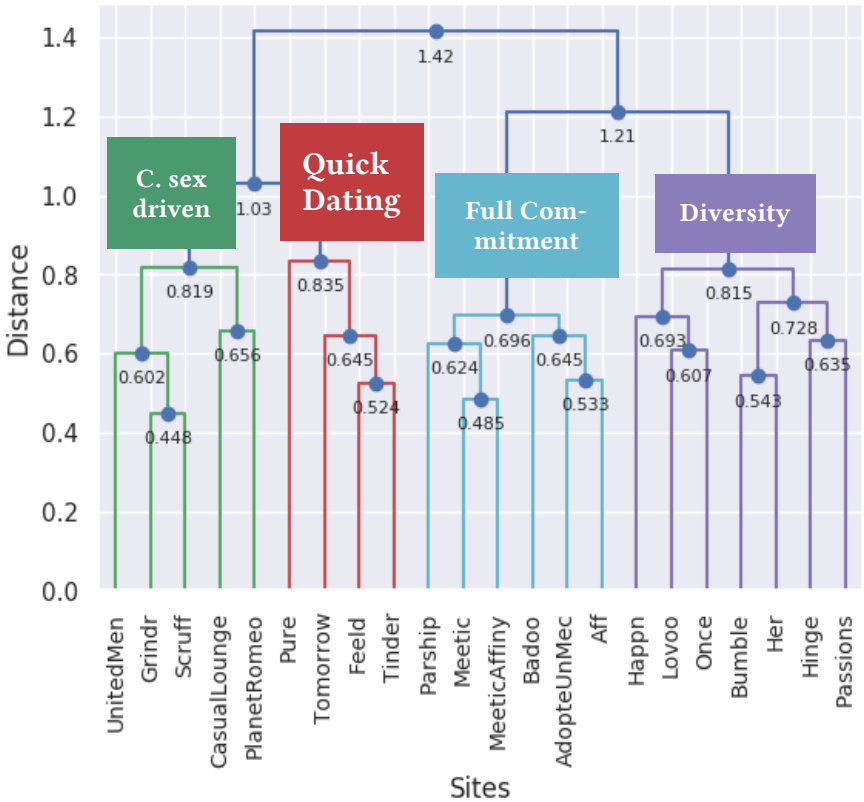

FIGURE 11 – FOUR CLASSES OF DATING APP EXTRACTED FROM A HIERARCHICAL CLASSIFICATION USING THE WARD INDEX

2.7.4. App Classification by Differences

Eight apps do not have unique variables for the set Y_2, but 14 apps contain at least one unique variable (see Figure 12), that contributes to the distinction of the apps among themselves. By manually analyzing the unique variables present in these 14 apps, I deduced the following rough classification into three classes:

Class 1 contains four apps (Aff, MeeticAffiny, Hinge, and Parship) that have extensive psychological questionnaires, and more variables in the form of taking a personality or compatibility test. In particular, there are questions about individual capital (e.g., "Describe the most important things in your life" on Aff). These require a significant amount of, mainly introspective, work on the part of the user.

Class 2 contains apps (e.g., Grindr, Badoo, and Scruff) that include online relational dynamics (e.g., "accept NSFW -Not safe for work- images" on Grindr) or online sociocultural capital variables (e.g., "PlayStation network" on Scruff). They reflect the users' sociability and users' online identities.

Class 3 contains apps (e.g., Adopteunmec and PlanetRomeo) that provide details about individual capital (e.g., woman's hairstyle on AdopteunMec). This thoroughly describes the users' external perspective.

It is worth noting that each class contains both Anglophone and Francophone apps, which suggests an imitation mechanism similar to the one observed in the previous sub-section.

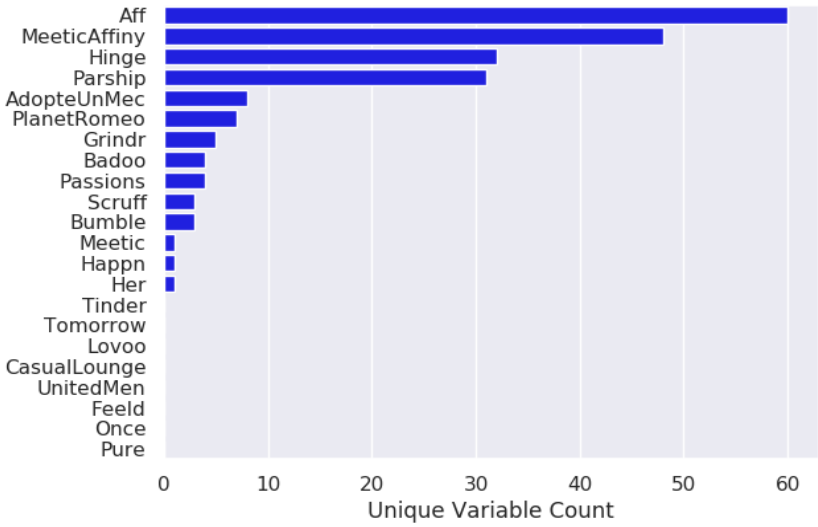

FIGURE 12 – DISTRIBUTION OF 208 UNIQUE VARIABLES IN 14 APPS

The dual analysis shows that the variables can be separated into two sets: One-third of the variables are common to more than one app, whereas the rest are used once only. The first set plays a part in creating a degree of similarity between dating apps, and my classification reveals that the structure of the dating app's landscape depends on this similarity distribution. The second set serves to differentiate the apps and, as mentioned, different strategies are carried out in order to compile the specifics for each app. The main factors involved in the construction of these two classifications are described in Chapter III about the developing practices.

2.7.5. Discussion: Procedural and Declarative Conventions

The state of the art on affordances shows that the profile page is a main affordance of dating apps, along with messaging (Wu and Ward, 2018, 2020). The profile page is often addressed in research by its visual affordance (Illouz, 2020). This is confirmed in the phenotype-variable set, where the only variable common to all platforms is the profile picture. However, the profile also contains textual information. Indeed, in the state of the art about self-description variables, I show that scholars investigate in-depth user practices of self-presentation and attractiveness evaluation, based on the information declared on the profile page (Fiore et al., 2008). Although some scholars claim the profile information is ignored as users privilege engaging in conversations (Zytko, Freeman, et al., 2015), there are contrasting results that show the profile information is relevant to craft an ideal self and to reduce uncertainty about the other's real identity and about how much the self is idealized (Ellison, Heino and Gibbs, 2006 ; Gibbs, Ellison and Lai, 2011 ; Warner et al., 2020). I confirm the importance of textual information on the profile page, through my phenotype-variable landscape. Despite the minimalistic design of certain apps, such as Tinder, based on swiping profile pictures, I show that the number of variables vary from one app to another and that they constitute an important part of the profile. These variables will certainly remain in the dating industry, as they form similarities and differences between apps that hold together the user experiences. They mediate users' interactions and guide, in part, algorithmic choices in companies (as other variables are accounted for, yet protected by the commercial secret of an algorithm). Their mediation with users is crucial as users rely on these variables to manually filter their research results, which gives them the feeling of having more control over automatic

recommendations (Tong, Hancock and Slatcher, 2016). Their relevance for apps is confirmed by a preliminary observation when collecting data: creating a profile page is mandatory for users to access the dating platform and to start browsing other profiles. The profile creation, however, is divided into two steps: the account registration and the profile edition. Although the first step is mandatory, the second is optional. This means that the platform guarantees a minimum of data collection during the registration, and that it gives a certain freedom to the user to decide to complete the profile. This is relevant, as it means that, to supply data, there are different degrees of user engagement required by the app: everybody has to provide a minimum of data, but not everyone has to create a detailed profile page. This also means that users attract other users' attention according to diverse semiotic material, depending on the type of app. It means that, in each app, users can attract others differently. The semiotic material plays an important role on affordances. Affordances are not merely possibilities of actions suggested through different forms of logical constraint design; affordances *tell what to do* via their semiotics. For instance, the profile page is an affordance that obliges the user to create a profile and that suggests fulfilling the profile in detail. The profile page also tells the user what to declare in order to seduce and find somebody: age, sex, etc. The semiotic material, along with the affordances, first establishes communication between the user and the machine, before the user is able to communicate with other users. As a preliminary step to dating, this design requires users to understand the machine and the conventional dating experience it offers. As graphical and textual landmarks, variables act as "grasps" and establish two mechanisms described by Boullier (2006), namely "procedural" and "declarative", where subjects are required to engage as both a reader and a user on the platform; they say, do, interpret, exchange, and negotiate the reality built upon the system by the designers and the users themselves.

In my previous analysis conducted on the affordances, I showed there are similarities across platforms. The similarities result in two classes of dating; "scroll dating by immediate availability" and "swipe dating by reciprocated attractiveness", with specific attentional regimes guiding the user's gaze. The first class configures the attention in loyalty and immersion. The second class configures it in reactivity and projection. If I combine the affordance analysis with the phenotype-variable analysis, I observe that a specific type of semiotic material completes the two dating experiences in a distinct manner.

On the one hand, the experience of scroll dating by immediate availability, where the attentional regimes are loyalty and immersion, groups all the apps defined as "communitarian sex-driven" and "full commitment", according to their variables. Only one app from another class, "diversity", is also found here. These apps contain a number of variables higher than the apps in the other classes. They require users to say much about themselves, and they enable users to obtain much information about the others. There is a broad variety of variable categories with detailed information about the self and the other. In particular, the "demographic" details can be found, such as birthdate and nationality, as well as "relational dynamics" such as sexual activities and ease of communication. These types of semiotic material are combined with a research of profile pictures in the form of a grid, which enables direct comparison with detailed information. This requires that the users invest more time online than with other attentional regimes.

On the other hand, the experience of swipe dating by reciprocated attractiveness, where the attentional regimes are reactivity and projection, groups two semiotic classes of apps: "quick dating" and "diversity". These apps combine a low number of variables with a visual dominance affordance based on swiping profile pictures which accelerates the dating experience. The categories predominant here describe the user's "online sociocultural capital" (e.g., Spotify songs, link partner's profile), and "socioeconomic" status (e.g., university and company name). These apps also specify the user's gender identity as an extension of their "demographic" description, with respect to the apps in the previous classes.

In the first class the attentional regimes of loyalty and immersion are oriented more towards sexuality and the dynamics of a potential relationship, whereas in the second class the attentional regimes of reactivity and projection are oriented towards networking and socioeconomic cultural status. In the next section, I finalize the data analysis with a qualitative study of input values that delimit what can be declared as a phenotype. Indeed, variables are designed in different format types, but scholars show there is only one free-text field for a self-description summary. The majority of variables have predefined option-lists (Olgado, Pei and Crooks, 2020). These standardized formats enable collecting data and applying algorithms (Fiore and Donath, 2004).

2.8. The Study of the Semantics of Attention. Focus on the Female Body Input-Values

Using a qualitative analysis, in this section I[42] address the following research question:

(RQ3): Given the morphological variables collected from a set of dating apps, which main input-value arrangements codify the women's digital body?

I show that, from the collection of variables and input values proposed to women to describe their morphology on 18 dating apps, the representations are reduced, despite some variations, to a very limited number of variables and input values for the profile creation. I identify categories that are part of a historical continuity of heteronormative stereotypes in relationships. I find that there is importance given to the conventional role of height and to the "upper body" (Perrot, 2006) and, in particular, to the hair, as it has been an attribute of eroticization of the female body throughout centuries. This erotic heteronormativity is coded in online dating.

The results illustrate the significance of the replication of entities in dating apps that convey normativity and provoke a reduction and standardization of user's representations. The results show, in particular, how the coding process of the body affects how women are erotically perceived by men, with a few number of variables and related input values. The results contribute to further research on gender and algorithmic studies with an anchor on the materiality of GUIs that mediate users' dating experiences and influence couple formation.

2.8.1. State of the Art: The Female Body in Online Dating

The founder of the MIT Media Lab, Nicholas Negroponte (1996), used the term "digitization" in reference to the material transformation "of atoms into bits". Philosopher Antoinnette Rouvroy (2013), analyzing the governance of algorithms, refers to the "statistical body" that reduces the body to a set of numerical descriptors. I favor the term "digitamorphosis" that is borrowed from the communication scientist Philippe Le Guern (2017) who used it to analyze the transformation of musical listening practices during the digital turn. This term accounts for the translation of the continuous (the body) into the discrete (its representation in a machine), which conditions the possibility of computational calculation (Berry, 2011). In this section, I identify the variables used in dating apps to describe the morphology of "female" bodies, where the binary categorization female/male is taken from my field observations, as the vast majority of the apps studied offer

[42] This section is the result of a collective work with one co-author; Prof. Pascale Kuntz.

only this option. These variables frame the dimensions considered important and presented to users by the company (Chaulet, 2009b) hence contribute to limit the scope of the coded gaze.

Due to the way the profile forms are designed on dating apps, users are required to manage these standardized data structures in order to describe who they are and to present themselves to others. These data structures also serve users to evaluate others and to find a potential date. Therefore, these structures contribute to a "sexual datafication" by "codif[ying] users' desires into a visual, structural, and linguistic order" while directing the audience's gaze (Saunders, 2020). This is a "coded gaze": embedded and propagated views by coding systems that make users recognizable to algorithms via categories and that enable individuals to be understood in relation to how they are seen by others (Cotter et al., 2021). More broadly, data structuration forms what Eva Illouz (2020) calls the "scopic capitalism"; a *visual* economic logic constituted by the association of the industries of beauty, fashion, sports, and media. However, women's sexual freedom is particularly affected in contrast to that of men's. For Illouz (2020), women are depreciated via image production for self-presentation; they are reduced to, and consumed as, merchandise by their sexualized bodies. Saunders (2020) shows that, more specifically in the analysis of pornographic sites, the sexual datafication is crafted by the industry via an hyper-categorization of mainly the female body, her behavior, and race. These observations confirm the central role of the female body in dating-app platforms. The role of the body is, however, not new in the literature.

Published in the mid-1980s, which saw the rise of personal computers and polymorphic information systems, D. Haraway's "Cyborg Manifesto" profoundly repositioned reflections on the multiplicity of forms of *encorporation*; some of which are part of a path "from the cyborg and the digital to the animal, passing through women's bodies", where "the fading of the bodily envelope and the undermining of classic dichotomies (inside/outside; self/world; nature/culture) do not prevent the presence of the living, of flesh and blood, in Haraway's machines" (Gardey, 2009, p. 211). The multiplicity of forms of encorporation[43] converges with the possibilities that actors have to experience *pluriverses* on the Internet (Boullier, 2009), without necessarily having a single, and universal embodied identity form. Some scholars (Détrez, 2002 ; Froidevaux-Metterie, 2018) moved away from the digital dimension of the body and its enveloping experience in online platforms while helping to clarify other material, symbolic, and normative dimensions offline. Other scholars, however, continued to explore the anchoring of the body in digital culture and assert that it is present and modifiable as a way of "manifesting"[44] (In French; "mise en puissance"), and "a project of the self" (Casilli, 2009) according to the platform type, e.g., video games, and dating apps. The increased adoption of dating apps contributes to the inquiry about the notion of the digital body and its possibilities of encorporation. Online dating is a paradigmatic example of the construction of relational and bodily experiences *with* and *within* digital devices. The extreme illustration of bodily engagement on dating apps is the recent interest in studying psycho-biological addictions on Tinder (Rochat et al., 2019). But beyond singular individual behaviors, the dating structures shape the way representations of the body are embedded in specific sociotechnical arrangements. In the previous section about the study of phenotype variables, I identified nine categories for representing a user. From those categories, "individual capital" is the first most representative category (32%). It refers to individual psychological, morphological, and health factors such as body parts of sexual excitation, sexually transmitted diseases, and hair length. This individual capital varies from one app to another (see heat map, Figure 10). In the analysis, the input values of these variables are absent. They are relevant as they delimit another level of granularity, what users can provide as a representation of their

[43] Briefly said, encorporation means that putative bodies do not entail the in-corporation into something specific and affixed
[44] I propose the translation of "mise en puissance" to manifesting in reference to the Cyborg Manifesto as a way to describe how the multiple possibilities of embodiments can be combined and projected with the intention of becoming it

bodies and how they capture others' attention (users and machine's attention). Indeed, body representations are encoded by variables (e.g., gender, weight, hairstyle). Additionally, the variables present predefined input values (e.g., female, 60 kg, wavy hair) that serve as inputs to algorithm. These inputs are materialized; they serve to allocate space in the computer's physical memory. This means that these representations tell the machine who the users are and based on which values they can be matched with others.

To my knowledge, these input values have not been previously studied in detail. From the previous state of the art about self-description variables, I identify references that cover the body as coded in dating platforms. The body description is often grouped with demographic, sociological, and psychological data (Zytko, Freeman, et al., 2015). A recent study shows that the ten most popular dating apps in the United States, accessible worldwide, predefine a "casting mold" to build a profile (Olgado, Pei and Crooks, 2020). The study does not provide an exhaustive analysis of the variables used; but, of those listed, only height appears in the morphological description of users. A study of three platforms for men seeking men confirms that the categories predefined by the creators of dating apps restrict the range of morphological values offered (Rodriguez, Huemmer and Blumell, 2016). Extracts from interviews with heterosexual male users on Meetic highlight the importance of weight in order to make a first contact with a woman in the platform (Kessous, 2011). These morphological variables are taken into account in the implementation of machine-learning algorithms (Tu et al., 2014) for recommending profiles: and height and weight play a particular role (Xia et al., 2016).

Illouz (2006) argues that, in the process of presenting the self, the self becomes an ontology open to an unknown general public that separates the body and the mind because "the use of written language accentuates the uniformity, standardization and reification" of the individual on the Internet. Lemeilleur (2014b) highlights that the profiles proposed by the apps translate the body "generally into four questions (Your height? Your figure? The color of your hair? The color of your eyes?)", but the author also finds that the body is activated by "the eye of the other that gives life to this inert body that has lost its capacity to move in time and space." (Lemeilleur, 2014b, p. 98). She revisits Haraway's cyborg manifesto and sees in it an opportunity for subjectivation that is experienced and renewed on dating apps. She defines this subjectivation as an "interstitial space" where the virtual body is an "ancillary" body at the service of becoming a subject, with its multiple physical and symbolic dimensions. In another study, Lemeilleur (2014a) shows these possibilities with the way women and men craft utterances on Meetic. However, in these opportunities for singularization, then she does not question the sociotechnical system specific to the dating market. In media studies, this system is questioned through the use of the female/male binary categorization. A study of affordances on Tinder and Bumble shows that this imposed binary categorization is "the product of a hegemonic cycle of heteronormative design practices" (MacLeod and McArthur, 2019, p. 825). The analysis of technical and marketing documentation of the Bumble app coincides with the previous observation and explains that "infrastructural design practices are based on an advertised identity [so-called feminist] but have been filtered through a racialized and sexualized lens" (Bivens and Hoque, 2018, p. 454). One of the few scholars that interrogates webmasters and app founders is Bergström (2019). She presents the discourse of male actors who embed their "vision of women" and the heterosexual relationship in marketing and interface design strategies through specific colors and semantics. However, these studies do not interrogate the technical and methodological constraints of programming practices, as I will do in the next chapter.

My study complements the literature with an analysis of the morphological descriptors of female bodies in a set of English and French dating apps. It contributes, with empirical evidence across platforms, to the analysis of social norms materialized in digital spaces. These results are the basis of the analyses in the next chapter that is about the role of the developers in the production of those variables and input variables.

2.9. Data Collection III: The Female Body Input-Values

The third data-collection required prior specification of the scope of variables associated with the category "body". This category refers not only to the human organism or the "visceral body" (Murray, 2018), as described by the life sciences, but also to the organism that, *in situ,* is inserted in networks (Détrez, 2002). The phenotype variables in dating apps focus on both the biological dimension and a broad system of associated symbolic and cultural values. I focus on the morphological variables that describe the external apparent structure of the body. This polarization enables me to place this analysis in line with the work of historians such as M. Perrot (2006), who writes on the representations of different parts of the female body, and to question the impact of the shift to *digitamorphosis.*

From the previous corpora presented, I constructed a corpus of 18 apps, chosen for the diversity of the target populations as described in the previous data collection. I excluded the dating apps that are exclusively for men seeking men, e.g., Planetromeo. In this corpus, I identified phenotype morphological variables that are provided to women in order that they present themselves to either women, men, or both sexes, depending on the options available during registration[45] (Table 4). In this corpus, I also accounted for the availability of gender identity beyond sex: Only five apps extend the binary male/female categorization, but their morphological variables remain the same, regardless of the value chosen. Four apps (Tinder, Pure, Feeld and Tomorrow) did not contain any morphological variables. The collected variables on these apps were extracted manually by following the process of creating a woman's profile on each of the platforms, without intervention on other people's personal data, as explained in previous data-collection processes. Finally, to situate where these apps are designed, I accounted for the country of the companies' headquarters.

TABLE 4 – APP LIST SAMPLE FOR THE ANALYSIS OF MORPHOLOGICAL VARIABLES AND INPUT VALUES

Qty. Variables Body	App Name	Gender Available	Version	Platform Type	Language chosen/ unique*	Company's Headquarter
8	**AdopteunMec**	No	june 2020	website	french*	France
6	**Meetic**	No	june 2020	website	french	France
6	**MeeticAffiny**	No	june 2020	website	french	France
6	**AdultFriendFinder- Aff**	Yes	june 2020	website	french	U.S
5	**Badoo**	No	5.158.1	android	french	Russia-UK
4	**Casuallounge.ch**	No	nov 2019	website	french	Germany
3	**Passions - Meet over 50**	No	v2.16.3(205)	android	french	France
2	**Parship**	No	june 2020	website	french	Austria
1	**Bumble**	Yes	5.173.0	android	french	U.S
1	**happn**	No	24.28.02	android	french	France
1	**Hinge**	Yes	7.9.2	android	english*	U.S
1	**Once**	No	2.91.2104	android	french	France
1	**Her**	Yes	3.5.11 (Build 472)	android	french	U.S
1	**Lovoo**	No	nov 2019	website	english	Germany
0	**Tinder**	No	11.17.0	android	french	U.S

[45] The declaration of sex in binary mode is mandatory to access the platform, determine the type of subscription and the results to be displayed. For example, on Meetic, a woman's account can search exclusively for women or men. On the other hand, on happn, men and women can be searched simultaneously. These options establish in advance to whom a woman's body is made visible.

Qty. Variables Body	App Name	Gender Available	Version	Platform Type	Language chosen/ unique*	Company's Headquarter
0	**Pure**	No	2.28.102	android	french	Cyprus-Portugal
0	**Feeld**	Yes	5.7.7	android	french	UK
0	**Tomorrow**	No	2.0.4	android	french	France

2.10. Results: The Eroticization of Women on Dating Apps

In the next sections, I first present a descriptive quantitative and qualitative analysis of morphological variables and the input values collected from dating platforms. Then, I discuss the particular focus given to women's hair to finally conclude with a discussion on the relevance of studying coding practices.

2.10.1. Normative Digitamorphosis of Female Morphologies

Four apps (Tinder, Pure, Feel, Tomorrow) do not contain phenotype morphological variables. For the 14 others, these variables have a special status: They are very few in number but are presented on the registration page for the creation of a profile and for access to the service. More precisely, the morphological variables represent only 2.7% of the total of 298 variables identified on all the apps in the corpus but, as they are placed on the first pages of the apps, where filling in is compulsory for some of them, their response rate has a much higher probability than others. The GUIs are indeed designed to encourage answering certain questions as a priority (Dror et al. 2013). Note that on other types of platforms, the results of a combined study of eye-tracking and survey show that both men and women report that textual information is important, but women pay more attention to the textual information when browsing (Schiessl et al. 2003). The positioning of morphological variables confirms their importance in the mediation user-machine.

The 14 apps contain between 1 and 8 variables: *height, eye color, hair length, hair color, hairstyle, body shape, weight,* and *bra size*. The distribution of these variables across the apps reveals three classes that can be positioned on a scale. At the first end of the scale is the first class of apps (Passions, Her, Bumble, happn, Hinge and Once) that describe the body solely by its height. The second class includes height, body shape (Parship) and weight (Passions). The third class (Adopteunmec, Meetic, MeeticAffiny, Badoo, Casuallounge) adds to the above variables the upper body: hair and eyes, and bra size for AdultFriendFinder.

A distinction is made between numerical variables (height, weight, bra size) and categorical variables (eye color, hair length, hair color and hairstyle). The numerical ones are described on a prefixed numerical scale whose minimum and maximum values vary from one app to another; with the exception of Parship that has a free field for height. For example, the weight scale on Passions, which targets people over 50, is 40-200kg, and that of Adopteunmec, which targets a younger audience, is 30-115kg. Bra size on AdultFriendFinder is defined on a set of eight measures (from 32/70 to 46+/105+). The categorical variables take a limited number of values. For example, body shape is described as *slim, athletic, normal, generous, BBW-BigBeautifulWoman.* Note that hair length is not entered as a numeric variable; the apps offer only between 4 and 8 values, from the following list: *prefer not to say it* (in French, *"ne se prononce pas"), bald, shaved, very short, short, medium-length, long, very long, crewcut* (in French, "*en brosse")* and *balding* (in French, "*dégarni").* These variables embody definitions of female eroticism, which install power relations through physical attractiveness, and have been little studied in intersectional analyses of dating sites (Levayer, 2019). In general, they are "normo-

weighted" (in French, "normo-pondéré") (Carof, 2016) and vary according to the representation of the body that each app structures according to its image, as shown above in the different weight scales.

The variables translate a normalized state of health or beauty that Illouz (2020) links to modern scopic capitalism. These images of female bodies in digital space are part of the continuity of the construction of visual culture for centuries. N. Mirzoeff (2009) recalls the importance given to eyes and hair in the definition of aesthetics, as early as the ninth century in the East under the influence of Ibn al-Haytham's camera obscura technique and often attributed to Western scientists such as Leonardo Da Vinci (p. 24). N. Mirzoeff (2009) also refers to an account of a marriage proposal, ten centuries later, in which the male gaze focuses on these two elements (p. 159). These attributes are still found in the contemporary French national benchmark survey on spouse choice (Bozon, 2006). I did not find these attributes in Swiss national surveys. However, the French survey merits highlighting, as half of the sample (7 apps) were created in France and none in Switzerland. In the following section, I focus the analysis on the hair, as it plays a significant role in the transcription of the body in the digital spaces studied.

2.10.2. Attention to Hair

The importance given to female hair is part of the history of pilosity and dates from antiquity. As M. Perrot (2006, p. 71) states, "Hair is the woman, flesh, femininity, temptation, seduction, sin. There is an eroticization of women's hair, especially in the nineteenth century", and I see this embedded on dating apps. Hair appears among the major body elements in six dating apps, three of which were created in France. Marketing and economic surveys by IPSOS[46] (a multinational market research and consulting firm with headquarters in Paris, France) and INSEE[47] (The National Institute of Statistics and Economic Studies in France) confirm the attention paid to hair; the proportion of the French budget devoted to personal care and goods, including hairstyling, has grown constantly since 1960. On dating apps, three variables are associated with hair: *length, color* and *style*. Their values vary in number, order, and statement, depending on the app (Table 5).

TABLE 5 – VALUES OF HAIR VARIABLES IN FRENCH AS STATED IN THE APPS

Variable	AdopteUnMec values	Meetic values	MeeticAffiny values	Badoo values	Aff values	CasualLounge values
Hair length	Shaved, short, mid-length, long	Short, mid-length, long, shaved, bald	Shaved, very short, short, mid-length, long, very long, bald		Long, mid-length, short, crew-cut, shaved, balding, bald, not determined	Shaved, short, mid-length long
Hair color	White, grey, salt and pepper, platinum blonde,	Chestnut, brown, black, blond,	White, blond, brown, chestnut,	Black, blond, brown, colored,	White, blond, platinum blonde, brown,	Ask me!, black, brown, blond,

[46] Les Français et le bien-être : quoi de neuf ? (May 2013). Retrieved from : https://www.ipsos.com/fr-fr/les-francais-et-le-bien-etre-quoi-de-neuf
[47] Les dépenses des Français pour leur apparence physique (January 2017). Retrieved from : https://www.insee.fr/fr/statistiques/2550287

Variable	AdopteUnMec values	Meetic values	MeeticAffiny values	Badoo values	Aff values	CasualLounge values
	blonde, chestnut, ginger, brown, black (erased: vivid colors) (added: colored, rainbow, tie & dye)	salt and pepper, ginger, other	grey, black, ginger, other	grey, ginger, shaved head, white, bald	grey, black, salt and pepper, ginger/chestnut, other, hair? What hair?, not determined	other, ginger, grey/white, bald
Hairstyle	Straight, wavy, curly, frizzy, afro, dreadlocks, spikes, african braids, bangs					

i. *Length* has ordered values from *short* to *long*; only AdultFriendFinder has *long hair* at the top of the list. Note the presence of *shaved* or *bald* values for women on all apps; they are placed at the end of the list, except for Adopteunmec. One assumption to explore further is that these cuts are currently fashionable or used as a form of militancy in the current feminist movement.

ii. *Color* is present on all apps with different values. The largest number is proposed by Adopteunmec and AdultFriendFinder (resp. 12 and 11) and some values can have a symbolic meaning. They refer to communities (e.g., *rainbow*) and modern aesthetic coloring techniques (e.g., *tie & dye, platinum blonde*). The order of values also differs, including for Meetic and MeeticAffiny that belong to the same business group but target different ages; *white* is in first position on MeeticAffiny and last on Meetic.

iii. *Style* is present only on Adopteunmec, where nine values mix hairstyle of mainly European and African origins. This could be explained by the design of the site in France, targeting the French, Belgian, Swiss, and Luxembourg markets.

The six apps that give attention to hair belong to one type of dating experience, according to the analysis of affordances: list-view dating by immediate availability. The related attentional regimes of loyalty and immersion, which retain the users in these apps, are guided by specific types of input values. In addition to the attention given to hair, five apps, the majority in this sample (Adopteunmec, Meetic, Meetic Affiny, Badoo and Aff) build the profile page based on "full commitment" related categories. One app, Casuallounge, defines input values for only the hair color and builds a profile page in combination with categories of the class "communitarian sex-driven". These apps, consistently with my previous results on affordance and variables, require more time and provide detailed information from users. These apps categorize users by the binary convention of heterosexual/homosexual; only Aff offers one additional category for gender identity (i.e., trans). Consequently, they code the cisnormative female body by capitalizing on the erotization of hair in a heterosexual way. The analysis of affordances and variables show that dating platforms *suggest* and *limit* certain actions. In this analysis, I also show that dating apps *indicate* what is attractive in a woman for her to declare to a man, and they ultimately *reduce* the input values that request a user to *choose* among limited heteronormative options.

2.10.3. Discussion: Data Reductionism and Normativity Coding

In summary, three main results emerge from this analysis: the limited number of variables available for describing the morphology of female bodies in a continuity of socio-historical representations, a certain uniformity associated with this reduced range of variables, and some distinctive elements, notably in the semantics of the values and the order of these values, associated with targeted populations in the dating market. Here, I am far from the myth of Big Data that gives the illusion that the volume of data makes it possible to handle the complexity of social reality or its diversity. It is true that, in addition to the variables and input values analyzed in this section, there are photos that play a major role, as I show in the study of affordances. The role of the profile photo has been highlighted extensively (Strubel and Petrie, 2017). I do not have access to the processing of the information provided by the photos (e.g., labels that classify images and particular features identified on the image). However, any type of algorithm can require a textual coding of this information, in the form of a finite set of variables similar to the morphological variables studied here. The coding is necessary in an initial step of programming practices for defining the variables that will take as input observations in user behavior. In a second step, the textual coding is necessary to interpret results. For instance, in image classification algorithms, data scientists are required to manually label picture features. A recent investigation, by AlgorithmWatch,[48] on the representation of the body on Instagram pictures shows the way the algorithm classifies according to the labels subjects define. These are in part extracted by Google's Vision API "Detect Labels"[49] and later refined by the data scientists. See the two indicators defined with their corresponding labels[50]: *raciness,* i.e., whether a picture contains sexually suggestive content like "skimpy or sheer clothing, strategically covered nudity, lewd or provocative poses, or close-ups of sensitive body areas"; and *nudity, i.e.,* "describing body parts, underwear or swimwear" in the picture. Therefore, the analysis of categories by their semantics is relevant, as the categories constitute an important mediation of the communication between machines and humans.

The definition of female bodies on dating apps confirms that computing practices are not neutral. The translation work of the body into a linguistic categorical form is inherent to the encoding of variables that enable algorithmic calculations. On the GUIs that mediate with users and machines, heterosexual and cisnormative female bodies are identifiable as idealized stereotypes. The values of hair color, length, and style convey

[48] Undress or fail: Instagram's algorithm strong-arms users into showing skin (June 2020). Retrieved from: https://algorithmwatch.org/en/story/instagram-algorithm-nudity/

[49] Google Vision API Detect Labels (April 2021). Retrieved from: https://cloud.google.com/vision/docs/labels

[50] "Raciness: For each picture, **the Vision API returns** a safe search rating indicating whether or not a picture contained "racy" content. The feature is measured on an ordinal scale with the possible values VERY_LIKELY, LIKELY, POSSIBLE, UNLIKELY and VERY_UNLIKELY. Racy, in this context, refers to sexually suggestive content like "skimpy or sheer clothing, strategically covered nudity, lewd or provocative poses, or close-ups of sensitive body areas." For the purposes of our analysis, a picture labelled racy is one that received a raciness rating of either VERY_LIKELY or LIKELY. A non-racy picture is one rated either UNLIKELY or VERY_UNLIKELY racy. Images marked POSSIBLE are labelled as undecided. Nudity: **The Vision API also returns a collection of labels** that describe the content of each picture (e.g. Landscape, Vacation, Window, Thigh). To complement the safe search rating, **I manually compiled** a list of labels indicating nudity. I started by analyzing which labels are most often associated with raciness to inform this list. These were mostly labels describing body parts, underwear or swimwear. For all labels tagged in more than 50 images, I **then manually noted** whether they indicated nudity, using samples of images to test our judgement. The relevant labels were: Abdomen, Barechested, Bikini, Bodybuilding, Brassiere, Chest, Lingerie, Muscle, Skin, Stomach, Swimwear, Thigh, Trunk, Undergarment, Waist. Since I were interested in exploring possible gender differences in the way Instagram's algorithms treat nudity, I filtered these labels for ones that are associated with one user gender in at least 90 % of pictures. **I adjusted the resulting list** so that only clearly gendered terms remained. The final list of labels indicating gendered nudity was: "Women: Brassiere, Lingerie, Undergarment, Bikini. Men: Barechested, Bodybuilder." Undress or fail: Does Instagram favour posts that show more skin? (2020). Retrieved from: https://docs.google.com/document/d/1L7A5hmskm3Y3huSXHNtIIoi-VijHD3dkDqubff4Yvkg8/edit#

extended meanings about the user's representation. They qualify the age, background, community, and contemporary beauty canons of a user, as predefined by the app. These variables and input values eventually become uniformly shared via the global accessibility of certain platforms, and the few variations observed are partly explained by the geographical and linguistic segmentations of the apps. As a result, the female body in dating apps remains strongly anchored in the myth of heterosexual femininity, and the digitamorphosis is not immune to the long history of the consolidation of this myth.

Much of the research in the computer science community focuses on the biases of data sources and the statistical biases of algorithms. When the databases on which machine-learning algorithms are trained contain sexist information - as in the case of Amazon's recruitment algorithm - then the decisions proposed by the algorithms reproduce them. Statistical models aim to overcome the problems encountered in data collection (e.g., omitted variable bias, selection bias). In addition to these approaches, there is a growing body of research on algorithmic equity, initially developed by D. Pedreshi et al. (2008). Among the avenues studied is "anti-classification" that aims to produce results with equal probability for all individuals, regardless of their group membership. The definition of equity, however, poses open questions that go far beyond the framework of computer science whose expressiveness seems limited in the modeling of all its complexity. The industry is also concerned with these issues and some companies are interested in building a gender diverse team of developers. Furthermore, there are training courses for raising the awareness of stereotypes in the digital world and in coding for young girls (Collet, 2019 ; Morley and Collet, 2017). However, they do not question in depth the apps' situated production mechanisms that contribute to the reinforcement of hegemonic views in gender and, more broadly, in dating.

In the next chapter, I analyze development practices in order to understand which design choices are conventional for creating dating apps. The analysis of their developing methods sheds light on the way users' representations and their experiences become programmable. In the following section, I conclude this chapter by providing a general view of the main results and contributions.

2.11. Conclusion

In this chapter, I have demonstrated, based on the study of GUIs, the structure of perception and interaction in online dating. Using the affordance analysis, I have shown the high number of affordances that frame the user dating experience and that provide both the possibilities and restrictions of actions. A major conditioning on the actions depends on the user's subscription plan that is defined by the company. I have identified two classes that reflect different dating experiences, according to specific combinations of affordances: "List-view dating by immediate availability" and "Match dating by reciprocated attractiveness". The former consists of 17 platforms (e.g., Parship, Grindr), where the possibilities of actions are immediate access and availability, which requires time for browsing and discussing in the app. It enables the user to compare profiles immediately accessible in the form of a list, like in a directory, with metrics for hierarchical profile ordering. The dating experience in this class is more similar to social networks, which require more time for socialization: Users remain available for discussions on the platform and do not merely choose a potential partner and leave the app. The user attention is captured here through duration, so that they become a regular user who stays for discussions, more than through intensity in order to feel excitement. Therefore, users have the possibility to be captured and to interact through two main attentional regimes: loyalty and immersion. The second class consists of 12 platforms (e.g., Tinder), where the possibilities of actions are mainly individual browsing of photos, reciprocity based on a binary choice, subscription type, and socioeconomic status. The experience is based on a preliminary evaluation, by browsing pictures and obtaining a match, more than on discussions. By affording a user to consecutively view profiles and to mark a quick interest, users are captured by browsing novelties. This salience produces permanent excitement, as ephemeral events arrive

between profiles, while the user browses. Furthermore, the experience is guided by sociodemographic preferences and the user's subscription plan, which adds a financial motive to the search for a date. Therefore, the apps in this class capture the users' attention mainly through alertness and projection.

An in-depth analysis of the variable landscape of dating platforms led me to propose a new typology of the phenotype variables that serve users to describe themselves in nine categories, supported by the literature, from "individual capital" to "relational dynamics". The computed dating apps' classification reveals four classes that reflect particular similarities and differences, across four dating structures "communitarian sex-driven", "quick dating", "full commitment", and "diversity". This classification is based on a bottom-up approach that does not necessarily regroup apps with the same language or common brand agglomerations. Despite the minimalistic design of certain apps that, such as Tinder, are based on swiping profile pictures, I confirm the importance of textual information on the profile page. The number of variables vary from one app to another and they constitute an important part of the profile. They mediate users' interactions as they enable both self-presentation and the declaration of preferences. The results provide insight into the textual information that can be used by users to attract another user's attention, i.e., to seduce. Beyond the affordances of interactions, online dating is also a narrative experience. These variables serve to represent the user, according to the platforms' interests. They also serve the mechanisms of filtering tools, and recommendation systems for browsing profiles.

Using the collection of variables and input values proposed to women to describe their morphology on 18 dating apps, I have shown that, despite some variations, the representations are reduced to a very limited number of variables and input values for the profile creation. These representations are part of a historical continuity of heteronormative stereotypes in relationships. I find that there is a conventional role of height and an importance given to the "upper body" (Perrot, 2006), in particular to the hair, as it is has been an attribute of eroticization of the female body throughout centuries. This erotic heteronormativity is coded in online dating through specific values that reflect a data reductionism on dating apps. The results serve more broadly as empirical material for further gender and algorithmic studies for understanding the influence of semantics in the amplification of stereotypes.

In contrast to previous research, I have analyzed dating structures as they are designed – and not advertised – for capturing user attention. My work is based on a combinatory analysis, quantitative and qualitative, in order to deconstruct the online dating phenomenon from three different standpoints. The analysis of affordances elucidates what users can do when dating; the phenotype-variable landscape shows what users can choose to say to present themselves; the analysis of the input-values on the female body qualifies the norms for building heterosexual attractiveness. My results contribute to understanding the way user behavior is produced and captured. According to every specific sociotechnical arrangement analyzed, I have extended the literature by describing and comparing the way dating platforms, via specific mediations, program the possibilities of finding a date or a partner. To my knowledge, this mixed-method of cross-platform analysis in dating apps is one of its kind.

I have also contributed, with empirical evidence, to the understanding of the reputation economy, also called attention economy, in online dating. More specifically, I have contributed to its understanding by elucidating the multiple attentional regimes (Boullier, 2009, 2019a, 2020) that, based on affordances, are designed for a user to find a date while being captured by the platforms' interest of engaging actors and making a profit. I have extended this conceptual framework of attentional regimes by showing that attentional regimes are not limited to guiding perception. They are also *interactions* suggested, by design, to tell the user what to do and say. Consequently, some scholars produce hasty and overrated analyses that qualify, in a general manner, dating app users as strategic actors in a market. Affordances teach users, by constraint, to adopt the

machine's dynamics and semantics for self-presentation and to browse profiles. According to the affordances, every platform can, more or less, convey users to learn how to attract and to find a user in an exploration regime or instead, strategically.

The phenotype-variable landscape of the dating market guides me to analyze in the next chapter the practices of developers. Developers mediate between the GUIs and users, as they have agency in the way affordances are implemented, and variables are defined.

CHAPTER III. ONLINE DATING AS A SOFTWARE PROGRAM DEVELOPMENT

3.1. Introduction

In Chapter II, I showed how the dating market constructs the perception and interaction of user experiences via GUIs based on a quantitative and qualitative analysis of affordances, phenotype variables, and women's morphological input values. The GUI configures and limits the way a user creates a profile, evaluates a potential date, gets in contact, and researches another user. Hence, the user can attract the attention of another through specific actions and semantics that define attractiveness (and, in particular apps, in a heteronormative way). At the same time, according to the design of GUIs, apps capture the user's attention via specific attentional regimes: loyalty, reactivity, immersion, or projection, and induce them to engage with the platform. This engagement varies in terms of duration and intensity, which ultimately affects when the user decides to leave the app to invest time in a face-to-face date.

Chapter II provided an external view of the app through the analysis of the user experience. This chapter provides an additional view of the online dating phenomenon: a view from the inside of the app *in development*. Based on an interview study with nine founders and developers, I analyze development practices in ten dating app companies. Firstly, I aim to understand how a dating app is developed, and secondly, why the landscape of phenotype variables in GUIs is what it is.

Firstly, results show that developers do not develop an expertise in dating. The development of an application follows generic engineering practices. These practices are necessary for developing both the back-end of an application (architecture, communication protocols, algorithms, etc.), and the front-end, where the main component is the GUI. Computers work thanks to the development of a software program or a combination of programs, which are a set of instructions to perform tasks. In other words, the programs tell the computer what to do. This part of an application is not visible to users. The GUI mediates between the developers, the machine, and the users, is the GUI. The GUI is what defines how a user interacts with an application. It allows the tasks that are computed in the machine after the creation of a software program to be delivered to end-users. In dating app companies, I identified four methods for developing an application. As explained in Chapter I (section ethnomethodology), methods are ordinary activities performed by social actors to build common sense knowledge as factual experiences with others. This is how actors create a situated meaning of an experience based on facts. The methods I identified show that developers act as translators at the intersection of different stakeholders. Indeed, I show that thanks to a human-machine learning process, developers establish a communication process between humans and the machine in online dating. This communication process allows developers to translate human interpretations of dating into an operational user experience in a pragmatic way. This human-machine learning process frames the discussion of a current debate in the literature that distinguishes human reasoning from machine thinking.

Secondly, the results show that the conventions of online dating are established by means of three mechanisms that guide the definition of variables for representing users. These three mechanisms are mimetism, distinction, and adaptation. The mechanisms are influenced by economic and sociotechnical factors in the dating industry that have an impact on the standardization of profiles in GUIs. These factors provide an understanding of the similarities and differences observed in the previous data analysis of phenotype variables in Chapter II, section 2.2. I discuss these final results in light of Gabriel Tarde's theory of imitation

(1895), in order to analyze the impact of the dynamics of development practices on the creation of technological inventions and, ultimately, on the social relations they mediate.

The development practices analyzed in this chapter provide a better understanding of the core of a dating app: the application of matching algorithmic systems. I will develop this understanding in the next chapter based on the case study of Tinder. Some of the material presented in this chapter was originally published in CSCW, where (Pidoux, Kuntz and Gatica-Perez, 2021) is the corresponding reference.

3.2. The Study of Development Practices

Based on an interview study I formulated the following two research questions:

(RQ4) What methods do developers use in their daily work, in order to make sense of dating?

(RQ5) Which factors influence the definition of phenotype variables shaping user modeling and matching in GUIs?

To address RQ4 and RQ5, I identified recurring themes concerning coding practices captured from the analysis of the founders' and developers' interviews. First, I focus on the methods used by developers to make sense of online dating as a software program. Specifically, I seek to understand the way developers build an application and learn to establish a communication between users and the machine. Secondly, I focus on the development practices related to the definition of variables in order to understand the economical and sociotechnical factors that influence the similarities and differences of dating apps observed in the previous chapter. Herein, I refer to "developers"[51] as actors who are involved in the technical side of developing a dating app; they may come from different educational backgrounds (e.g., engineering or computer science), and ho may have different responsibilities (e.g., testing, front-end development, back-end development). Often, "their working practices differ from the fields of specialization that engineers follow" and "with the increase of private companies, engineers also become managers" (Sainsaulieu et al., 2015).

Firstly, the results show that developers make sense of online dating as the systematic development of software based on four methods: deconstructing, persuasion, explicitness, and compartmentalizing. These methods enable developers to translate a meaning of dating into operational instructions for the machine. *Deconstructing* involves identifying elements in a software program that translate the concept of dating into a pragmatic user experience. *Persuasion* is the process of guiding development practices by a belief. It enables capitalizing skills to start a project, integrating habits and negotiating the implementation of a feature based on business interests. *Explicitness* is the process of obtaining or producing information in an organized, clear and exact way to avoid ambiguities and define dating. *Compartmentalizing* creates a clear division between the development and the business operations of a company, as well as the user experience based on the development of distinct environments in a program: production and test. Compartmentalizing affects the understanding of user behavior. Based on these four methods of developing a software program, I posit that development practices in online dating imply a type of human-machine learning that enables establishing a communication between humans and the machine. This learning process enables developers to translate the companies' meaning of dating into pragmatic and systematic operations that the machine can use in order

[51]There are different terms in the literature, which require further study. These terms are: "programmers", "developers", "software developers", "software engineers", "coders". Considering the profession is not under a specific regulation imposing one specific term, I decided to refer mainly to the term "developer", for the sole purpose of readability.

to later deliver a GUI to users. This process does not only involve only developers. Developers work in close interaction with colleagues in charge of the company's business' interests (e.g., how to retain users in the app), and with other developers who are responsible for other components of the application (e.g., server, quality tests, etc.). Within these interrelated practices, developers play the role of translators and teach others their knowledge: how to think and behave like the machine in order to establish a communication.

Secondly, I show that the definition of variables is structured by a combination of two main mechanisms, mimetism and distinction, which are intertwined at different levels. A mimetic mechanism is shaped by general software development standards governing the creation of mobile apps, and by a quest for efficiency through reusing existing techniques. It is reinforced by the agglomeration of brands and app forerunners that set trends. A distinctive mechanism is imposed by the app store release conditions, advertising, and the app's business model, as well as the founders' personal experiences, which contribute to the creation of what I call "myself-variables". These are variables that describe the founder's private perspective as an implicit user representation technique for product design. This double mechanism contributes to a stabilization of the similarities and differences between app and variable classes. Then, a third mechanism is presented. I show that the reviewing process of the software program is fed by the dynamicity of the Agile methodology driving software updates, the analysis of automated user traces and direct feedback. The continuously adapting environment in which developers find themselves, leads to a reduction in user diversity in favor of standardization for technical, financial and branding reasons. This in-depth analysis goes a long way towards completing pioneering studies (Bergström, 2019 ; Churchill and Goodman, 2008) that have mentioned the relevance of developers' work in dating apps. I show how these actors, the developers, influence the definition of variables, and, consequently, user modeling and computed algorithmic outputs from their initial conceptual choices.

Finally, I discuss these results in light of Gabriel Tarde's theory of imitation (1895). In the discussion, I show that the dating industry builds an expertise based on the construction of technologies, and not on dating, through the imitation or counter-imitation of the dating app models that dominate the industry. The imitation dynamic exacerbates the spread of the views of group leaders in the market, which is influenced and established by the developers' work driven by trial and error dynamics and individual technical choices made on "rough consensus and running code". The dominant definitions of dating, as embedded and spread in the platforms via variables, reinforce the standardization of user experiences, which reduces diversity and the technical originality of apps.

In the following sections, I first present the state of the art related to the dating app market in which developers' practices are framed. In addition, I present the state of the art related to the technological framework that guides the development of apps more broadly. Then, I present the few studies about development practices that have been conducted in the dating industry. Second, I present the methodology of the interview study, including the participant recruitment process, the sample construction and the interview analysis. The results are presented in two sections. The first section of results describes the four methods that developers use to make sense of online dating as a software program. The section concludes with the analysis of a human-machine learning process to frame the discussion of the current debate between human reasoning and machine thinking. The second section of results describes the three mechanisms guiding the definition of variables that frame the perception of users in GUIs. The section concludes with the analysis of the mechanisms in light of Gabriel Tarde's imitation theory (1895).

3.2.1. State of the Art: Dating App Market

The dating industry consists of an agglomeration of brands that gathers the most popular apps in different markets, and small independent companies targeting specific niches (Albury et al., 2017 ; Bergström, 2019 ; Fiore and Donath, 2004). The development of online dating as a business can be traced back to the website Match.com, launched in 1996, because of its brand positioning that translated into quality-type variables describing a person (Arvidsson, 2006). Currently, Match makes up part of the major brand agglomeration, The Match Group, with around 30 worldwide applications and 9.6M paying users (Q3 2019). Generally speaking, as various surveys in several countries show, online dating is a widespread practice: 30% of adults in the United States have used a dating app or website (2019),[52] as well as 18% of French adults (2014) (Bergström, 2019). In the US, 12% of adults committed to a relationship with a person they met online, whereas in Switzerland that result was 20% for couples within a five-year relationship and 1.1% for couples within a 15-year relationship (2018).[53] The apps' spread is reinforced by the common adoption of advertising strategies, associated with the business model of the dominating platforms GAFAMT (Boullier, 2017b, 2018b). The adoption of advertising strategies by dating apps has been confirmed by a recent technical report by the Norwegian Consumer Council.[54] The investigation shows five dating apps: Tinder, Grindr, OkCupid, happn and Muslim share personal data with third-party advertisers like MoPub (the advertising company owned by Twitter). Moreover, spearhead dating apps like Grindr, with its real-time mobile geolocation, and Tinder, with its the swipe gesture (Sumter and Vandenbosch, 2019), are used as references that foster mimetic design practices. These different elements have led to the current situation, where the most popular apps set the trends, and the small independent companies follow them. But both have to guarantee a certain distinctive element that will potentially define the innovation and the community they are addressing (Birnholtz et al., 2015). However, to the best of my knowledge, there is no analysis of the development practices that define the specifics of dating apps as an innovation. In this research, I investigate the mechanisms of the industry that influence the establishment of conventions in the dating industry and, more specifically, the definition of variables in the developers' work.

3.2.2. State of the Art: The Mobile App Technical Framework

Dating apps, as with other mobile apps in the software industry, follow the standards of tech companies in the United States, which foster mimetic programming practices. Apps are coded and released under the technical references dictated by Google and Apple, via their respective operating systems (iOS and Android). The companies offer APIs (Application Programming Interfaces) and SDKs (Software Development Kits) to facilitate coding tasks. These companies play a major role in the standardization of apps' development practices, and the ergonomic design of apps that reflect the respective brands of each company. Indeed, Android provides developers with a rich software stack and environments, of which they may choose to exploit aspects such as virtual machines, emulators, testing tools, documentation and code. Similarly, iOS structures the mobile market with some distinctive features and programming languages (Iversen and Eierman, 2014). For instance, the most common SDK is Facebook Connect or Login, which is used as a "third-party identity provider". This Single Sign-On (SSO) system allows users to log in to a new app with their existing Facebook

[52]Pew Research Center (February 2020): The Virtues and Downsides of Online Dating. Retrieved from https://www.pewresearch.org/internet/2020/02/06/the-virtues-and-downsides-of-online-dating/
[53]Federal Statistical Office (November 2019): Families and Generations Survey. Retrieved from https://www.bfs.admin.ch/bfs/fr/home/statistiques/population/enquetes/efg.assetdetail.10467789.html
[54]Mnemonic Technical Report (January 2020). Retrieved from: https://fil.forbrukerradet.no/wp-content/uploads/2020/01/mnemonic-security-test-report-v1.0.pdf

account, and developers can "request access to read parts of the user's Facebook profile or write data back to their profile" (Robinson and Bonneau, 2014). Cross-platform connectivity has been identified in dating apps (Albury et al., 2017 ; Hsiao and Dillahunt, 2017a), and is made possible via the APIs and SDKs delivered by the aforementioned companies. The dating industry relies on this particular technological availability whereby software developers working for dating companies are "API consumers" who write code to call an API (e.g., from Facebook), and software developers at Facebook, Google and Apple are "API producers" (de Souza and Redmiles, 2009) who write and deliver the guide for the implementation. In this research, I identify the impact of this IT development environment, shared by all stakeholders, on the development of a dating app and the definition of variables that serve user representation via GUIs.

3.2.3. State of the Art: Practices of Dating App Developers

Beyond the dating industry, various in-depth studies have been conducted in the CSCW community, highlighting the relevance of studying the development and engineering processes to improve design accuracy and user interaction (Dolata and Schwabe, 2018 ; Grinter, 2000 ; Tenório, Pinto and Bjørn, 2018). Ethnographies are suggested as a methodology to follow the actors (Wolf and Blomberg, 2020), but dating app companies seem impervious to this kind of field study. Online dating remains a "Pandora's box" with several methodological issues to study actors involved in creating dating apps in order "to understand the extent to which technological design informs dynamics of human relationships" (Zytko, Lingel, et al., 2015). Indeed, previous studies in online dating do not look at development practices partly because dating apps patent their matching systems and protect them with intellectual property.[55] Dating apps do not reveal their engineering techniques/secrets of the trade, which are often protected and hidden from public view when dating apps are discussed in the media.[56]

To the best of my knowledge, only one study has been published (Churchill and Goodman, 2008) which takes into account developer practices. It was an internal study into the company Yahoo! Personals, an early online dating service. A public presentation (Devendorf and Goodman, 2014) shows the entanglement of different processes and actors in online dating. Based on an interview study, Churchill and Goodman (2008) analyze the disjunctions between "design choices: the development and implementation of recommendation algorithms, the design of profile pages and other parts of the website [in combination with] business roadmaps and customer service issues of satisfaction and safety" with app usages (Churchill and Goodman, 2008, p. 89). One major result is that "interfaces are created specifically to produce algorithm-appropriate inputs". Therefore, profile pages enable users to render themselves visible both to the pool of daters in the dating platform *and* to the software that sorts them (Churchill and Goodman, 2008, p. 93). However, the results of the study focus on the user interviews and do not present the practices of developers, nor a systematic analysis of interfaces. User profiles, along with their variables, are the entry point for potential communication between users, coders and other elements of the dating business. Focusing on another type of expert, another study (Zytko, Grandhi and Jones, 2016b) shows that online dating coaches develop their techniques partly from the variables available in the interfaces, in order to provide users with advice. More recently, a sociological study (Bergström, 2019) showed that the "dating technicians" convey their definition of intimate experiences via the platform, anticipating the users' desires in their absence. Interviews with founders and webmasters

[55]See for instance Match group list of patents. Retrieved from https://policies.tinder.com/intellectual-property/intl/en
[56]See for instance Tinder's post. On their blog Tinder clarifies that the Elo Score method (i.e. assigning a ranking score to every user according to how many swipes s-he received) is no longer used in the app. Instead, they apply machine learning without explaining the method (March 2019). Retrieved from https://blog.gotinder.com/powering-tinder-r-the-method-behind-our-matching/

indicate that their technical choices arise from the focus on developing an online service under the influence of marketing, and not under that of dating expertise. The results of the study disclose three design principles: mimicry of other competitors, segmentation of the target audience, and stereotyping love and sex in heterosexual normative relations. The functioning of dating apps seems to reflect the strategies of its producers more than the uses of its consumers (Bergström, 2011, 2019). However, the results of the study do not explain however, through which practices of development those design principles are implemented. The study is focused on the actors' marketing speech that also has an impact on interface design. The observations are consistent with those of the previous study conducted into Yahoo! Personals, showing that there are business processes of customer targeting and market segmentation entangled with a "sensitive branding strategy" (Churchill and Goodman, 2008).

As pointed out by Boudreau (2011), it is necessary to see dating apps as "multi-sided platforms" that support interactions across multiple sets of actors, and that can facilitate technical development. One could conceive of these developers as "a figure that articulates the technical issues and constraints to the social, economic, practical, and political reality in which a project takes place" (Schmitt, 2016). Consequently, developers contribute to the design of "an artifact which, beyond its technical materiality, is part of a system of uses and beliefs that must be taken into account to allow the usability and intelligibility of the programs" (Schmitt, 2016). To extend the literature on dating app development practices, in the first part of the results of this chapter, I am interested in understanding how developers build an environment that enables the communication between a software program and the end-users. In the second part of the results, I study developers within the dating industry and the technological framework of the market, to understand why the phenotype variable landscape offered to users is what it is, and to elucidate more broadly, how conventions are built in the industry via marketing strategies. I now present the methodology of the interview study before presenting the results.

3.3. Methods

3.3.1. Participant Recruitment

Seven interviews were conducted with nine founders and developers from ten dating apps, between March 2018 and January 2020. Participant recruitment was a difficult task. Twenty dating companies in France, Switzerland, Germany, the United States, and India were contacted by e-mail, contact forms, and LinkedIn. Most of them did not reply, and only one company agreed to do an interview. Engineers and developers were also contacted personally through LinkedIn, but did not answer. Participants were finally recruited by word of mouth: two were met during an annual technology conference, and others were introduced by acquaintances who knew about the research. The issues encountered in trying to reach companies and developers reflect the opacity of the dating industry: algorithms are fiercely protected and developing practices are not reported externally. Although the sample is thus limited, it allows for access to additional knowledge about dating apps. Given that this study is exploratory, there was no expectation that it would be representative, but I aimed to preserve diversity in two of the dimensions: job position and type of dating app market. In addition to educational background, job position helps to identify the type of knowledge engineers acquire through experimental practices (Vinck, 2014) in relation to their company responsibilities. Participants had to be either the founder or the developer of a dating app, and either currently employed in or having worked in that industry previously. It was also important to have participants from different dating apps, following the assumption that marketing segmentation strategies have an influence on the designs that app technicians conceive (Bergström, 2011, 2019).

3.3.2. Participant Sample Construction

The sample is composed of nine participants: six individual interviews, and one group interview with three participants. These three participants are partners and had created five dating apps using the same code. Despite the apparent homogeneity due to recruitment barriers, I was able to meet the diversity objective, at least partially, and ten dating apps are represented in this sample (see Table 6 for details). However, all the participants in the sample are men. The lack of gender representation reflects the demographic characteristics of the IT environment (Chabaud-Rychter and Gardey, 2002 ; Collet, 2019). Few apps are founded by women, and the two I located were contacted without success. One woman was interviewed, but she was excluded from the study because she was working in the customer service department, without any direct involvement in programming practices. Her mediation work merits attention in further studies, however, as I observed that despite the division of labor based on gender, women play a major role in other departments in interaction with developers.

TABLE 6 – LIST OF PARTICIPANTS AND DATING APP CHARACTERISTICS

No.	Qty. Participants	ID	Profession / Position in the company	Qty. apps / Main markets / Popularity acc. to interviewees	Creation year / working period
1	1 developer	I1	Software engineer / Quality assurance engineer	1 / Portugal, France, Russia / medium popularity	2016-today
2	1 developer	I2	Computer scientist / Server developer	1 / Switzerland / app sold to an advertising company	2015
3	1 founder-developer	I3	Computer scientist / Founder and server developer	1 / France, Belgium / low popularity	2017-2020
4	3 associates, of which one is a developer	I4 I5 I6	Sociologist / Product owner and Founder Engineer / Full stack developer and Founder Lawyer / Associated partner	5 / France and Spain / medium popularity	2004-today
5	1 developer	I7	Computer scientist / Android lead developer[57]	Portugal, France, Russia / medium popularity	2016-today
6	1 founder with technical skills	I8	Architect / Founder	1 / United States / low popularity	1990-2000
7	1 developer	I9	Applied mathematics / Data engineer	1 / United States, Worldwide / high popularity	2004-today

A larger sample of developer interviews, including female participants and those working on different apps, would be necessary in order to assess the significance of our findings. As seen in our exploratory analysis, personal and professional experience, as well as the resources available at the company, have an impact on programming practices. Therefore, one would need to check whether or not other categories of actors and settings have a similar impact on programming practices too. Actor diversity is also linked to the type of position they occupy in a company. I sampled only a few job positions (e.g., lead developer, QA engineer,

[57]Working on the same dating app as I1

data engineer, product owner) associated with the recruitment process. Those holding other positions could also be interviewed to evaluate their degree of influence according to their responsibilities, and their interactions with other teams.

3.3.3. Consent and Ethics

The study adhered to ethical procedures, and a data management plan concerning personal data that was approved by the EPFL Human Research Ethics Committee (HREC), No. 007-2018 / 22.02.2018. See Chapter I, methods of inquiry for more details.

3.3.4. Interview Procedure

Semi-structured interviews were conducted and audio was recorded via phone calls or Skype by myself, the researcher, who also transcribed them. Recordings ranged in length from 54 minutes (min.) to 75 minutes (max.). Discussions continued with three interviewees via e-mail and chats. Participants gave their written consent, their names are pseudonymized, and the names of the apps are omitted to protect their identity and avoid possible links between the interviewees and the companies included in the quantitative study. It is worth noting that I have previous professional experience in development, which facilitated communication and comprehension of the technical vocabulary. Moreover, by recruiting developers directly, the interviews were experienced as a space for free expression, enabling interviewees to evaluate their work and express themselves outside of commercial constraints.

The interview protocol focused on the participants' educational and professional profile, a description of the app's functionalities, its design, most important variables, business model, match definition, daily work, tools, releases, and problem-solving. Given that demographics were not of particular interest to this study, they were excluded to protect participant identity. Open discussions were allowed when new questions arose or when the interviewees wanted to talk about other topics. This approach favored a two-step reflexive analysis: interviewees instinctively opened with their standard speech taken from marketing and business strategies, and then later, when they went into detail about daily practices, they encountered moments of doubt, hesitation, and various issues that had to be disentangled before I was able to see action and cooperative work emerge (Star, 2010).

3.3.5. Interview Analysis

A grounded theory methodology was employed in this analysis, using NVivo software for qualitative coding. I coded inductively the emergent terms in the interview transcripts. The first In Vivo (Miles, Huberman and Saldaña, 2020) coding cycle was based on participants' own language, as identified in the data when referring to actions in development practices or components such as server deployment, testing, tracking and databases. Terms were discussed with another researcher before performing a second coding cycle with descriptive short phrases, in order to select those that were evoked by more than one person, and to identify general methods that enable regrouping individual actions. From those methods, I grouped and separated the practices linked to the definition of variables in a third coding cycle, in order to understand the results of the data analysis in Chapter II.

3.4. Results I: Online Dating as a Software Program

The analysis of interviews shows that the development of a dating app relies on generic engineering practices that enable construction of a software program. This is a necessary step before creating a GUI for end-users.

> *I9: "[It's] generic software engineering, if you can engineer one thing, you can probably engineer another one, you modify it for dating environment but not a huge modification [...] There is not a lot of dating specific stuff. A lot of techniques we did, we imported them from, it was on... for instance, how to recommend stuff, in Amazon how to recommend stuff, ok we change movies, products, store products to people and it did work."*

By analyzing the way in which developers describe engineering practices in a dating app company, it is possible to understand how a dating experience is created. To develop a software program, developers apply four methods: deconstructing, persuasion, explicitness, and compartmentalizing. They serve developers to create a dating experience. To create it, developers translate a dating definition into something computable. Through an analysis of those methods, I deconstruct the practices by which the meaning of dating is translated into operations that are understood by the machine, before the meaning reaches end-users via GUIs. These methods play a major role in the transformation of the dating experience from its definition by the designers, founders, or product owners, until it is delivered in the GUI.

3.4.1. Deconstructing

Deconstructing means identifying elements, and the relations of elements, in a software program that translate the concept of dating into a pragmatic user experience. These elements are often hidden behind the general commercial objective of a dating app. Developers call the process "breaking down the product". Firstly, deconstructing makes it possible to search and identify those elements to make them visible. Secondly, it makes it possible to analyze the difference between what is predicted and what happens for users in reality, so problems in the software program can be identified and fixed.

First, deconstructing the meaning of dating into tasks or stories involves the developer searching for the key elements in the user experience. It makes it possible to identify and select which elements will be implemented in the app through regular meetings. To apply the agile methodology mentioned below, developers have to first deconstruct and to understand the elements involved in the process.

> *I1: "so we are following the Kanban, an agile[58] method for development process and we say we are working in this task, what we will do after this, we are working in a sprint where you have the tasks and what will you do for the next sprint, imagine you have a big product and you cannot start implementing, right? So we will breakdown in technical tasks and stories, we define them so everybody understands what the story's about."*

Secondly, developers acknowledge there are always problems that are not under their control, or that were not planned. Therefore, deconstructing enables them to understand a situation from the user's perspective:

[58] I explain this method in the second part of the results. For more information at this point, see Manifesto for Agile Software Development (2001). Retrieved from: https://agilemanifesto.org/

> *"I2: Usually we [need more extra time]. I mean … you get used to it and know where the problems could be, after the third time you will calculate more time in that feature or in that area of that feature.*
>
> *Researcher: Can you give me an example?*
>
> *I2: Sometimes, which is always hard to do right, is location update. I mean also so many things can go wrong with location because I mean the customer may have a bad phone, you have no reception, or there is like operating systems updates that turn the stuff around so that's always hard, actually all the asynchronous things are hard, not hard but not that easy to solve."*

All developers in the sample evoked a problem of usage related to the mobile phone models. Developers develop a program based on specific mobile phones that they have in the company. They usually consider the most used ones among users. However, if users with other mobile phones register with the app they will experience a problem in the usage of the dating app. This is because the usage in that specific model was not considered in the development and test phases. Consequently, developers have to identify a posteriori the elements that provoke a failure to update the software.

In summary, deconstructing enables defining, explaining and reviewing what can be implemented as a dating concept in computable terms and in coherence with the whole technical architecture beyond the product design.

3.4.2. Persuasion

Persuasion is the process of guiding development practices by a belief. The choices made by persuasion can be arbitrary and mainly driven by the personal motives of the developer. They can also be made by the promise of success of the future app to be developed.

I observed persuasion in three main practices. First, when founders persuade other persons to build a dating app based on the promise of success. It requires symbolic means, and not financial as shown in the excerpt below:

> *I3: "I must admit that I was lucky to get the idea of the project off the ground. The graphic designer when I spoke to her, she didn't know the applications well, we discussed for quite a long time, I showed her a lot of things from other applications, she simply believed, she said 'yes, in fact I can see something that feels good'. After that we never, we didn't sign or write anything, neither we set them in stone. But discussing about it, the idea was that if we manage to have investors interested in it, if we create a company, the idea is that she joins the board, as partners, but clearly to be transparent we didn't discuss percentages, the idea was to trust each other first, to go all the way without being immediately into the numbers […] I think that we always have uncertainties, because we never know to what extent it will work or not. The second version [of our app] that we think is better and that can allow us to reach more people, maybe in the end people will tell us why you did it. For me, there are always uncertainties, but the idea is to have confidence in your intuitions, in your desires, to follow through, and then you have to learn if things don't work and correct them, but you simply have to trust."*

Persuasion enables bringing other skills into the project for developing an app without any guarantees of the results or any legal commitment. The method of persuasion is based on establishing trust and accepting the uncertainty that exists when a market study has not been conducted.

Second, when developers are working together, and are making technical choices.

> *"I3: [the app] works with Google technologies*
>
> *Researcher: Why did you choose Google?*
>
> *I3 : It's not me who chose, it's the partner, it's true that he's a big fan of everything associated with Google, especially Android, that's Google, so in fact he said listen, "I love Google, I've already worked on projects where we were on these Google platforms and with Google tools and it went well, so if it's okay with you, we'll go on that", I didn't have any other preferences so I said okay, we'll go on that."*

Persuasion in this case requires trust in the technologies the developer knows and that he is accustomed to using, and the financial means available. Indeed, this developer stated later that with Google there are no initial costs for using their services until a certain volume of data is reached.

Finally, I also observed persuasion in a particular case of collaboration. In this case, three partners share the code of the platform but each one owns a different brand of the platform in a different country. In the conversation below, while the product owner (I4) persuades the developer (I5) implement a feature in the interests of the business, the developer (I5) argues against it for technical reasons. The discussion demonstrates the tension between defining a new user experience in dating, and actually implementing it.

> *"I4 : for example, I believe that the integration of video is a feature that is absolutely necessary for the survival and expansion of our business [...] I see a certain type of use that users will be able to make, especially with 5G, which today is not present, but in the future it will be completely different in my opinion, there will be another dimension of sociability that will be created thanks to permanent mobility to high definition with 5G and with the video that will accompany this type of meetings*
>
> *I5 : [the product owner] (I4) is free, he doesn't have the technical constraints in his head, it's true that as soon as I have an idea how I'm going to do it technically, how much it's going to cost, I have all the limitations, all the blocks, because I know perfectly well how it works in the background, the example of video is a very good example, when we tried to make a first integration of video last year we fell into technological problems that made the final product, So for the moment we haven't released it yet because we are waiting for sufficient technological evolutions to be able to present a decent product to our customers. So it's true that sometimes the considerations are technological, it's true that on the drawing board when I4 starts to develop his ideas, that he's completely free, it's good because it forces us to try to push the thing further, well sometimes it doesn't work because we have technological blocks but in any case the motivation is there, that's for sure."*

Here persuasion creates tensions when partners are negotiating technical choices that depend on the same code and are implemented across brands. While the product owner tries to pursue a new definition of dating by the anticipating a possible success, the developer evaluates the feasibility of the implementation according to financial and technical resources.

3.4.3. Explicitness

Explicitness is the process of obtaining or producing information in an organized, clear and exact way to avoid ambiguities and define dating. Through this method, developers ask other humans to define dating in

a computable way so the meaning is translated into the machine. It enables translating the general idea of dating, as conceived by the founder of an app, into a computable experience and secondly, understanding a problem with the app as experienced by a user. In this later stage, developers ask users to express their experience into a set of instructions in order to get to the root of the problem.

First, a general idea of dating is translated into an app by a developer at a creative agency.

> *"I2: There are people who come with ideas, we elaborate the details and the right questions because they come to you and say we just want an app that is beautiful, and you say well you should also be able to meet with somebody in the app, right, that's just the idea, then we do all the details.*
>
> *Researcher: What is an example of a right question you normally ask?*
>
> *I2: In this context for example if, what happens, it's really a stupid question but, what happens if somebody deletes a match, should they be able to rematch or is it just gone forever?"*

Explicitness enables obtaining logical instructions. It is a method for obtaining knowledge from others in an unambiguous and procedural manner.

Secondly, explicitness is useful when developers seek to understand *bugs,* i.e., technical dysfunctions encountered with the app, from the user's perspective. The fact that developers cannot access the user's perspective means that explicitness is necessary to "find the source of the problem", as a developer (I2) explains:

> *"I2: What happens quite often is that some users say that in their case it doesn't work, normally they say it like that and you are like, what doesn't work right? Then they describe it, and then it still works in your app, in the app you have in your phone, and then you have to investigate, and maybe he or she has much more items on their phones than me for example who, working in an app I delete it several times a day because I have to test different stuff so you will never have that history which the user has, somebody who has the app on their phone for several months or even years right, and then it's hard to find out why the user has that specific problem that you don't have. Then it's really hard because it happens that we also tell the user he or she should come to our office to plug in the phone and see what the real problem is [...] or we tell them they should make a video and we can see a video of what he or she does to find out, to see what path the user takes, and another thing is that the problem is not even in the app but in the server or in a third party server which you don't have, yeah, finding the source of the problem is something which is actually is daily business but it uses a lot of time because normally it is not that obvious."*

In their practices, developers recognize that others have an important stock of knowledge that requires explicitness to access it and understand a situation from another perspective. With this method, developers learn to communicate in the language of the machine. Otherwise, they cannot implement and review the actions that define dating in a software program. Developers also teach others to communicate in the same way via explicitness. That is how users and developers translate the meaning of dating into a computable experience.

3.4.4. Compartmentalizing

Compartmentalizing is a process in software development, also called "compartmentation". It is "the process of keeping resources with differing access attributes in separate groupings." (Butterfield and Ngondi, 2016). Compartmentalizing enables modularity to establish relations between components in a software program.

In the development practices I analyzed, compartmentalizing also creates a clear division between the development and the business operations of a company, as well as the user experience based on the development of distinct environments in a program: production and test. Creating separated environments is a common practice in software engineering so that changes, updates, and testing can be performed in a controlled way without interfering with the user experience. However, compartmentalizing also affects the understanding of user behavior as I observed it in two situations. First, when testing, and secondly, when analyzing user behavior for commercial purposes.

First, for testing software updates, compartmentalizing allows developers to protect the user data, and to perform tests with "test user data", that is fake users replicated from the production environment into the test environment.

> *"I1: what happened to me is when checking some things I couldn't check because I didn't have the data. Let's give an example, ok, you want to check the users in Moscow [this developer is established in another country where the app company has offices too], you want to check a hundred female users and a hundred male users in the dating app so what happens is that we will not test everything in the live environment because live is something we never touch, because live is real data so we want to do this in a pre-released environment, which is a test environment or the development environment. We need users, a lot of data, so how can we check it if we don't have data? We cannot deploy [...] You can of course create your own data in test environment, generate by yourself, but in live you cannot because live is where the real users are and it affects the business, where the metrics and revenue, and other things are being calculated."*

Developers generate fake data for the test environment to simulate the conditions of the production environment. Consequently, the tests conducted into a new meaning of dating to be implemented are based on a reality that is different to the one where users are connected. The replication of user data and their assignment to distinct environments replaces the techniques of sampling and representing users as in traditional statistics. In addition, the creation of these two environments separates the dating experience into two distinctive worlds within the company. While the environment of users is shared with commercial departments for analyzing user behavior to serve marketing and financial departments, the test environment is dedicated to the developers and their peers for testing updates in the software program.

Secondly, although compartmentalizing separates a company's commercial and technical interests within a company, developers and colleagues from business departments can hardly work independently. The latter can analyze user behavior due to the way in which developers collected the data. Consequently, developers and colleagues from business departments find themselves working together to find explanations about user behavior. One developer working in an app well known worldwide explains this tension:

> *"I9: Yes, well there were dozens of those we ended up tracking, votes,[59] unique vote on a person, in a given time period, whether people don't vote on a given people because you see it multiple times, time span, number of conversations, the big one was whether you hit the fourth way, which was, you know, if you started a conversation with someone how long it continues with any contact exchange, if someone sends their phone number. So what else, there is a lot of more, but none of them is particularly fancy [...] it's an open question on whether or not most of them are useful. A lot of them were driven by the people needed to justify their existence, and, you know, the senior*

[59]Votes are the likes received in a profile represented by the text "like" and its related swipe gesture or icon.

> *management wanted to look at metrics whether they were useful or not. So you had a lot of stuff like, if you were trying to incentivize people to upload a photo, you were tracking the number of photos uploaded, if you were trying to incentivize people to vote, then we would track votes. Time spent on the app was way more complicated because that is really hard to track but it's been a while I forgot most of it, but there were few thousand things that were used to track, and there was things mostly to track the effectiveness of the product features so if you were looking, trying to change, you know, voting patterns by gender, you would want to track all that."*

In the development practices observed, compartmentalizing is a method that involves first a mediation between the human and the machine, and later an interaction between humans directly within a company. Actors working in a company interpret and try to understand user traces in order to translate them into quantifiable indicators that measure the app's and the user's performance. The human intuitions on how dating, or more precisely, the business should work (e.g., changing voting patterns by gender) are translated into decidable conventions (e.g., track user gender). Then, it is possible for the developer to code for the machine that has to track user behavior in a finite and precise manner. Reciprocally, the developer, along with the product owners, adopt the logic and binary language of the machine to be understood by the machine. Consequently, humans behave in part like the machine but also make use of intuitions to interpret the outputs that the machine is displaying later after tracking user behavior. Within a loop, human interpretation about the outputs is again translated into computable, decidable conventions for the machine.

3.4.5. Discussion: Human-Machine Learning

The results provide empirical evidence of development practices in dating app companies. They confirm the previous observation about developers and founders of dating apps: these actors do not have expertise in dating or couple formation (Bergström, 2019). I extend that affirmation by showing that developers' expertise is based in software development; this expertise is based on four methods that allow the establishment of a human-machine communication process that is possible thanks to the task of translation that developers learn.

A dating experience contains a finite number of elements for defining the tasks of the application (deconstructing). Although choices can be arbitrary, the dating experience has to be implementable according to the technical resources available (persuasion). Moreover, the dating experience has to be defined in a procedural and unambiguous way (explicitness). Finally, dating requires testing and making profit (compartmentalizing).

Software development has its origins in the general principles of engineering. However, the four methods I present show that in practice, there are ambiguities and uncertainties that developers have to manage in order to be able to establish a communication with the machine. Developers create a dating app according to the company's business interests, the usages, and the possibilities offered by engineering techniques. At the intersection of this dynamic, developers play a major role as translators. Indeed, they translate humans' ideas about a dating experience into the language of the machine: binary actions in a finite sequence of logic instructions that allow the tasks of the application to be configured. In other words, developers tell the machine what humans expect from a dating application. There is a *human-machine learning* process in which the developers are the main actors of translating a dating definition into an operational experience. This type of learning is necessary to communicate with the machine. It is also applied in human interactions that take place before or after communicating with the machine. It enables humans to understand how to implement, or update, a definition of dating so it becomes a user experience.

Current research at the intersection of cognitive science and computer science investigates new interfaces for a dynamic and collaborative human-machine learning setting. The goals is to create a setting "wherein the human intelligence, which can capture the right data, can be combined with the machine's ability for fast and exhaustive data processing to achieve effective learning." (Doltsinis, Ferreira and Lohse, 2018). Other scholars define and compare the human's and the machine's capabilities as learners to define a new type of "mutual human-machine learning" as "a bidirectional process involving reciprocal exchange, dependence, action or influence within human and machine collaboration, which results in creating new meaning or concept, enriching the existing ones or improving skills and abilities in association with each group of learners." (Ansari, Erol and Sihn, 2018). However, what I show through the analysis of development practices in online dating is that there is already a human-machine learning process taking place in computer-mediated communication. Actors learn to translate the social world into something computable. This type of learning requires both logic and intuitive reasoning from actors, as demonstrated by the situations described in the methods of persuasion and compartmentalizing. The analysis of development practices frames the discussion in the literature that distinguishes between human reasoning on the one hand, and machine thinking on the other. According to my observations, humans and machines are becoming increasingly entangled through a common language.

3.4.6. Discussion: Human Reasoning or Machine Thinking

In Chapter I, the pragmatic approach of Livet (1994) explains how actors learn to communicate by reviewing and readjusting interpretations in action. Without guarantees about the others' intentions (e.g., the desire of establishing a relationship) that are inaccessible and undecidable, actors identify decidable conventions in the environment (e.g., an affordance) and in human behavior (e.g., a body gesture) that enable pursuing actions (e.g., requesting to go on a date). In Chapter II, I have shown the GUI conventions that guide users' interactions and perception in a decidable way, as the machine requests. One remaining question is how those conventions come to be. In this chapter, I argued that developers have a key mediating role in translating the meaning of dating. Although not interested in online dating and the establishment of a human-machine communication, recent research in cognitive psychology and software studies shed light on this mediation. On the one hand, there is a focus on the way developers reason when programming. In this literature, developers are distinguished from other humans who are non-technical experts. On the other, there is a focus on the way a machine performs calculations. In this literature, humans are distinguished from machines. However, machines and humans (experts or not), are entangled in professional, and intimate daily practices. Online dating is a paradigmatic example of those entangled practices. Therefore, it is relevant to understand how humans and machines communicate through the combination of the literature that place actors in opposition to one another.

To Olivier Houdé (2019b, p. 47), "algorithms are the mental schema of computer scientists". They "think algorithms". Houdé (2019b) distinguishes that schema from the schema of a lambda person. Before I explain this type of reasoning it is worth defining algorithms in informatics according to this author. Algorithms are "the mechanizable organization of elementary operations to perform a task that have to lead always to the good solution". These "operations or instructions are a finite and unambiguous sequence transformed in calculations of actions (decision-answer)" via a computer (Ibid., p. 47). Following Houdé (2019b), these algorithms of developers, and at the same time the algorithms of the machine, are not the same as human algorithms. Human reasoning is in part, based on algorithms with specific cognitive properties that cannot be compared to computers. Systematic classification, deduction, and logic are central to human algorithms, for instance. For clarity, I name the algorithms used in programming situations "computable algorithms" that require a type of "algorithmic-thinking" from humans. To Houdé (2019b), computer scientists consider that human reasoning can be modeled into algorithms, even heuristics: the contrasted system of logic as I will

show. That generalization of human reasoning as computable algorithms inspired from informatics is antinomic to Houdé (2019b). Computable algorithms are formulated by developers to be efficient and fast. Human reasoning is fundamentally distinct. It is argued that the human brain has two cognitive systems: system 1 is *fast* but this is not the logic reasoning. System 1 privileges intuitive reasoning; heuristics that are automatic. This system enables approximations based on habituation and can lead to bias or irrational decisions. System 2 is *slow*, logical, and analytical. These are the human algorithms. System 2 is rational and privileges deductive reasoning (Kahneman, 2013). The "speed" is key in human cognition (Kahneman, 2013) and human's system 2 is slower in comparison with computable algorithms.

Another type of reasoning is evoked by Mackenzie (2013). To this author, software developers and programmers of machine learning algorithms work in a "regime of anticipation": they implement a "generically abductive practice for anticipation". The author opposes this *implemented practice* to previous definitions of abductive reasoning. "Drawing on C.S. Peirce, […] anticipation works through a form of abduction, which involves the process of reasoning temporally from data gathered about the past to simulations or probabilistic anticipations of the future that in turn demand action in the present" (Adams et al, 2009, p. 255). "Prediction is perhaps the most highly valued abductive operation. Although not all anticipation is completely predictive (for instance, promises or hopes are anticipatory without being necessarily predictive), and not all abduction is predictive, simulations and predictions are key components of the regime of anticipation." (Ibid.). To Mackenzie (2013), abduction as defined by those authors "is less about reasoning and more like a sensibility to change and events." However, based on the analysis of conference presentations and online competitions for developers, Mackenzie (2013) explains that developers' abductive practice is agnostic to the field of application, there is no claim about certainties, only about the potential of prediction. The author calls this limitation of anticipation in practice, "predictivity", which is based on the "optimization of the predictive power of statistical models" (Mackenzie, 2013). This predictivity is interiorized by developers throughout the different practices they are involved in. For instance, the author explains developers mainly address predictive problems, e.g., "classifiers: machine learning processes that assign cases to categories." They also pay attention to the problem of "feature selection, which means finding the variables in a model that have higher predictive power" (Mackenzie, 2013). This regime of anticipation is comparable to the way the machine applies calculations. According to Pasquinelli (2019), machine learning calculates "the statistical distribution of a pattern" where prediction is essential. He explains a classification process in mathematical terms: "machine learning is used to predict an output value y given an input value x. Algorithms draw a function that relates x to y by learning from past data in which both x and y are known: $y = f(x)$. Constructing such function, the algorithm will be able to predict y based on future configurations of x." (Pasquinelli, 2019). Therefore, the analysis of Mackenzie (2013) can be read as the assumption that developers have an abductive reasoning inherited from the machine. It also assumes that developers communicate exclusively and individually with the machine for solving predictive problems. On the contrary, Burrel (2016) explains that programming conventions enable both communication with the machine in a formal language that the machine uses for calculations, and communication with other human developers that reuse the code and read the mathematical formulations. In contrast to Mackenzie's (2013) notion of predictivity, this two-fold communication assumes that developers have to be understood by the machine and their peers. This approach gives agency to human actors that have the capacity of learning beyond the constraints of the machine. While a machine *thinks* in mathematical operations, humans "*learn* through their capacity for reasoning to make sense, find semiotic relationships, build meaning, produce narrative analyses, and make interpretations" (Burrell, 2016).

Heuristics and logical reasoning are two cognitive systems of humans (Houdé, 2019b ; Kahneman, 2013). Why then would developers be limited to reason with a predominating system only? For instance with system 2 that is rational and logical because "they think in computable algorithms". Engineering is often introduced as "a rational activity of problem-solving and as the conception of innovating solutions" (Vinck, 2014).

Engineering, like computer science, has the reputation of being based on formal scientific knowledge. "Mathematics, in particular, would be the foundation of their way of thinking" (Vinck, 2014). Throughout history, experts in engineering and other domains have reasoned and applied calculations with objects that have material limitations without abandoning desires, intuitions and also bias that lead sometimes to discrimination. See for instance, classifications systems with paper records in hospitals or migration procedures (Bowker and Star, 2000) or more broadly the formalization of knowledge into tables (Goody, 1979). Instead of separating the social from the technological, the humans from the objects, it is relevant to understand the mechanisms that create relations between them, as the STS approach suggests (see Chapter I). However, Vinck (2014) elucidates that what engineers learn during their training diverges from what they learn in practice. According to Vinck (2014), focusing on engineering training implies the assumption that engineers' work is a matter of calculation, modeling, formalization and execution. In contrast, the engineers work as studied in daily practices shows they require different types of knowledge: both theoretical and practical knowledge acquired in the course of the action. For instance, engineers translate economic objectives, adopt tools, apply the rules of thumb, collect and interpret feedback, and learn about the different actors and structures involved in a project. Hence, engineering practices fall under exploration, experimentation, and communication. It is a cooperative practice that requires negotiation and overcoming problems and failures with other actants, human and non-human (Vinck, 2014).

As Gardey (2002) elucidates, objects have both technical and social characteristics that influence each other; human usages transform the techniques, while, reciprocally, said techniques reconfigure social relations. Gardey (2002) extends this STS approach to the point where techniques can inherit a sex and contribute to the solidification of social relations, in particular the relations of gender dominance. Her approach helps to reconcile the analysis of social structures on the one hand, and of techniques and practices on the other (Ibid., p. 240). These are two types of sociological analysis of the reality often distinct in the study of online dating. While some scholars consider dating platforms as a technique (STS approach), others consider dating platforms as a space of couple formation (Sociology of Bourdieu). I explained this distinction in Chapter I. However, through the analysis of interfaces in Chapter II, I showed that specific sociotechnical arrangements of perception and interaction, as well as of heteronormativity, constitute the online dating phenomenon where techniques, cognition, and affective relationships are hard to separate. Gardey (2002) conducted empirical research on sociotechnical relations. The results show the value of adopting her approach in order to understand the entanglement of human reasoning with objects, like a machine, in development practices. Her work focuses on understanding the way "technical practices – those multiple times and spaces where the interaction of people and things take place – build, stabilize, reconfigure and reproduce social and gender relations" (Gardey, 2002, p. 241). She traces in detail networks of objects, humans, and historical usages, as well as advertisement material, in order to understand the process of the sexuation of the typewriter, and the construction of femininity in the practice of dactylography. More specifically, she shows "the presence of women in administrative work before the introduction of the typewriter, as well as the way in which the typewriter (Typewriter of Sholes manufactured by Remington) was appropriated in France by the male stenographer community and how the first dactylographers then actively contributed to the definition of the use of this tool for the business world, at the same time as they invented the (masculine) profession of commercial shorthand typing." (Gardey, 2002, p. 245).

In this chapter, I have clarified the methods that build sociotechnical relations between developers and the machine by acknowledging that developers, like other humans, rely on both cognitive systems, heuristics, and logic to understand the machine, to translate the ambiguities of human behavior, and then translate it into the machine's language. This is what enables a communication process, thanks to human-machine learning. The human-machine learning consists of a double movement of translation and interpretation. Humans translate their logic and intuitive reasoning into decidable and mechanical actions for the machine's language, while the machine in turn gives new signals that become ambiguous and undecidable to human

interpretation. This highlights a paradox in artificial intelligence: that, based on the Turing test, the machine as coded by a human seeks to make its identity *undecidable* by humans (Auray, 2002). However, as shown in the methods of developers that I have studied here, humans are performing a translation work so human behavior becomes *decidable* for the machine.

3.5. Results II: Variable Coding Mechanisms. Between Mimetism And Distinction

In this section, I elucidate the specifics of online dating and the GUI, by focusing on the definition of variables. As presented in Chapter II, the variables play a major role in the definition of users and dating experiences via profile forms. These variables, that are presented in GUIs, are a key mediation between users and the application. They allow the application to collect algorithmic input data to compute profile recommendations on the one hand, and allow the users to present themselves and evaluate others on the other. The variable phenotype landscape in Chapter II reveals both strong similarities and differences between the 22 dating platforms analyzed; the development practices elucidate the mechanisms that lead to such a landscape.

The similarities and differences between apps result from a design and coding process, which combines mimetism and distinction mechanisms that regulate the creation of dating apps and stabilize the dating industry. The interviews presented in this chapter contribute to confirming the influence of factors previously identified in the literature, and to clarifying them according to actual coding practices in online dating companies. In the following subsections, I first analyze four intertwined economic and sociotechnical factors triggering mimetism and leading to app similarities. Secondly, I identify three distinction mechanisms creating app differences. Lastly, I draw attention to the need to integrate an additional component into the analysis: the dynamic nature of app development, influenced by both software methodologies and by user traces and feedback, places developers in a position of mediation between business and the user satisfaction that frames their creativity. Such settings put founders and developers into a position requiring continuous adaptation, driving user modeling from a self-referential process towards standardization. Developers make sense of dating as an adaptation of generic techniques of software engineering, where the specifics of dating are driven by imitating what works in other apps. This imitation limits the possibilities of innovation that I discuss according to Gabriel Tarde's theory (1895).

3.5.1. Mimetic Mechanisms

Dating app mimetism is favored by four factors: (i) the facility of coding mobile apps via available solutions such as SDKs and APIs, (ii) the efficiency of reusing code and copying functionalities, which is increased by the agglomeration of brands, (iii) the trends imposed by the first apps in the market that implement the newest technologies (e.g. geolocation), and (iv) for apps targeting heterosexual customers, the retention of women in order to attract men that are more financially profitable in the current model.

First, available technologies influence variable choice, and the quantity and volume of data that can be collected. A pioneer (I6), who created a dating service in 1990, recalled the difficulties of early programming and the transformation of the data collection process, where paper questionnaires were transformed into a digital database. At first, he and his associate were distributing questionnaires to clients by hand in public spaces. Once they were filled in, they initially used a scanning program to collect the data, but eventually abandoned this method in favor of adopting the Microsoft database, Access, and created a website so that the entire data collection process became an online one. The founder stated that: *"Problems were primarily*

keeping updated technologically and developing the web interface to stay fresh and appealing, and technologically to be able to do complicated searches on a variety of factors — it was very challenging." Similarly, other founders who were also developers mentioned merging from website to mobile dating services. This transition obliged them to acquire specific skills in line with the dominant operating systems, namely iOS and Android. Google and Apple build standardized development kits that cover the whole chain of app production, including data structure and storage. One founder (I3) illustrates this well: "*The matching algorithm is on the server I developed in Java. It was deployed on Google servers. We use Google technologies, what they call the Google Cloud Platform, with the deployment of the server they call the App Engine. Everything, the databases, etc., are on those servers and on Google technologies. For example, the Google Data Store."* The choice of using Google server to store data was linked to costs, he stated: *"There are trial versions with a budget they allocate in advance. So in the beginning you don't pay the first couple of hundred euros, they pay them. And in fact for it to become expensive you have to reach a number of users that is very high. At the moment, to be transparent, we pay zero for the servers because we have to get to tens of thousands of users, quite large numbers, so that it becomes expensive to start having costs."* The storage is not only dependent on the number of users but also on the dimensions. In this app, the profile page comprises few variables, only nine, and the conversations are deleted after 24 hours, so as to reduce the amount of data that has to be stored. The main variables in this app were extracted from the users' Facebook profiles. In the same vein as Google and Apple, Facebook offers a Login adopted by the majority of dating apps in this research's sample. This SDK allows one to call upon an API that is intended to provide user authentication and data access according to the variables defined by Facebook. However, as CSCW researchers have pointed out in other implementations, "more permissions can be granted without the developers knowing how much data is extracted" (Robinson and Bonneau, 2014). The same founder (I3) said: *"It's true that it's rather simple to integrate, it's used a lot now […] and it allows us to reach 90% of users"*. The convenience of implementation encourages (and even implicitly steers) platforms to define part of the users' identity according to the same variables defined by Facebook: name, age, sex, photo, education, high school/university.

Secondly, the agglomeration of brands enables communication among companies, which favors the reproduction of functionalities across apps. A data engineer (I7) recalled his experience: "*We were talking to our sister companies, hey what are you doing? Can we borrow your stuff? Take some of that. It depended on the company how open they were. Tinder was particularly open, and Match occasionally played along, so it really depended."* In particular, apps replicate variables, when companies merge, under the same code. The practice of reusing code and assembling components is common among developers, as "rewriting available code without a good reason is perceived as redundant" (Burke, 2019). This makes it possible to save on developing time and costs, which companies capitalize on. Three founders (I4, I5, I6), who own five apps, decided to team up, as explained by one of them (I6): *"Each [of us] has our own company, he has his own company, we have our own company, and we have created a joint venture […], we are 50-50 owners of the platform, so everyone develops their sites from the platform."* The developer-owner (I5) added: *"not the brands but the technical platform, the code in fact, the program is there anyway."* The five apps reuse the same variables despite targeting different markets (countries and communities with specific origins and sexual orientation) according to their brands. From the app classes in Chapter II, one notices the presence of at least one of the apps of the well-known agglomerations or one of the oldest apps in the market. For instance, Meetic -Match Group- and independent European companies (e.g., Parship, AdopteunMec) are in the same class, suggesting that smaller and newer companies copy them and are merely positioned in different countries.

Thirdly, actors can also imitate apps implementing the newest technologies, which act as a model to follow. For instance, Grindr has seen exponential growth, mainly due to its pioneering introduction of mobile geolocation, which has rapidly spread to other apps due to smartphone expansion (Sumter and Vandenbosch, 2019). One founder (I5) explained: "*when Grindr arrived [...] it forced us to go mobile very quickly, [...] [Our application] arrived very, very late [...] it wasn't great because we weren't specialized in it, it was still very new*

to us [...]. Technically, we still integrated the same Grindr technologies. Very quickly, we realized that it was quite important, things that we couldn't do before the smartphone era, [...] now all our services are like that because it's the most logical and it's true that it's Grindr who imposed the standard." Geolocation is now enabled by default in every mobile app in this research sample, and some websites too, unless it is disabled by the user. Websites without geolocation require entering the city, zip code, region or country manually. This reflects a convention in online dating, along with the profile picture and the Facebook login.

Finally, one variable plays a specific role in heterosexual dating apps that display extensive market penetration: the sex variable is present in all the heterosexual apps of the corpus, and it is either obligatory to fill it in, or it is extracted by third-party implementations. Dating apps are a "class of technologies [...] built for specific users, e.g., women as customers [...] which in effect codify gender difference and reinforce the traditional gender hierarchy" (Bath, 2014). Specifically, the variable "sex" provides the subscription plan setting (e.g., Pure and Adopteunmec, where only men pay) and defines profile result options that are sometimes set by default according to the app, as previously observed in CSCW research (Hsiao and Dillahunt, 2017a). The interviews confirm that attracting women is a business goal that developers must adopt. As explained by an engineer (I7): *"women are the principal draw of dating apps, otherwise it's full of dudes. We were completely ignoring non-straight people, you can safely ignore them and nothing will change, maybe like 5/10% unless you are targeting those demographics. [...] You know 90/10% is considered the gender split, though it's more like 95:5 or 99:1, but in general getting young women onto the platform was considered crucial to its continuous growth and health. So you can still see a lot of marketing effort in the west, pushing to try to [attract] 18 to 30ish women, trying to campaign to that demographic."* In dating apps "the exemption from payment granted to women makes them the service to be offered by removing their status as clients on the same level as men" (Bergström, 2019). This configuration is coded into functionalities as one developer (I1) expressed: "*We introduce features, and they are mainly for women (e.g., initiate video calls) to give [them] more advantage. [...] As a male user, if you want to get noticed by all the women in your area you can pay a bit more to get that feature."* A study has confirmed the importance of the sex variable for targeting men, and it is used in the definition of an objective function for recommendation systems like Tinder (Jia, Liu and Xu, 2018).

3.5.2. Distinctive Mechanisms

Differentiation from competitors is a compulsory strategy, as is acquiring broader markets. To repurpose or to replace a characteristic of an existing technique is common to the more general production of products in the market (Akrich, 1995). The distinction strategy can be observed in the variable landscape. Tinder, Meetic, and Hinge, belonging to the same agglomeration, namely the Match Group, appear in different classes (red, blue and purple, respectively) in Chapter II. Another agglomeration, the Meet Group (purple class) owns Lovoo and is closer to Hinge than the other corporate group. Bumble shares its infrastructure with Badoo, both from the MagicLab agglomeration, but the two companies are regrouped into two different classes. A distinction is consequently applied as a business strategy, within or outside the same business associations. Such economic decisions affect the apps' conception and developers' work, as explained by a lead developer (I7): *"I've implemented new features and fixed bugs but the company wasn't engineering driven, so I was always involved in endless discussions regarding product and business models."* To attract users, dating apps target a niche. This is a differentiation strategy based on market segmentation (Bergström, 2019). More precisely, I found that distinctive variables are defined through three mechanisms: (i) the app store release conditions, (ii) advertising and the app's business model, and (iii) the "I-methodology" (Akrich, 1995) expressed by app founders, which introduces information about lifestyles and meeting expectations in the development phase.

First, one identifies a distinction mechanism imposed by the operating system markets when publishing an app. *"In Android, you can release [immediately], you just put it in PlayStore, and it will be in PlayStore,"* explained one developer (I1). His colleague (I5) added: *"In AppStore […] they demand you have different features from your competitors […] I'm not sure what effective ways [there are to do this], but I think it passes by changing metadata and pictures of the app and paying for reviews"*. This could partially explain why, in the quantitative analysis, multiple apps have several unique variables. It is an easy strategy to "pass the distinction test" of releasing an app in the mobile stores.

Secondly, specific variables play an important role in advertising, which is a significant component of the dating business models. This integration is facilitated through SDKs that allow the creation of a coded bridge between dating apps and third-party advertising implementations. According to a recent Norwegian Consumer Council report,[60] four dating apps share the data provided by their respective users for the following variables: birthday, age segment, sex, sexual orientation, desired relationship type, country, ethnicity, religion, education level, and GPS location. Declarative variables are also used to market the platform by contributing to identifying users and shaping algorithm outputs. The owners of the five apps target specific populations and communities (e.g., Arab-French gay men or French-speaking countries) using the variables "origins", as one developer (I5) highlighted: *"We're lucky again [because Grindr is losing popularity], so it's actually the secondary platform that's going to stand out with other features, or by offering a more specific niche, or by offering something that Grindr doesn't necessarily have or can't offer, simply because of its concept."* The variable "sex" has a particular dual status, in addition to the already identified status in the mimetic mechanism. Apps can define two distinctive business models by either ignoring the sex variable, as in Parship where both men and women pay a subscription, or by not requiring it, as in homosexual-oriented apps like Grindr and Her. The latter, together with more generalized apps like Bumble and Tinder, do not define a subscription according to sex. Users have limited free access to the service and can then either choose to pay a subscription, or unblock functionalities via one-time purchases. All the interviewees adopted one of these three business models according to their segmentation strategy.

Finally, the possibility of entrepreneurship, facilitated by the founders' coding skills or engineering profile, permitted the creation of dating apps where the founders are also the developers of the app. This double role facilitates the quick integration of their personal experiences into the profile construction without conducting a study. As indicated in previous research (Akrich, 1995 ; Oudshoorn, Rommes and Stienstra, 2004) "when there is no other available means of bringing in the end-user, or when organized tests seem too complicated or too expensive, designers become the layman and rely on personal experiences". The study shows that what I called "myself-variables" emerge from the founder's private perspective as an implicit user representation technique for product design. In particular, from the reproduction of their lifestyle and relationships, and their own self-image in the community to which they belong, this could be considered personal market research. The four founders who were interviewed drew on their own dating frustrations offline and when using existing services, to transform these experiences into a new product. One founder (I3) claimed to be a user of several dating apps for a long time, and explained that he was tired of not meeting women in real life, although he had been chatting frequently with them online. In his app, the main variable captures dates for a meeting, and is coded to shorten the time spent online: *"The idea was to say, from the moment you say 'I'm available on Thursday night,' how can I minimize the time spent on the app? So we decided to only show the profiles available the day before, which says you only have 24 hours to chat — because I think now in 24 hours people get to chat and see if there's a feeling, and it's a little less like before that people needed*

[60]Mnemonic: Technical report "Out of control" (January 2020). Retrieved from https://fil.forbrukerradet.no/wp-content/uploads/2020/01/mnemonic-security-test-report-v1.0.pdf

to chat for 3 weeks. I think that's less the norm, so 24 hours was enough, and then the last idea to continue minimizing time is that everything is deleted the day after the appointment." At the same time, translating the owner's profile into variables contributes to brand construction, as made apparent by the founder of Attractive World (Marsaud, 2017); the website's service was designed for *"qualitative, serious, original and selective top-end singles"*. He was attending a business school, was single, and had an active finance network. Users were then expected to match a specific civil status, location (Paris area), and occupation, i.e. "*superior socio-professional categories such as communication, advertising, arts, and finances"*. This brand definition, using self-reference for developing a new app, is an attitude shared in innovation, far beyond the online dating app industry.

However, in this industry, one specific factor plays an important role: the founders' communities of affiliation. When defining declarative variables, none of the founders in the sample, regardless of their sexual orientation, recalled standard user modeling methods — instead, they followed an informal process. In particular, two founders made the explicit point of considering their practices as a generalized culture in gay male apps, thereby distinguishing their culture from heterosexual communities. There is in fact a double movement of distinguishing from the heterosexual community, while representing the users of their own community, which also implies imitation. Founder (I5) claimed: *"[There is] almost no need to do market research. You just have to look around you to see how people, your friends around you, use all these apps and you immediately understand very quickly how the market works, between our experience, those of our friends and those of our interlocutors, through these apps we have a perfect view."* Another founder (I4) said, *"stats, numbers [...], all those things are not particularly useful. What is useful is to understand the needs of gays that are quite specific, because the guy needs to know: is the person on the screen nearby, is he available, is that the real picture, [...] what does he like to do, is he active, is he passive, etc., that's the real need of gays. If the app helps them, actually it can't help them, [the app] identifies them, it has to at least meet those needs, and that's what we're trying to do by adding features or by adapting those features to meet those particular criteria that are related to the gay world, to the gay dating world"*. The quantitative study confirms that the variables referred to above (e.g., "location", "login status," and "sex position") are present in apps for men, where the first two play a particular role: the variables are used as filters to manage the number of profiles to browse in a grid by providing immediate access to users who are nearby and available online. The "login status" by default shows results in a chronological order, such as Grindr and Scruff, for example, which differentiates the user experience from apps like Bumble.

"Dating app technicians are rarely trained on love or sexual encounters" (Bergström, 2019), and the methods that I previously presented show the development is driven by standards of software programming. In addition, the analysis of the variable definition in dating apps shows that the dating is based on the founders' personal dating experiences, as well as the technical skills adopted from general standards. Consequently, developers integrate stereotypes in the user experience by expressing them through variables that ultimately influence matching outputs.

3.5.3. Continuous Adaptation. Traces and Feedback

Software engineers work in an environment of continuous experimentation (Schermann, 2017). Consequently, variables initially defined by founders are transformed over time from internal practices (those of developers) and external practices (those of users). The dynamicity of the developers' adaptation is induced by three factors: (i) agile methodology that affects the daily development work, (ii) user traces, and (iii) user feedback, which cannot be captured from automatic tracking, yet contributes the most to engendering modifications, as previously identified (Akrich, 1995).

First, all the developers and founders, except the pioneer (I6), specified using "Agile Software Development" methods (Medeiros et al., 2020) for work organization. Let me reiterate that, for the precursors' manifesto,[61] agility means closer contact with users, collaborative work with colleagues and customers, testing, permanent deliveries, and corrections within shorter periods. However, defining technical specifications, prioritizing functionalities, and A/B testing (e.g., running two or more variants of an application in parallel) are a large part of developers' daily work, according to the company leaders, product managers and clients (in the case of a contracted developer working at a creative agency). This fact can lead the variable definition task being bypassed or set aside. Besides the development model, Agility helps app versioning following each operating system update, which is contingent on the materiality and diversity of the mobile devices manufactured. Two interviewees involved in testing tasks insisted on their efforts to continually adapt.

Secondly, dynamicity is stimulated by the automatic analysis of online user traces as expressed in four interviews. Traces are integrated into business metrics to evaluate platform performances and are examined by developers (Schermann, 2017), while also contributing to the revision of the founder's initial idea. One founder (I3) explained he was using Google Analytics Firebase SDK to analyze user engagement. The tool also provides an understanding of the app's main concept. The app was based on the functionality "calendar" containing the variables "dates" and "times" where the users indicate when they are available so that the matching system suggests results with similar availabilities. However, when analyzing the traces, it is mainly the interface design that captures the founder's attention. The founder said: "*I was looking at everything that is analytics in particular to see the people who came once but who did not come back, the people who opened the pop-up but did not create an appointment, was the pop-up too complicated? I was trying to understand things a little bit.*" Indeed, human interpretation is necessary to complement automated tracking tools, where uncertainty about the quality of the information provided by the traces remains high, along with the fact that user behavior is hardly controllable and only partially captured through traces. Herein lies a significant conflict, i.e. between the founder's myself-variables and what users think about his user model. Thus, software updates are required as a trial-error dynamic, in order to retain users or capture new ones.

Finally, due to the incompleteness of automated traces and the difficulty of adequately adapting software to each user, direct user feedback emerged as a useful resource for updating the implicit user model. When reporting-bugs and improvements, this activity "engages users and developers in active and participative communication", as CSCW researchers have observed in other collaborative spaces (Breu et al., 2010). One founder (I6) said: "*[Friends and customers were] telling us how they would like to find somebody. It started with age range, yeah, we would allow people to search by age range, so ridiculous thinking of it now; some people say, 'oh no I don't want 20 to 30, I want 20 to 24, or 30 to 32', or something like that, so we would basically end up making it more flexible, and you could save your own search, some sort of like looking for real estate where you could create a search and save it, well we did it for people.*" Big companies have dedicated customer service teams to filter users asking for modifications that are to be handled by the development team. Generally, the presence of dating apps in social media provides another form of contact. For companies, trade-offs need to be made between the user's requests and what can be implemented within a budget, and the overall impact on system designed. As one developer (I2) pointed out, *"you cannot make everybody happy"*. There is a continuous struggle between offering a personalized versus a one-size-fits-all service, and it is the latter that contributes to having more users in the pool and enough profit from trading personal data to respond, in particular, to Apple and Google app stores' conditions claiming a 30% share of mobile app transactions. This is a statement made in the dating industry by the Match Group: *"The success of our products will depend, in*

[61]Manifesto for Agile Software Development (2001). Retrieved from: https://agilemanifesto.org/

part, on our ability to access, collect, and use personal data about our users and subscribers [...] As the distribution of our dating products through app stores increases, in order to maintain our profit margins, we may need to offset increasing app store fees by decreasing traditional marketing expenditures, increasing user volume or monetization per user".[62]

The increase of user adoption is necessary for business growth and the process of variable definition is lost in the app production chain. While variables gain attention during the initial stages of dating app creation, mainly for business positioning reasons, they are transformed throughout the whole process of developing and releasing a dating app with different components (design affordances, user profiles, matching systems, SDKs, trace analytics, feedback), wherein developers play a major role. These actors mediate between technical and business user components (profile forms with variables that enable personal data collection), where similarities and differences can be re-examined.

In the following section, I begin by discussing the limits of user complexity coding for filtering and matching. Then I discuss the analysis of development practices in light of Gabriel Tarde's (1895) theory of imitation. This theory sheds lights on the impact of the conceptual choices and dynamics of the dating industry.

3.5.4. Discussion: Coding User Complexity for Filtering and Matching

Previous studies in user representation have described the tendency for some developers to become the user model (Oudshoorn, Rommes and Stienstra, 2004). Here I show how founder preferences and experiences are translated into, and explicitly expressed in, some variables of the dating app profile pages. Through their coding on the machine, as I showed in the previous analysis of developers' methods, these variables have the agency of transform social relations. They guide the user's attention towards what app's normativity considers attractive, in order to seduce and find a date. More generally, when designing technology, "user representations are often simplifications of the complexity of and differences among people in the real world" (Oudshoorn, Neven and Stienstra, 2016). These observations are also dealt with in my study: the actors' diversity and the richness of their personal traits and life trajectories are significantly diminished throughout the design and test tasks that the actors engage in. In addition, the mediation with the computer implies by default a reduction of the users' reality into the machine's language. User feedback aims at completing the available information. As previously explained, current software development conducted in the Agile framework, combined with the ongoing information gathering from users, promote continuous improvements. However, digital traces are far from being sufficient for capturing the diversity of individual behavior (Schermann, 2017), particularly when trying to grasp the complexities of couples underlined in sociological studies (Kellerhals, Widmer and Levy, 2004). As observed in this study, in an attempt to overcome this limitation, users provide direct feedback through other means (e.g., direct mail, social media, founders speaking to them), but their requests are not all implemented due to technical, financial or branding reasons. Consequently, users feel limited with respect to describing themselves and their preferences. This limitation defines the matching outputs, and users tend to ignore variables when assessing profiles (Fiore et al., 2008). This attitude is counterproductive to bonding (Zytko, Freeman, et al., 2015) and to algorithmic prediction, which leads researchers to capture other invisible traces (Akehurst et al., 2012). However, increasing the number of variables could engender cognitive overload and memory confusion due to being confronted with too many options (Tong, Hancock and Slatcher, 2016). These variables mediate between the

[62] See p. 14 of Match Group's financial report (2019). Retrieved from: https://s22.q4cdn.com/279430125/files/doc_financials/2019/ar/Match-Group-2019-Annual-Report.pdf

companies, and the users. The definition of these variables constitutes a fundamental step in the mathematical modeling of algorithms. The modeling implies an inherent reductive translation process of the users' representation. The reduction is linked to the material and logic operations of the machine that merits further research for understanding the simplification of dating in computer-mediated relations.

3.5.5. Discussion: The Imitation of Dating Technologies

The three mechanisms I identified in the dating market are mimetism, distinction and continuous adaptation. They merit a discussion in light of Gabriel Tarde's theory: "The Laws of Imitation" [1890] (1895). The theory provides a reflection on the idea of "inventions" in the dating industry, to designers and developers as they influence more broadly the development of technologies, and the formation of social relations that they mediate via GUI.

Following Tarde (1895), socialization is imitation. An actor imitates anything: an idea, a behavior, a gesture, a quality, whether it is symbolic in the case of traditions, or material in the case of techniques. With this concept of the social as imitation, Tarde's work (1895) remains relevant today, in the social sciences but also in the computing sciences, as it facilitates the study of online platforms (Boullier, 2017a, 2018a). It is also relevant to highlight that Tarde's theory was interested in media. Indeed, he was interested in the spread of ideas via the newspaper, an important medium at the time. The theory is adapted to my analysis of the way the ideas of dating apps founders are embedded into interfaces through specific variables. I showed this with the analysis of the variable landscape (Chapter II), and their replication across platforms which forms classes of dating (Chapter II).

Tarde (1895) postulates three forms of imitation: "imitation, counter-imitation, and non-imitation" (translated differently in the literature but I translate the terms literally, as they appear in the reference quoted). The non-imitation is to avoid influences and, consequently, remain at the margin of society, in the wild. The other two forms refer to the mechanisms I observed: mimetism and distinction. While mimetism is imitation, for Tarde (1895), distinction is a divergence from imitation as it necessarily refers to the model of imitation. For this reason, he calls this mechanism counter-imitation. Counter-imitation is to be situated in relation to others, never in isolation.

"There are two ways of imitating, in fact: to do exactly like one's model, or to do exactly the opposite [...] a society is a group of people who present among themselves many similarities produced by imitation or by counter-imitation. Because [humans] counter-imitate each other a great deal, especially when they have neither the modesty to imitate purely and simply, nor the strength to invent; and, by counter-imitating each other, that is, by doing or saying the exact opposite of what they see being done or said, as well as by doing or saying precisely what is being done or said around them, they go by assimilating more and more." (Tarde, 1895, p. 16)

Imitation and counter-imitation correspond to what I observed in the dating industry in three different analyses.

First, the dynamic of imitation and counter-imitation is revealed by the binary conventions of gender and sexual orientation that guides founders' and developers' practices in defining variables. On the one hand, heterosexual platforms imitate each other. In these platforms, men are offered a service via the erotization of the female body, coded in the machine and presented via the GUI. In contrast, some development practices seek to distinguish themselves from heterosexual apps by offering a service for the homosexual community, exclusively for men-seeking-men or women-seeking-women. These practices reinforce the intra-group similarities by counter-imitating those actors external to the group. Hence, according to Tarde (1895), counter-

imitation diminishes the possibility of invention in the sense of becoming original. It also reduces diversity by reinforcing homophily and the amplification, by the power of replications, of gendered social relations of domination as I showed in the study of the input values in Chapter II. The morphological body of heterosexual women is coded in the machine to attract men and it is replicated across platform via interfaces. As Gardey (2002) explains, the qualities assigned to techniques naturalize social gendered relations of domination. On dating apps, like with the typewriter keyboard, that serves as an interface between producers and end-users, it is "possible to transmit propositions of usages from a series of objects to others, establishing continuities of affinities between different technologies. In that sense, techniques play the role of "mediator" (in French, "passeur"). It means that an object despite itself, can transmit precise representations of scenes interpreted somewhere else, and that also the characteristics that are designed as techniques of techniques contribute to naturalize social relations." (Gardey, 2002, p. 256). On dating apps, the visceral body of humans is translated into discrete finite categories readable by the machine in a binary language. I put forward that this process of translation "assigns a sex" (Chabaud-Rychter and Gardey, 2002) to the machine that is coded in its physical memory and displayed on materialized GUI. The assignation of a sex has an impact on the perception and interactions of users when dating. Dating apps are defined as female users to capture male users for evaluating their attractiveness and adapting their actions accordingly. This definition is reinforced by the dynamics of imitation observed in development practices.

Second, platforms imitate each other by the type of dating experience they convey through affordances and variables. For instance, in the analysis of app classes I showed, the "communitarian sex-driven" class (containing five Anglophone and Francophone apps) is characterized by the granularity required for describing sexuality and physicality, and it contains all apps exclusive to male users, as well as CasualLounge for heterosexual ones, conveying mainly sexual encounters (see Chapter II). In addition, in the study of affordances, I showed 80/84 affordances are common to at least two platforms. There were only four affordances that appeared in only one app, which illustrates this mechanism of imitation that guides the design of user's perception and interactions for finding a date. Among those unique affordances, I highlighted a particular case of one app. The dating app Hinge presents the unique affordance of "feedback we met" (for requesting the user to give feedback in the platform after a face-to-face meeting), which indicates the lengths to which dating apps go. That affordance, seemingly powerless, has agency to stand alone with its materiality and semantics for transforming social relations. The affordance is patented by the Match group, which affirms its agency. "Objects, signs and circulating entities have an agency of their own and cannot be flattened under the powerful agencies of structures (societies as a whole) nor of individual preferences (opinions and decision of rational agents)" (Boullier, 2017a).

Finally, in the variable landscape analysis, I showed there are 14 apps that contain at least one unique variable, which fosters similarities by counter-imitation. The uniqueness is based on two practices: increasing the number of variables, and the granularity of the semantic expressions used. Yet, the similarities remain despite the language of platforms that are accessible worldwide. In the analysis of app differences, I presented three classes of dating apps (see Chapter II). For instance, class 1 contains four apps (Aff, MeeticAffiny, Hinge, and Parship) with extensive psychological questionnaires, and more variables in the form of taking a personality or compatibility test. In particular, there are questions about individual capital (e.g., "Describe the most important things in your life" on Aff).

To analyze these variables replicated in the dating industry is to interrogate the definition of an invention more broadly. While "inventions are discoveries, imitations are social repetitions that enable inventions to spread" (1895). However, following Tarde (1895) there are two mechanisms of creating inventions that have a different impact. Dating apps are inventions in the first mechanism of "logical duals". This first mechanism is to Tarde (1895) the substitution of one invention by the other. For instance, in the history of dating medi-

ation we see the substitution of the personal ads to find a partner in newspapers by modern websites designed as a list-view, which imitates the design of a directory based on pictures, as I showed in the analysis of affordances. The outcomes of inventions as logical duals are "natural propagation, violent substitution or irruptions". The second mechanism of inventions are to Tarde (1895) "logical unions" where, together, the inventions strengthen each other and can produce a real social progress in contrast to logical duals. This is possible through imitation and counter-imitation to a certain degree: an invention requires enough combination of properties for actors to build originality. This is not the case in online dating where the similarities and differences across platforms standardize and stabilize the position of dominating groups.

Imitation is particularly critical to online dating. As I showed throughout the comparative analysis of platforms and development practices, entities replicate and spread the ideas of the dominating groups in the industry (e.g., the Match group) across the market whereas small companies imitate or counter-imitate them to create niche-dating apps. To Tarde (1895), inventions are driven by beliefs, and imitations by desires. Along with these beliefs and desires come the pitfalls of imitation. For instance, an "up-down mechanism" where "superior" entities have more chance to influence than "inferior" ones (Tarde, 1895). "*The so varied social relations [...] can be reduced to two groups: the ones tend to transmit from one [person] to another, by persuasion or by authority, willingly or by force, a belief; the others, a desire. In other words, the ones are varieties or velleity [(in French, "velléités")] of teaching, the others are varieties or velleity of command. And it is precisely because the imitated human acts have this dogmatic or imperious character that the imitation is a social link; because what binds the human, it is the dogma or the power*".[63] (Tarde, 1895, p. 15). These mechanisms are materialized in online dating, where beliefs and desires are in tension, as I showed with the methods for building a software program, e.g., persuasion. A founder or a developer can easily be convinced, and convince others, to adopt a technology by believing in the brand of the dominating groups (Apple or Google), which finally leads to imitation by desire: the desire of being like other dating apps that are profitable. These mechanisms guide the construction of a dating experience as the development of a technology, which is fundamentally distinct from building dating as an expertise in relationships. In fact, dating apps increasingly disregard their responsibilities on dating and couple formation, instead taking a position as technologies for "social discovery". This position is illustrated by the press communication of the Match group's last financial report in 2020: *"As more of life moves online, we believe it creates opportunities to apply our expertise in making meaningful connections for dating to the growing space of online social discovery*".[64] Consequently, business now becomes more dependent on data collected online, instead of traditional marketing strategies. As I showed, the dependency on the online advertisement economy confirms the relevance of studying variables of imitation. In this chapter, I showed that believing in technology is detrimental to offering a user experience grounded in matchmaking, or *a minima* in finding a date, rather than in metrics of user engagement and user adoption. In the compartmentalizing method, I illustrate this problem with the interaction of a developer and a product owner seeking to interpret and make sense of traces, like a vote on a profile, to "change user behavior" in order to increase revenues.

The mechanisms of imitation (of beliefs and desires), as observed in the dating industry, are embedded in material entities that decrease the creativity of actors to build inventions of social progress. To Citton (2010),

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[63] "*Ces rapports sociaux si variés (parler et écouter, prier et être prié, commander et obéir, produire et consommer, etc.) se ramènent à deux groupes : les uns tendent à transmettre d'un homme à un autre, par persuasion ou par autorité, de gré ou de force, une croyance ; les autres, un désir. Autrement dit, les uns sont des variétés ou des velléités d'enseignement, les autres sont des variétés ou des velléités de commandement. Et c'est précisément parce que les actes humains imités ont ce caractère dogmatique ou impérieux que l'imitation est un lien social ; car ce qui lie les hommes, c'est le dogme ou le pouvoir.*" (Tarde, 1895, p. 15)

[64] Match Group's financial report (2020). Retrieved from: https://s22.q4cdn.com/279430125/files/doc_financials/2020/q4/Earnings-Letter-Q4-2020-vF.pdf

imitation can be a mechanism of learning in new mediated situations with technologies. However, for Citton (2017), learning by imitation requires "joint attention" that is observing, imitating and doing together. That means going beyond the competition and accelerated rhythm of technology production, that capitalizes on attention, to capture users in the platform. Consequently, human attention is mainly captured on the machine and not with others for learning. This type of imitation divides and standardizes, resulting in a self-referential process of reputation. The mechanisms of imitation and counter-imitation in the dating industry are reinforced by development practices guided by the Agile methodology as I showed. All the founders and developers in my corpus adopt this methodology. Although the original agile manifesto considers close co-operative work, the initial values are lost in daily practices ruled by business interests. In addition, the learning process between humans and machines becomes difficult because of the modularity offered by a program's architecture. Although it provides efficiency for coding tasks, it also requires more time later for making sense of the results obtained or the dysfunctions encountered. For instance, as I showed in the compartmentalizing method, building a program makes it possible to import libraries that are third-party implementations external to the dating company. The implementation later requires important analytical work from the developer's side to understand the on-going process. Indeed, the developer (I9) described some of his tasks as trying to understand what was happening in the data pipeline architecture of the company that consists of different components distributed within the company in different departments, and outside. The continuous adaptation of technologies to the market is therefore driven by trial and error, as shown by the constant practices of platform versioning and A/B testing. More broadly, the Agile methodology and the modularity offer a short-term efficiency where development practices are mainly driven by "rough consensus and running code";[65] that is developing based on individual technical choices, usually those of a dominating leader. This leads developers to "share mistakes" and repair them *a posteriori* in dedicated situations of collaboration. The consequence of these dynamics is therefore a limited opportunity for developers to build expertise in relationships initiated online. This is because developers have to invest more time and reasoning in building and repairing the technology. While the literature pays particular attention to the effects of algorithms in online dating, less attention has been paid to the agency of developers, who are important mediators in the replications of dominating technical views in online dating.

3.6. Conclusion

This chapter presented a view of online dating experiences in development based on an interview study. It has elucidated the methods used to translate a definition of dating into a computable user experience. In addition, the analysis of development practices, linked to the definition of variables, explained in part the quantitative observations made in the analysis of GUIs in Chapter II.

In the first section of results of this chapter, I presented four methods used by developers to build a software program. These four methods are guided by the machine's behavior and the algorithmic-type thinking that it requires. However, developers' methods for making sense of online dating as a development practice require more than a set of rules in the form of an algorithm. The methods used are deconstructing, persuasion, explicitness and compartmentalizing. When building a program, developers make use of both logic and in-

[65] "Phrase [that] encapsulates the prevailing technical and organizational values of those who were involved in the Internet standards process from the mid-1970s to the present: "We reject: kings, presidents, and voting. We believe in: rough consensus and running code." This phrase-which became a motto for Internet standardization-articulated a common set of beliefs about the work culture and engineering style of Internet standardization." (Russell, 2006)

tuitive reasoning for interacting with humans and the machine. Building a program for online dating involves different actions: defining, explaining, understanding, interpreting, convincing, and discussing. Actors constantly review their actions, which shows they do not follow an ideal plan with clear inputs and outputs. The analysis of development practices contributes more broadly to the way human experts in computing-related practices learn to communicate.

The literature is divided in two. On the one hand, there is a focus on the way developers "think as computable algorithms", in contrast to non-expert humans. On the other, there is a focus on the way machines "think in mathematical terms", in contrast to humans' capacity to learn. However, through the four development methods that I analyzed, I posit that one cannot separate human and machine actions, as their behaviors are entangled. Therefore, they learn together. To a certain extent, both logic and intuition enable developers to learn to communicate with the machine and with other humans, *like* the machine. Yet, this adaptation to the machine's language is what enables developers to translate the ambiguity of human behavior into a dating experience that is computable. This is what I define as human-machine learning that implies a back-and-forth movement of translation and interpretation *with* the machine and other humans. Otherwise, as simple as the machine is, it is not possible for the machine to understand humans in order to deliver a product that that creates a user experience. Developers translate the idea of dating, as formulated by companies and product owners, into finite and decidable criteria for the machine to understand. Then, the machine provides outputs about user behavior. These outputs require humans to interpret and make sense to find an explanation about the users' realities. However, this human-machine learning does not mean that developers are reduced to "think in algorithms" or to be fully logical and rational. The method of persuasion illustrates the way personal beliefs drive technical choices that can transform the meaning of dating. The analysis interrogates the way artificial intelligence (AI) is conceived today. While the main drive of AI is to copy human intelligence, I show that humans are learning to mirror the machine. In this way, together they are building a new type of intelligence that ought to be defined in future research.

In the second section of results of this chapter, I studied the economic and sociotechnical factors that influence the dating industry. These factors influence user representations in profile forms. The definition of variables is shaped by the practices of founders and developers when creating and releasing a dating app. I identified three general mechanisms that partially explain the similarities and differences that persist across platforms, as I showed in the analysis of phenotype landscape and app classes in Chapter II. The results contribute to the deconstruction of mechanisms of imitation through variables and development practices that build online dating as a generic software program. The results show developers' lack of expertise in matchmaking, because they are focused on developing a technology that works and retains users in the app. I shed light on the way developers influence user representation and the overall dating experience by paying attention to the process of defining variables that replicate dominating and normative views on dating. The technical expertise is driven by a mechanism of imitation that favors the standardization of the concept of dating, and therefore reduces diversity and originality in any attempts to create new definitions of dating that are closer to reality. However, when translating a definition of dating into a machine, it cannot be avoided a reduction process of the reality. The reduction is inherent to the machine's language.

In the next chapter, I will study the matching algorithmic system of the dating app Tinder to understand how they are built and how they work. This study is an additional standpoint of the online dating phenomenon that I analyze from the insights on the app itself.

CHAPTER IV. BUILDING AN EXPERTISE IN DATING: ALGORITHMIC MATCHING VS HUMAN MATCHMAKING

4.1. Introduction

In Chapter III, I showed how developers build users' dating experiences, based on an interview study with nine founders and developers of ten different dating apps. More specifically, I showed first, that there are four methods (deconstructing, persuasion, explicitness, and compartmentalizing) that developers use to make sense of online dating as the systematic development of a software program. These methods enable developers to understand and adopt the behavior and language of machines; a process I called human-machine learning. Secondly, by analyzing the practice of variable definition, I showed that economic and sociotechnical factors guide the development of an app and its release in the mobile stores regulated by Google and Apple. These factors standardize and reduce the way users are represented in the dating apps through specific variables. Three mechanisms guide the definition of variables (imitation, distinction, and adaptation) and influence the creation of innovations in the dating industry more broadly. Through the discussion of the mechanisms in light of Gabriel Tarde's theory of imitation (1895), I showed that the dynamics of innovation in the dating industry are driven by the dominating apps in the market, and that these dynamics encourage imitation or counter-imitation, meaning that limited variables and techniques are developed. Consequently, the creation of new apps reinforces the position of the dominating apps and limits the disruptive potential of founders to create original inventions. Hence, the innovative desires of newcomer apps are in fact driven by imitation, provoking the replications across platforms that are observed in the GUI analysis in Chapter II.

Chapter III provided a view of the app development practices that partly guide the definition of affordances, variables and input values analyzed in Chapter II. Development practices also provide an understanding into the way a dating app is developed under the guidance of the more generic engineering principles of developing a software program. It is important to recall that computers work thanks to the development of a program or a combination of programs, which are a set of instructions to perform tasks. In other words, the instructions tell the computer what to do. The GUI mediates between developers, the machine, and the users. It allows the tasks that are programmed in the computer to be delivered to end-users. A software program is a translation of the algorithms combined with command instructions, allowing them to be executed by the machine. Indeed, algorithms are "the mechanizable organization of elementary operations to perform a task that have to lead always to the good solution". These "operations or instructions are a finite and unambiguous sequence transformed in calculations of actions (decision-answer)" via a computer (Houdé, 2019b, p. 47). In that sense, when we remove the command instructions for communicating with the machine, algorithms as the mathematical modeling are the core functionality of the service provided to users in the app. When a dating app recommends profiles to users by means of a GUI, the algorithm running is the underlying mechanism of the recommendation that the user receives.

In the present chapter, I[66] study the matching algorithmic system of the dating app Tinder, based on a qualitative analysis of technical documentation, to understand how the system is conceived and how it works. The chapter provides a view of the app from the inside, which is invisible to users from the GUI. In the first section of results, I focus on an analysis of Tinder's patent, filed in 2014, to analyze the mathematical procedures of the app's matching system. Tinder defines the way profiles are ranked and recommended based on constructed variables and a principle of asymmetry according to sex. In addition, I analyze a machine learning conference given by Tinder's Chief Scientist in 2017 that presents the adoption of neural networks for representing user preferences. I show that Tinder defines a "socio-computable distance" for matching users, which transforms the probability of finding a date. Finally, in the second section of results, I present the analysis of matchmaking expertise in a Swiss matrimonial agency based on an ethnographic study. The results are discussed in contrast to the service provided in dating apps. This chapter provides an understanding of Tinder's matching algorithmic system, which focuses actors' expertise on learning the machine's outputs to decrypt online user behavior. Secondly, the chapter focuses on the way in which the matchmakers' work fosters a common definition of dating that is negotiated through a process of continuous learning with members of the agency. The analysis provides a link to the actor analyzed in the next chapter: the user. The analysis of a matching algorithmic system is a complementary view to the user's perception and interactions with the GUI. The analysis of user practices is a view on the social dating phenomenon from the outside of the app, but in operation with the matching algorithmic system, that has an influence outside of the app, in the offline environment of actors. Some of the material presented in this chapter was originally published as a book chapter, the corresponding reference is (Pidoux, 2019).

4.2. Study of Matching Algorithms and Matchmaking

Based on a qualitative study I formulated the following two research questions in this chapter:

(RQ6): How do machine-learning algorithms on Tinder make sense of dating by computing a match?

(RQ7): In contrast to a "computable matching", how do matchmakers in a matrimonial agency make sense of "human matchmaking"?

First, to address RQ6, I identified two technical documents, a patent and a presentation given in a machine learning conference, as relevant sources for analyzing the mathematical procedures that define Tinder as a recommendation system based on matching algorithms.

The first part of results, the analysis of Tinder's patent, show three quantification practices: variable weighting, variable construction, and ordering profiles. The first quantification practice shows the importance given to specific variables (age difference, sex and education level) for modeling heterosexual users, which favors an asymmetrical matching based on a patriarchal model. The second quantification practice shows five constructed variables that measure qualities between users, which enables an approximate comparison and then a ranking recommendation based on similarity. The constructed variables are gender-role traditionalism, intelligence quotient (IQ), readability, nervousness, and physical attractiveness. Together they foster the recommendation of similarly "attractive" users. The third quantification practice is the use of ordering algorithms that determine the position of a user in a hierarchical order in the recommendation

[66] Part of the material in this section is the result of a collective work with Kyle Matoba.

system's results. The order of profiles on Tinder is based on the scores computed. Based on those quantification practices, I argue that Tinder defines a "socio-computable distance" for matching that is heteronormative, reductive and competitive. Indeed, users inherit numeric values according to their phenotype variables (e.g., age, sex) that fluctuate depending on how their values compare to the values of their peers, as well as on how frequently they appear in the results list of other users. The results contribute more broadly to questioning the definition of online platforms as "social spaces" (Auray, 2016) or in contrast, as private spaces detached from social spheres (Bergström, 2019). Tinder redefines the dating experience in a mathematical way that prescribes users' attractiveness and the probability of being matched with another similar user in alignment with the reputation economy. It favors homogamy beyond traditional sociodemographic data accounted in sociological studies.

In addition, the results of the analysis of the machine learning conference show the evolution of Tinder's system through the adoption of neural networks. The way the technique is implemented by Tinder is called "TinVec". I show that the technique is based on two quantification practices that do not necessarily discard the other practices analyzed in the patent. Indeed, the former practices are well-known conventions in statistics, also used in machine learning. The two additional quantification practices are reduced variable selection and averaging. The former serves modeling user preferences strictly based on their right-swiping behavior on other profiles (i.e., right swipes are the number of likes given to other users). Averaging is using the mean to compute predictions. It builds a prototypical model of preferences to recommend a new profile in the app based on the average obtained from the sum of the previous right-swipes given to other profiles. In light of these results, I argue that these techniques and the way they are conceived, limit dating apps' capacity to build expertise in dating. This difficulty is compounded by the fact that humans have trouble interpreting the outputs of neural networks (or because they do not decide to look for technical interpretation solutions), and by the fact that user preferences are conditioned by the design of the GUI, and reduced to their analysis in an aggregated way (averaging right swipes). Hence, the comprehension of users' preferences is not a primary issue.

Secondly, to address RQ7, I identified methods that are relevant to matchmakers for building expertise throughout their daily practices. Through these methods, they make sense of matchmaking as an expertise that implies quantification practices, but in particular, relational interactions in direct and permanent contact with the members of the agency. The results present seven methods of matchmaking: (i) profiling, (ii) value estimation, (iii) normalization, (iv) data collection, (v) elicitation and omission, (vi) time and quantity management, and (vii) ambiguity tolerance regulation. These methods were analyzed in three different temporal stages of matchmaking: presenting an attractive profile to join the agency, selecting a match for introducing the potential couple, and obtaining feedback from both persons after their face-to-face meeting. The last stage of the process, discussing directly with the members about the encounter, is particularly crucial for matchmakers to learn to review the persons' preferences, as well as the matchmakers' preferences that led them to create a match in the first place. The dating apps do not consider today direct and personal feedback. In the last section of results, I present ten differences identified between the matchmaking expertise in the agency, and the dating apps. The differences are mainly focused on the business model, on the management of timing and quantity of dates, the personalization and normalization of preferences, and the capacity for tolerating ambiguity.

In the following sections, I present a state of the art that traces key quantification practices in the history of mediated services for finding a partner that lead to the actual scenario of computational dating based on matching algorithms. In addition, I present a second state of the art about matchmakers, who have played a major role as intermediaries of couple formation throughout history. It is important to underline that, to the best of my knowledge, few studies have been conducted into matchmakers' work. Similarly, there are few studies into developers' work in online dating. Dating expertise remains marginal and obtaining access to

this field of study for conducting investigations is rare. Then, I present the two methods used in this study: a qualitative analysis of technical documentation for Tinder's case study, and an ethnographic study conducted in a Swiss matrimonial agency. The results highlight the contrast between the matchmakers' expertise and the dating apps' technological expertise. Finally, the results are presented in two distinct sections. In the first section, I present the five methods resulting from Tinder's technical documentation analysis. In this section, I discuss the definition of a socio-computable distance by Tinder. In the second part of the results, I present the seven methods that matchmakers use to build expertise, in comparison to dating apps. In this section, I discuss the ten differences between matchmakers and dating apps. This discussion lays the groundwork for further research into the possibility of building a matchmaking expertise for dating apps. A conclusion summarizes the main results of this chapter.

4.2.1. State of the Art: A Short History of Dating Quantification Practices. From Choosing a Partner to Matching

Dating apps are part of a long-lasting tradition[67] of media created to find a partner. They can be seen as a continuation of personal press advertisements from the eighteenth century (Cocks, 2015 ; DeSingly, 1984), mail-order brides (Wang, 2010), and the Minitel in the 1980s and its messaging service labelled "pink"[68] (Boullier, 1989). These media have had an important influence on computer-mediated dating. They enabled the emergence of a "technical writing", as a practice linked to the device functionalities for creating a new identity based on "individual expression" beyond the social actors' traditional affiliations offline (Boullier, 1989) thanks to GUIs. Previous studies in online dating contribute to the understanding of two user practices when dating, that are related to the textual and graphical dynamics offered by the medium: *self-presentation* and *choosing a partner*. Some of the studies focus on the level of the individual and seek to understand the way a person presents attractiveness and evaluates somebody else through declarative variables and a photograph (Birnholtz et al., 2014 ; Fiore et al., 2008 ; Gibbs, Ellison and Heino, 2006). Other studies focus on the user dynamics of contacting and discussing with others before choosing a partner based on sociodemographic variables (Bergström, 2017 ; Fiore et al., 2010 ; Lin and Lundquist, 2013 ; Skopek, Schulz and Blossfeld, 2011). The quantification practices involved have received less attention (Hicks, 2016); these practices shed light on the techniques that lead to the actual computational scenario of dating.

According to a genealogy of marriage courting traditions, and dating service techniques (Bergström, 2019), actors find themselves in a challenging position between letting love emerge as idealized in the romantic tradition, and producing the conditions for finding a partner via intermediaries where probability is at the core of this production process. "In romantic narratives, chance and probability are therefore not contradictory. Since the random and spontaneous nature of the encounter is a key element in the representation of love, the actors evoke it in their own love stories. Presenting it as the work of chance is a way of signifying the union as a love relationship and making the experience intelligible as such." (Bergström, 2019, p. 32). The genealogy presented by Bergström (2019) shows the delegation and the production of new tasks for

[67] Given the lack of studies about the history of intermediaries for finding a partner in Switzerland, and more particularly about online dating in Switzerland, the history that is referred to here is based on different studies compiled that have documented the phenomenon in United States, England, France, Poland, China, India, Egypt. Without the pretention to generalize, the main goal is to point at some technical transformations that facilitated a major movement of the professionalization of dating as a computational practice. Further situated studies in Switzerland are necessary to better understand the transformations linked to the particularities of the Swiss population in every canton.

[68] In French "*messagerie rose*". The colour refers to the type of content (romantic and sexual) produced within the service.

finding a partner, traditionally done by families and actors themselves, to new computer-mediated techniques that assist actors within an economic market. Nevertheless, the genealogy ignores dating app algorithms that are anchored in the mathematical notion of probability. The short history I present here sheds light on the quantification practices involved in dating as translated into computational practices of modern online platforms. It shows that the construction of the notion of probability conveys a pragmatic reasoning to quantify affectivity that is both mathematical and materialized via specific tools and formats. Moreover, this history facilitates a comparison with the history of matchmaking developed in matrimonial agencies in the second part of this section, which is based on distinct practices.

Economic theorists have studied *tools* for the spousal choice, in contrast to sociologists who have focused on social *spaces*. One can position dating apps in another historical continuity, that of a moral rationality that is materialized through accounting objects following Max Weber's reflections on capitalism and religion. Harro Maas (2016, p. 34) traces household practices of moral accounting back to the Victorian period. To manage emotions, actors used structured and portable means like almanacs to weigh facts and organize them according to time. The most renowned case is Benjamin Franklin's *Moral Algebra* (Figure 13). Franklin suggested applying this method to his nephew's choice for a wife in 1779. It consisted in creating a balance list on paper, divided into two columns (pros and cons), with motives and weights attributed. The method formalizes the process of teaching people how to find a partner. "By the way, if you do not learn it, I apprehend you will never be married", advised the uncle. Thereafter, Charles Darwin adapted the method in 1838 (Figure 14), when deciding whether or not to marry his cousin Emma Wedgewood. Darwin used the columns "marry" and "not marry", without including weights (Maas, 2016). The objectification of affection is not something that emerged specifically with online dating.

April 8, 1779

If you doubt, set down all the Reasons, pro and con, in opposite Colimns on a Sheet of Paper, and when you have considered them two or three Days, perform an Operation similar to that in some questions of Algebra; observe what Reasons or Motives in each Column are equal in weight, one to one, one to two, two to three, or the like, and when you have struck out from both Sides all the Equalities, you [...] This kind of Moral Algebra I have often practiced in important and dubious Concerns, and tho' it cannot be mathematically exact, I have found it extremely useful. By the way, if you do not learn it, I apprehend you will never be married.
I am ever your affectionate Uncle,
B. Franklin

FORM OF THE PAGE
TEMPERANCE
Eat not to dulness: drink not to elevation

	Sun.	M.	T.	W.	Th.	F.	S.
Tem.							
Sil.	*	*		*		*	
Ord.	*	*	*		*	*	*
Res.		*				*	
Fru.		*				*	
Ind.			*				
Sinc.							
Jus.							
Mod.							
Clea.							
Tran.							
Chas.							
Hum.							

FIGURE 13 – BENJAMIN FRANKLIN'S LETTER TO HIS NEPHEW (GIGERENZER AND STURM, 2012) (LEFT) AND THE "LITTLE BOOK" HE CREATED TO ACCOUNT VIRTUES (RIGHT). [69]

[69] A table with 7 columns for the 7 days of the week and 13 rows for the 13 virtues. The Autobiography of Benjamin Franklin edited by Charles Eliot presented by Project Gutenberg (2016). Copy and re-use of this material is allowed under the terms of the Project Gutenberg License. Retrieved from: https://www.gutenberg.org/files/148/148-h/148-h.htm.

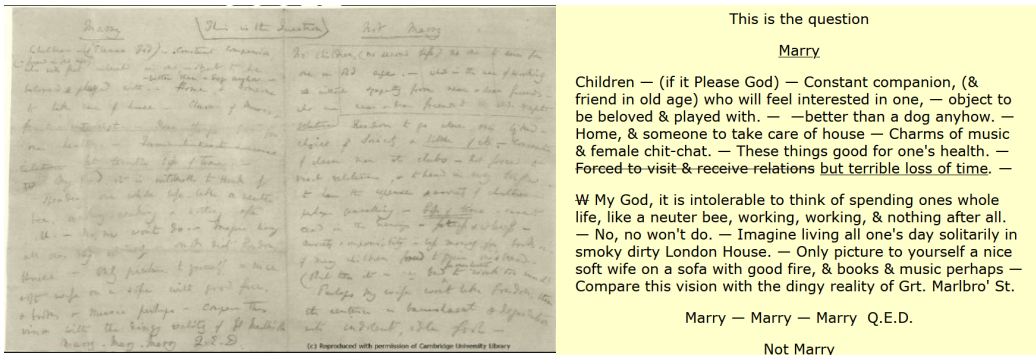


FIGURE 14 – DARWIN'S WRITINGS (LEFT) AND DIGITAL TRANSCRIPTION (RIGHT).[70]

This is part of a shift in history from mental to written calculation traced back to the Victorian England (Gardey, 2008). While mental calculation was a proof of human mental rapidity and virtue, written calculation enabled others to verify an accurate account of the mental calculation through cognitive devices (paper, tables, objects). Hence, through written calculation actors gave access to the accuracy of the account (the result), as well as to the steps of their arithmetic reasoning, to the first options chosen, and the intermediary arithmetic operations. The calculation then became a socialized practice in a different way. Its written inscription enabled the recognition and the verification of the calculation by others, as well as its circulation and reuse in communities (Gardey, 2008).

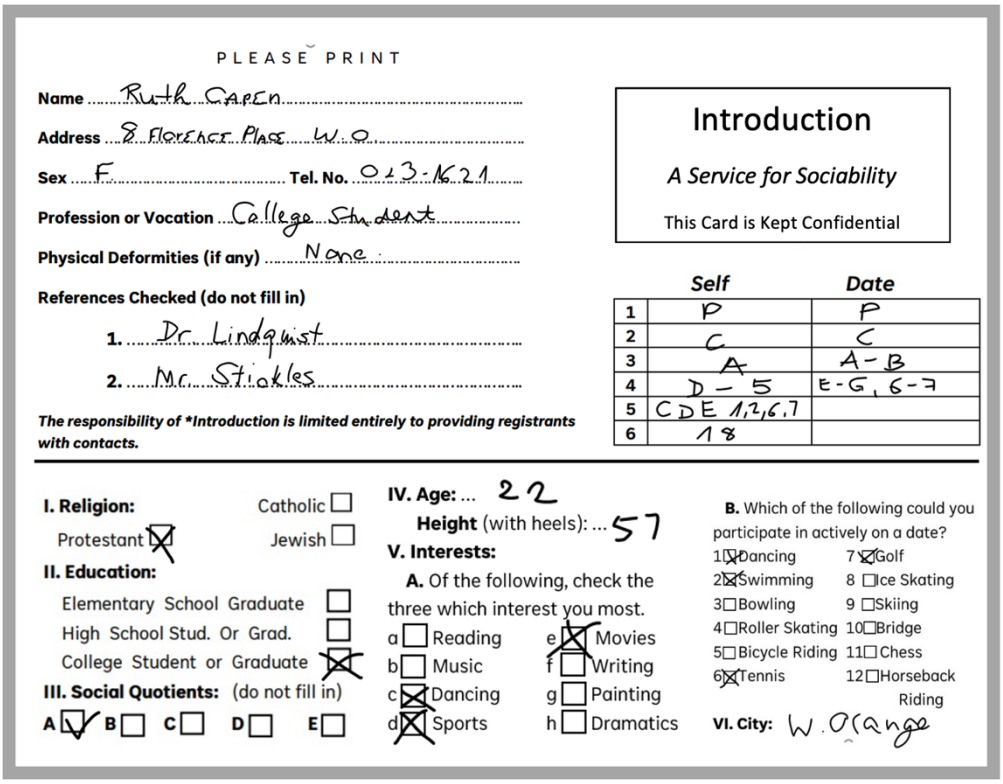
Gigerenzer and Sturm (2012) explain that Franklin's method was widespread for personal use, and it introduced elements for quantifying uncertainty. His method influenced rationality theory and what is known as *probability* during the Enlightenment period, between the seventeenth and eighteenth centuries. Modern theories, derived from interpretations of Franklin's moral algebra, put forward the idea that complex problems require complex algorithms by using all the available information to master doubts. The mastering of uncertainty requires using existing evidence to make predictions in order to reduce said uncertainty. In other words, one can see how these tools translated emotions into probability calculations for guidance and control of the self through weighted facts, acknowledging at the same time that there will always be a certain level of uncertainty and unknown.

From household individual usage, the calculations for evaluating a potential partner became systematic and increasingly automated, and were scaled up within private commercial structures through different techniques. As part of the industrialization period in nineteenth-century France (see the nomogram of Philbert Maurice d'Ocagne), new techniques to make the calculations mechanical were introduced. However, the human was still the main actor to produce an exact account, and the machine served to control or to verify the account in specific situations. The main motivation of the machine was then to print and to reproduce results, as well as to automate *data processing* at scale (Gardey, 2008).

Matchmakers, along with scholars in computer science (Hicks, 2016), were among the first to use paper machine-readable questionnaires for semi-automated processing in the domain of couple formation. In this way, they contributed to structure their know-how in the domain of couple formation through tables for data processing. "Table, as a graphical reduction enabled structuring and ordering knowledge" (Goody,

[70] Darwin Online, right to reproduce the image given by John van Wyhe (May 2021). Retrieved from: http://darwin-online.org.uk/content/frameset?pageseq=1&itemID=CUL-DAR210.8.2&viewtype=image.

1979). Since the eighteenth century, matchmakers in European societies have changed the framework, format, and content of the process of meeting a partner via intermediaries (Cocks, 2015). This change was accelerated in the twentieth century by the popularization of matrimonial agencies in Great Britain, France, and the United States (Ahuvia and Adelman, 1992 ; Cocks, 2013 ; Gaillard, 2017). These agencies gained experience with well-equipped procedures such as press ads, specialized magazines, e-mail, computer databases, telephone lines and, later, with the internet. In 1942, an agency founded by sociologists in the United States defined a measure called the "social quotient" (Figure 15). It illustrates the introduction of measures in the domain of relationships that are made explicit to the service's end-user via paper forms and numeric values to weight personal qualities. These quantification tools for choosing a partner evolved with the invention of computers and the internet. They allowed for the comparison of personal qualities of a larger number of persons and in a faster way. In Chapter III, a founder described this transformation of the dating service he was providing. Initially, the founder was distributing and collecting data in different locations through paper forms in order to match clients manually later. The matching results were then sent by mailbox. With the arrival of computers and software programs for handling databases, he was able to collect data directly from his dating website and automate the data processing. This shift to computers requires algorithms: the core functionality of a system.


PLEASE PRINT

Name Ruth Caren

Address 8 Florence Place W.O.

Sex F Tel. No. 013-K21

Profession or Vocation College Student

Physical Deformities (if any) None

References Checked (do not fill in)

1. Dr Lindquist

2. Mr. Stickles

The responsibility of *Introduction is limited entirely to providing registrants with contacts.

Introduction

A Service for Sociability

This Card is Kept Confidential

	Self	Date
1	P	P
2	C	C
3	A	A-B
4	D-5	E-G, 6-7
5	CDE 1,2,6,7	
6	18	

I. Religion: Catholic ☐ Protestant ☒ Jewish ☐

II. Education:

Elementary School Graduate ☐

High School Stud. Or Grad. ☐

College Student or Graduate ☒

III. Social Quotients: (do not fill in)

A ☑ B ☐ C ☐ D ☐ E ☐

IV. Age: ... 22

Height (with heels): ... 57

V. Interests:

A. Of the following, check the three which interest you most.

a ☐ Reading e ☒ Movies

b ☐ Music f ☐ Writing

c ☒ Dancing g ☐ Painting

d ☒ Sports h ☐ Dramatics

B. Which of the following could you participate in actively on a date?

1 ☒ Dancing 7 ☒ Golf

2 ☒ Swimming 8 ☐ Ice Skating

3 ☐ Bowling 9 ☐ Skiing

4 ☐ Roller Skating 10 ☐ Bridge

5 ☐ Bicycle Riding 11 ☐ Chess

6 ☒ Tennis 12 ☐ Horseback Riding

VI. City: W. Orange

FIGURE 15 – LIFE MAGAZINE. QUESTIONNAIRE TO CALCULATE A SOCIAL QUOTIENT IN THE AGENCY "INTRODUCTION, A SERVICE FOR SOCIABILITY".[71]

[71] "Introduction, a service for sociability" (1942), image recreated from the original one for the purpose of research (see Federal Act on Copyright and Related Rights, Art. 24d[21] Use of works for the purposes of scientific research). Retrieved from: https://books.google.ch/books?id=gU4EAAAAMBAJ&pg=PA78&redir_esc=y#v=onepage&q&f=false.

Matching algorithms are developed in mathematics and computer sciences. The term matching here means to *assign* one element to another one, and then to *recommend* these elements to each other. Matching algorithms were not developed for the formation of couples, although the name would suggest it. One of the first well-known algorithms in the literature is the Gale-Shapley algorithm (1962), similar to a lesser known algorithm called "the assignment problem" from Kuhn (1955) and Mukres (1957) (Kao, 2008, p. 68). The Gale-Shapley algorithm seeks to find a solution to the "Stable Marriage problem" and the "College admission problem", also called "Hospitals/Residents (HR) problem". Marriage is used as an illustration of the general attempt to solve an assignation problem. The Gale-Shapley algorithm solves the assignation of elements in a list to other elements in another list according to a list of preferences provided by each element. The lists have the same number of elements and the algorithm follows iterations until the optimal element is assigned to each element in the opposite list in a specific ordering. The stable marriage problem that this algorithm seeks to solve is based on a one-to-one matching (assigning a partner to every person in the list), while a matching of many-to-one option (assigning a student to one school among many schools) refers to the college admissions problem. This assignation principle is common to platforms we know today, e.g., centralized job search engines that connect employers with job-seekers directly; the professional network LinkedIn that matches users with others based on professional skills and with job vacancies posted on the website; the platform and cleaning company Batmaid that matches clients with cleaners; Airbnb; Uber, etc.

Different limitations were encountered with the aforementioned matching algorithms. For instance, formulating an "effective heuristics" algorithm when having arbitrary capacities in hospitals (Kao, 2008, p. 393), dealing with incomplete lists which means a person might not appear in the opposite list of preferences, favoring one gender over another. The one selected will be the one with the "dominant" preference list. Finally, the "implementation efficiency"; i.e., how much time and memory does it cost to compute algorithms (Kao, 2008). These are problems that we also know today. The neutrality of algorithms on modern platforms is a widely debated interdisciplinary issue in academia, but also in the media which raises users' awareness, as illustrated by the analysis of media controversies about Uber's algorithms (Cardon and Crépel, 2019). Although the logic behind dating platforms is still opaque, it is known that algorithms act as structural assumptions that shape users' behavior when searching for other users (Hutson et al., 2018). Searching is therefore a preliminary computing practice regulated by matching systems that conditions the choice of potential dates. However, there are efforts in computer sciences to improve algorithmic systems. After the initial algorithms of Gale and Shapley, one can find the "Optimal Stable Marriage" by Irving, Leather, and Gusfield (1987); "Stable Marriage and Discrete Convex Analysis" by Eguchi, Fujishige, Tamura and Fleiner (2000); "Ranked Matching" by Abraham, Irving, Kavitha, Mehlhorn (2005); and "Stable Marriage with Ties and Incomplete Lists", by Iwama, Miyazaki and Yamauchi (2007) (Kao, 2008).

Today, the increased power of the computer's hardware and the development of machine learning algorithms introduces new possibilities for quantifying relationships online, through the construction of "vector spaces" (Mackenzie, 2017) with many dimensions (variables) describing one element. That the element analyzed is a person or an object is irrelevant, as they become data points with variables positioned in the vector space that require human interpretation later. As Efron and Hastie (2016) show, in the computational era, algorithms run by computers are the preferred choice as a new methodology for handling new types of mass-produced data. They do the statistical work that is no longer manageable by conventional statistical methods, as they become exhausted when taking into account a big quantity of variables to produce a result at speed. Humans are not able to manage a high quantity of variables either. The algorithm is therefore the tool for operationalizing calculations with a computer (based on memory space and the succession of operations one after the other), but it is based on classical statistical inference theories. Pasquinelli (2019, p. 12) shows that: "machine learning is incredibly efficient *qua* algorithm for analyzing data and approximating a mathematical function that describes them. What machine learning calculates is not an exact pattern but the statistical distribution of a pattern". As Burrel (2016) highlighted, one form of opacity of platforms penetrating our

daily lives arises from the characteristics of the mathematical procedures underlying machine learning algorithms. These can have a peripheral or central role in the results produced by the platforms. Burrel's (2016) approach is relevant as the technical complexity of modern matching systems is frequently attributed to "the algorithm". As Dourish (2016) points out, not everything in information systems is algorithms *per se*: there is architecture, data flow, a communication network, a memory hierarchy, and materiality. In a delocalized way, algorithms are distributed across systems, which shows the dichotomy between the functionality of the program run, and the materiality of an application requiring systems to operate. Paradoxically, everything that requires a set of instructions to produce a result can be defined as an algorithm. In that sense, a software program is considered an algorithm because it is a set of instructions telling a computer what to do. As I showed in Chapter III, a software program is a finite number of successive operations to produce one output given a set of inputs. Indeed, algorithms are the language of the machine and without it nothing happens in the computer, in an application like Word, Facebook or in a dating app. In order to decenter ourselves from the simplifying *a priori* of an algorithm, we must account for all the elements that themselves contribute to "the constitution of what we call algorithms" (Jaton, 2017).

In Chapter III, I showed different components in the development practices for building a software program, e.g., a server, SDK, variables. These different components make it possible to run the core of an application: its matching system. However, I also showed that developers were more focused on the development of a technology and not on building expertise in dating and relationships. Therefore, in this chapter I focus on the analysis of a matching system to understand the core of the service that is provided to users. Indeed, according to the mathematical procedures used, the platforms can evaluate users and present them to other users via GUIs. The definition of mathematical procedures influences the range of options users can choose from, to form intimate relationships without users being necessarily aware of how these results came to be.

To show how the probability of dating someone is calculated, I conduct a case study based on the app Tinder in order to analyze, from technical documentation, the mathematical procedures underlying the system. Tinder is an application that illustrates the shift of modern quantification practices for dating and, more broadly, of other types of application that use machine learning. Tinder is the most commonly used dating app worldwide, and is the dating industry's flagship product (see Chapter I, methods of inquiry), which sets trends and limitations for innovation in the market. Indeed, in Chapter II, I showed in the analysis of affordances and variables replicated across platforms that Tinder defines a distinct class of dating and user representation. In addition, in Chapter III, I showed that developers copy Tinder's techniques, in particular those developers working for different app companies but collaborating under the same brand agglomeration (i.e., The Match Group).

Tinder relies on a recommendation system "designed to provide suggestions on items to users by learning patterns from user behavior" (Zhu and Sun, 2016). These systems use for instance, collaborative filtering, a type of machine learning method designed to model how users come to like similar items, and thereby give a simultaneous model of users and items. Dating app recommendation systems, however, add an additional level of complexity because the "items" are also users, and have their own preferences. Predicting reciprocated preferences in order to suggest users to users is an active research area in computing literature (Xia et al., 2016). Milano et al. (2020, p. 959) direct attention to those systems' wider impact: "they shape user preferences and guide choices, both individually and socially". However, conceptual choices are often invisible to the user.

The information that users can access in Tinder's matching system is limited by the GUI. Tinder's profile design is at first sight picture-based with two main choices: like and dislike (the swipes).[72] Additionally, under the picture a user can preview the name, age, education, job, distance in kilometers or miles between two users, place of residence and, more recently passions, recent activity and sexual orientation according to what the user decides to fill in as input data. There is an option to display more information, such as a description, Instagram account and Spotify songs, too.

4.2.2. State of the Art: The History of Matchmaking

The professionalization of matchmaking can be traced back to traditional societies where marriage was viewed as a religious obligation. Matchmaking provided "effective mechanisms to maintain strict norms of sexual chastity, religious endogamy, and socio-economic homogamy" (Peres, Meisels and Frank, 1980). For instance, the traditional *shadchan* in Israel was a man considered a matchmaker whose role it was to arrange a marriage between suitable individuals. His experience was mainly based in the negotiation and creation of balanced preferences. They could "tell reasonable demands and aspirations from exaggerated ones" between the families involved in the arrangement (Peres, Meisels and Frank, 1980). The earliest references in European Jewry trace their existence as an established institution, or "marriage brokers", in the twelfth century. However, their expertise was transformed by the increasing creation of "commercial matchmakers" that adapted to modern social changes (Ibid.).

Modern matchmakers rapidly integrated computer-quantification techniques, but they were mainly advertising a service focused on interpersonal skills. As a new commercial entity, these matchmakers reconciled the interests of several actors – individual, family, industry and state. Matchmakers worked with close networks and were known in villages (Hashish and Peterson, 1999). In Egypt, matchmakers were women that took the initiative to seek candidates for an alliance, and they received remuneration or modest gifts in exchange for a concluded marriage (Ibid.). Later, with the creation of "marriage, or matrimonial, agencies", the dynamics of traditional matchmakers were adopted for matching children from families based on variables such as ethnicity and religion under the principle of homogamy (Hashish and Peterson, 1999). However, the inclusion of individual interests[73] was added to those of families, which became a tension in the matchmakers' work, for instance in Urban China (Pettier, 2019). Matchmakers continue to be present in Asia, and in Europe despite their stigmatization (Kalifa, 2011). As a reference, there are 41 marriage agencies in Switzerland, according to a search on the internet search engine local.ch. The recognition of the profession in Switzerland could date back to the nineteenth century according to an "extract from the deliberations of the Federal Council" (1904)[74] that I identified from archives to trace Swiss matrimonial agencies.

[72] Other affordances like superlike and rewind exist but are not covered in this study.

[73] "This phenomenon is identified as a product of a rise in liberal economics in Western societies, while late medieval texts, particularly legal codes, highlight individual choice and romantic love as a present element in marriages of any social class." (Cocks, 2015, p. 18)

[74] The excerpt mentions that "Meier-Halte practiced in the years 1887 to 1894 in Zurich and for more than two years in Oerlikon the profession of marriage agent." (p. 667). The document also legally recognizes their status as part of other types of trade. The agent Meier-Halte was accused of fraud by a client. However, at the time payment for the service was not mandatory, "the question [was] whether this treatment of the marriage brokerage contract is based on the analogy with gambling and betting, or on the theory of the immoral contract." (p. 665). Agents' transactions were subject to "severe" scrutiny on the "true essence of marriage." This was a measure of the time that was part of the Swiss history of the right to marriage and divorce according to good morals, and it is worth researching in the future. According to the documents digitized and indexed by the Swiss Confederation on their

Using the services of an agency is still justified by individuals as gaining access to a network, although a different and wider network than that which exists in traditional matchmaking. Like intermediaries in other sectors, matchmakers "create links where socio-economic transactions take place" (Granovetter, 1985). Yet, a matchmaker's expertise was based in other skills than merely "networking", and the service followed different processes. Matchmakers established a recruitment process to build their network, which is selective, as shown in an agency in Urban China (Pettier, 2019) or in an English marriage bureau in 1939 (Cocks, 2010, p. 120). "With the growth of businesses in the field, agencies create marketing niches" (Ahuvia and Adelman, 1992, p. 455) and "by categorizing [these actors] contribute to a cognitive segmentation" (Bessy and Chauvin, 2013) of the clientele. In addition to the selective recruitment of potential candidates, scholars (Ahuvia and Adelman, 1992) define other processes. The "model of the marriage market" consists of "Searching (information acquisition), Matching (decision making), Interacting (relationship formation), and Commitment." The latter involves the individuals requesting the service, while the first three steps describe the matchmakers' work: "Searching consists of information acquisition [for] learning about who is available as a potential mate. Matching is the process of using information on eligible others to determine which relationships will be pursued. [Interacting] covers the myriad of complicated interactions through which two people form or reject a romantic relationship […] The development of these relationships is generally accomplished through interpersonal communication […] The interacting stage, like the searching stage, has a large element of information acquisition. The difference between the two stages is that researching gathers information from the environment outside a dyad or through mediated communication (e.g., singles ad or mutual friend), whereas interacting yields information from within an ongoing dyadic relationship" (Ahuvia and Adelman, 1992, p. 454).

Often referred to as the ancestors of modern online dating platforms (Hicks, 2016), matrimonial agencies relied on primarily direct and human matchmaking. It is argued that matchmaking is mainly a feminized profession in contrast to the masculinized work of technology development. While women[75] dominated the matchmaking market, men began to take over through technology (Hicks, 2016). In contrast to developers, for matchmakers the quantification tools assist their work, but these are not the core of their expertise. Agencies and their matchmakers create a market, like dating apps, by defining the value of "qualified" individuals (Karpik, 1989) according to specific comparable attributes. Like dating applications, they rely on the collection of data from forms that feed automated processes by computers. "Modern matchmakers use the practice of traditional *khatbas* matchmakers via a semi-automated process using computers where similar data is collected about individuals" (Hashish and Peterson, 1999). However, matchmakers also rely on interpersonal skills to be "good listeners" and willing to provide seduction and self-esteem advice to clients (Ahuvia and Adelman, 1992). Matchmakers are "researchers, communicators, and decision makers" (Dissanayake, 1982), as well as relationship consultants (Chwieduk, 2010). The different roles establish a direct human mediation, between these experts and individuals seeking partners, that dating apps do not establish. They are intermediaries of couple formation that support *negotiations* between individual and family preferences in Sri Lanka (Dissanayake, 1982). In modern international agencies in Russia, Ukraine and Belarus, individuals seeking a partner establish specific preferences for the matching but these are also negotiated with the matchmakers (Sizaire, 2018). However, matchmakers can favor a couple's model under heteronormativity

portal, this extract is the oldest document found in these archives. Retrieved from: https://www.amtsdruckschriften.bar.admin.ch/viewOrigDoc.do?id=10075834

[75] See for instance, Joan Ball, "a computer dating pioneer who started the first computer dating service in England, in 1964. Ball's computer dating service also pre-dated the earliest American computer dating services, like Operation Match at Harvard" (Wikipedia). Retrieved from: https://en.wikipedia.org/wiki/Joan_Ball

(Sizaire, 2018). To better understand the way a human matchmaking is operationalized in contrast to matching algorithmic systems, I analyze the matchmakers' practices observed *in situ* in a Swiss matrimonial agency.

4.2.3. Methods: Qualitative Analysis of Technical Documentation

For the qualitative study of Tinder's matching algorithmic system, I analyze publicly available technical documentation. Technical documentation is used in media studies to analyze dating app infrastructures and deconstruct gender scripts in apps such as Bumble (Bivens and Hoque, 2018). The method consists in analyzing the marketing speech and the conceptual choices in comparison to affordances in the app. In HCI this type of analysis is an entry point to commercial algorithms (Diaz and Diakopoulos, 2019). The method consists of analyzing the conceptual choices of the Walk Score (a patented algorithm for measuring the walkability of a given geographic area) to compare them with user experiences. Although scholars (Diaz and Diakopoulos, 2019) state/claim/argue there is no full description of how the score is calculated and averaged, they identify different components that have an impact on the user experience. These components include the aggregation of data, the categorization of places, their corresponding weights and the API implementation. Finally, in software studies, Mackenzie (2013) also analyzes machine learning conferences. The method consists in analyzing the programming practices that are encouraged by the companies' business interests. The author (Mackenzie, 2013) sheds light on the relevance of optimizing the predictive power of statistical models in machine learning, for instance through *feature selection*, "which means finding those variables in a model that have higher predictive power" (Ibid.).

More specifically, following Burrel (2016), I center the analysis of Tinder's technical documentation on the mathematical procedures that become conventions to define the way profiles are recommended in the app. I identify six sources where Tinder provides information about the app according to three different audiences: regulators, users and technical experts. The sources are (i) patents, (ii) a blog dedicated to the app's functionalities updates,[76] (iii) the privacy policy,[77] (iv) an engineering blog,[78] (v) a Subject Access Request (SAR),[79] and (vi) a presentation about Tinder's recommendation system given by its Chief Scientist at a machine learning conference in 2017 (Liu, 2017) along with its accompanying video.[80] Two sources, the patents and the machine learning conference, present the most detailed information about the core of the matching algorithmic system on Tinder. I will focus the analysis on those two sources. It is worth noting that the SAR allowed me to confirm the type of data collected by Tinder in comparison to what is stated in the patents and the machine learning conference. I discarded the engineering blog as it is limited to generic techniques about the architecture of a software program and iOS development. The diversity of sources reflects the lack of transparency about the matching system. To users, there is limited knowledge that can be acquired, in particular if they do not have technical expertise. Users only have privacy policies and the GUI at their disposal, and these say little about the way profiles are recommended.

[76] Tinder blog. Retrieved from: https://blog.gotinder.com/
[77] Tinder's Privacy Policy. Retrieved from: https://policies.tinder.com/privacy/intl/en##how-we-use-info
[78] Tinder Engineering Official Tech Blog. Retrieved from: https://medium.com/tinder-engineering/
[79] As I have an account on Tinder I enacted The Right of Access based on the GDPR and the LPS to obtain the records of my personal information held by the company, as well as the automate decisions made by the system.
[80] "Dr. Steve Liu, Chief Scientist, Tinder." (November 2017). Retrieved from: https://youtu.be/j2rfLFYYdfM

4.2.4. Methods: Ethnographic Study

In 2019, I conducted observations in a Swiss agency for matchmaking with 14 international partners under the establishment of a research agreement. I followed the work of two matchmakers *in situ*. The matchmakers are here pseudonymized as Fanny and Federica. The observations describe three different practices in a typical workday: the interview of a new member (the naming convention used by the agency to refer to the clientele), the introduction of four matches to registered members, and the follow-up of four ongoing dates. In the analysis I will present, members are given a pseudonym and the name of the agency is omitted for confidentiality reasons. The observations were accounted in a journal-field notebook, and later transcribed and organized in a chronological way to describe a typical workday in the agency. The observations were presented to the matchmakers for their validation. The matchmakers gave me additional material that I analyzed in the agency (but did not keep for confidentiality reasons) in order to support my observations, such as e-mails, access to an anonymized dataset, the hand-writing notes of matchmakers, and the online form for members to register with the agency. I also corresponded continuously with them after the observations to discuss the on-going process of matchmaking in the agency. This study followed ethical procedure HREC No: 022-2018 / 28.05.2018 approved by the EPFL's research committee.

In the following sections, I first present the results of the patent analysis and then the results of the machine learning conference. Finally, the results of the ethnographic study are discussed in comparison with the first study of Tinder.

4.3. Results I: Patent Analysis. Ranking Attractiveness Recommendation System

Tinder's patent No. US 2014/0074824 A1 (Rad et al., 2014) was first published by the United States Patent and Trademark Office[81] in March 2014. There are in total eight versions published, the latest one in 2019. A patent is a "title issued by an authority" which grants its holder an exclusive right of exploitation, on a certain territory (national or regional, e.g., the 38 countries of European Patent Office) and for a certain period of time (usually up to 25 years) (Lacour, 2021). Publishing new versions of a patent means that the company wants to extend the patent's validity or to add new components to the invention. However, the original invention of the patent cannot be modified. In the United States, a patent publication process takes about 18 months (Rabeharisoa, 1991), which means that while Tinder's matching system evolves, the state of the art is not reflected in the patent. That is one limitation of analyzing the patent. That is the reason why I analyze the machine learning conference in the second section to reflect on the system's update. Patents present other limitations. They are standardized in order to be registered: "patenting conveys and legalizes a certain definition of the technical invention [according to] institutionalized practices" (Rabeharisoa, 1991: 3). However, patents allow make it possible to account for the technical knowledge and know-how produced. In addition to protecting the invention, patents serve as a tool for selling an idea to investors without revealing too many details, which limits the observations that can be made. Finally, it is worth noting that an algorithm on its own cannot be patented. They have to be protected as one part of a whole computing

[81] More specifically, a US patent is defined as "a property right granted by the Government of the United States of America to an inventor, to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States for a limited time in exchange for public disclosure of the invention when the patent is granted." Retrieved from: https://www.uspto.gov/learning-and-resources/glossary#sec-P

system. I took advantage of this condition as Tinder's patents present different mathematical and technical elements that enable the computation of the matching in the dating app.

The patent contains 15 pages describing the invention. The applicants are the founders of the Tinder application, among whom is Sean Rad. This publication officially qualifies the original character of the applicants' proposal, which is "a system and method of the matching process". At the core of the process the patent presents "various scoring algorithms" for recommending profiles that "may be chosen using predictive analysis, such as logistic regression" (Rad et al., 2014).[82] Regression is a type of supervised machine learning from statistics. It confirms the principle of machine learning as the calculation of the statistical distribution of patterns (Pasquinelli, 2019) and the focus on optimizing predictive power as stated by Mackenzie (2013). In the following section I present three quantification practices of Tinder's matching algorithmic system: (i) variables weight, (ii) variable construction, and (iii) ordering profiles. They explain the specificity of Tinder's matching algorithmic system as a recommendation system for ranking attractiveness beyond the generalities of machine learning. To explain every quantification practice, for each case I present an excerpt from the patent and then interpret it.

Before presenting the results, it is worth noting that the patent states that Tinder collects data from different sources. By connecting with other platforms, Tinder retrieves profiles from social networks (such as Facebook) to get a history of the individual's behavior (e.g., marking an interest, a like, to a type of content), and to collect declarative data (e.g., date of birth or education level). Together, they form the genotype and phenotype variables of a user as I defined them in Chapter II. The patent provides a complementary view to what is visible from the GUI. The cross-platform connectivity on Tinder also confirms some development practices identified in Chapter III, i.e., reusing variables that are retrieved from exogenous sources via the SDK's Facebook login, which leads to a standardization of the user representation on profiles that is controlled by the dominating platforms.

4.3.1. Variable Weight. The Patriarchal Model of Dating

Variable Weight is the importance given to a variable that matches two users. It is the assignment of a greater or lesser weight to the variable. In practice, weighting can be done deliberately by the person defining the variables or automatically by means of algorithms. Although the assignment method chosen is not made explicit in Tinder's patents, this step in programming is essential for deconstructing the way a match is modeled.

[82] In Tinder's FAQ website, it is affirmed that Tinder applies automated decision-making and profiling as defined by the GDPR to make "compatible recommendations" (see https://www.help.tinder.com/hc/en-us/articles/360003082172-Profiling-and-automated-decision-making-at-Tinder). Recent GUI features on Tinder present additional privacy settings in relation to this. In the profile section one can find "recommended ranking" briefly explained as follows "if you disable this feature, your profile will not appear when users rank their matches by recommendation."

[0061] In some embodiments, matching server **20** may be configured to evaluate the likelihood of contact between user **14** and an entity in pool **30**. Matching server **20** may be configured to compare demographic data between user **14** and pool entity **30***a*. In another embodiment, matching server **20** may be configured to weigh the demographic similarities and differences based on the sex of user **14**. The demographic data may include, but is not limited to, age, education, ethnicity, income, and location.

[0062] As an example only, assume that Harry and Sally are registered users who have profiles in matching server **20**. Harry has submitted a search request to matching server **20**. While fulfilling this request, matching server **20** evaluates Sally's profile since her profile is in pool **30**. As part of the

[0063] In another embodiment, matching server **20** may be configured to compare the locations of user **14** and pool entity **30***a* in increments of ten miles. In yet another embodiment, matching server **20** may be configured to score the location comparison in light of other factors; as an example, matching system **20** may be configured to return a score consistent with a 10 mile difference in location even though there is a 50 mile difference between user **14** and pool entity **30***a* if user **14** and pool entity **30***a* have the same income, education, and age. An advantage realized in several embodiments is that it better approximates how a user evaluates entities. Entities that live further away are generally less appealing to a user; but, users may still be interested if the entity matches their preferences in other categories.

FIGURE 16 – TINDER'S PATENT, PAGE 6

Based on a likelihood function, Tinder estimates the *probability* of a user being contacted by another user or obtaining a match. The likelihood function can be defined with different mathematical formulas that are not detailed in the patent. However, in a general manner, this function serves to calculate the probability of matching based on the weights attributed to some variables and the input values that describe the sample.
The passage above shows that a score is produced to analyze the level of similarity and difference between two users with respect to the following variables: income, education, ethnicity, gender and age. In the example presented, however, the gender difference has a more important weight. Indeed, a woman with lower qualifications and who earns a lower salary than a man does obtains a better score for being introduced to this man than another woman equivalent to him. Furthermore, the comparison of locations is not measured solely in kilometers or miles because demographic characteristics (income, education and age) have an impact on the weight of geographical location. Tinder states (without citing its sources) that "empirical data has shown that demographic differences have a different impact for women and men"; and in another passage, "that people prefer to find someone in a nearby location, but they might be interested in getting to know someone who lives far away if other criteria are met". Tinder then gives an advantage to a user by reducing the distance displayed[83] in the app if the two users have similar sociodemographic characteristics despite being geographically far away.

Geographers argue (Lévy and Lussault, 2013) that "the topological and topographic pairing" provides fruitful dimensions for understanding individual spatialities contributing to the formation of social space. However, the social space for finding a date on Tinder remains normative. From the GUI, users consider that the possible space of interaction between two users on Tinder is based on Cartesian landmarks captured by the mobile phone's GPS. That is why scholars call dating apps "geo-social apps" (Roth, 2014 ; Schreurs, Sumter and Vandenbosch, 2020 ; Sion, 2019). However, according to the patent a certain social status (depending on income, education and age) has more weight when compared to other individuals, which influences the geolocation that is displayed. Indeed, the patent states that the real geolocation can be modified. Here, a socioeconomic network is more important than the cartography. The latter only gives the illusion that the profile is more attractive since proximity in a Euclidean spatial frame of reference is displayed to the user on the GUI.

[83] Thanks to the GDPR, Tinder has recently added in the app a pop-up message to inform the user the app ignores user settings to display more options.

evaluation, matching server **20** looks at the differences between Harry and Sally's stated age, income, education, ethnicity, and location. In this example, Harry is 10 years older than Sally, makes $10,000 more per year, and has a Master's degree while Sally has a bachelor's degree. Even with these disparities, matching server **20** will give Sally's profile a high score which makes it more likely that Sally's profile will appear in Harry's result list. However, if it was Sally who submitted the search, and matching server **20** was evaluating Harry's profile, a different score is possible. So, if it were Sally who was 10 years older, made $10,000 more per year, and had a Master's degree while Harry had a Bachelor's degree, matching server **20** would give a low score to Harry's profile, making it less likely that his profile would appear in Sally's result list. Matching server **20** may be configured this way because empirical data has shown that these demographic differences do not have an equivalent effect on the choices men and women make regarding matches.

[0065] In another embodiment, matching server **20** may be configured to evaluate the age difference between user **14** and pool entity **30***a* using ranges as well as a sliding scale. By way of example only, matching server **20** may be configured to assign a high value to an age difference between 0 and −5, while assigning a lower value to an age difference between +2 and 0. An even lower value may be assigned to an age difference between −6 and −8. Even lower values would be assigned incrementally as the age difference increases outside of the ranges discussed. The higher the assigned value is, the more likely it will be that pool entity **30***a* will be included in result list **31**. Yet another embodiment may apply this

FIGURE 17 – TINDER'S PATENT, PAGE 6

combination of ranges and a sliding scale but use different values and ranges depending on the sex of user **14**.

[0066] As an example only, consider a situation in which a registered user, Harry, requests a search to be performed. While fulfilling this request, matching server **20** evaluates Sally's profile, which was in pool **30**. As part of the evaluation, matching server **20** compares the ages of Harry and Sally, and determines that Harry is two years older than Sally; this determination leads to matching server **20** assigning, in this example, points to Sally's profile. Matching server **20** may also be configured to assign 50 points to Sally's profile had she been five years younger than Harry; but, if she had been up to two years older than Harry, matching server **20** may have been configured to assign 40 points to her profile. Matching server **20** may be further configured to assign 30 points to Sally's profile if she was 6 to 8 years younger than Harry. However, if Sally were more than 8 years younger than Harry, matching server **20** may be configured to further decrease the number of points assigned to her profile: if she was 9 years younger, then 25 points; if she was 10 years younger, 20 points; if she was 11 years younger, 15 points; etc. The more points assigned to Sally's profile, the more likely it is that her profile will appear in Harry's result list. Thus, matching server **20** may be configured to assign a score based on age difference using a combination of ranges and a sliding scale.

FIGURE 18 – TINDER'S PATENT, PAGE 7

Another passage marks the weight of age difference in relation to sex. The variable constructed is defined by Tinder in another passage as "gender-role traditionalism". The system scores a person based on his-her sex and age difference in respect to a user of the opposite sex, which favors asymmetrical matches between older men and younger women.

Through these practices, user qualities are quantified by giving an advantage, or disadvantage, in numbers to a user when compared to another one. The convention is conditioning dating based on the patriarchal model of heterosexual relationships[84] which merits further analysis in gender studies.

4.3.2. Variable Construction. Matching Similarly Attractive Users

Variable Construction compares qualities between users, which enables an *approximate* comparison and then a recommendation based on similarity.

[0050] Matching server **20** may be configured to analyze one or more portions of the text of an entity's profile and generate a readability score that may be used in various ways, such as in the process of searching for matches for user **14**. In some embodiments, matching server **20** may analyze factors such as, but not limited to; average number of words per sentence, total number of words with greater than three syllables, and total number of words in the profile. Matching server **20** may also concatenate all of the collected responses with a single space between them. It may further break the text into sentences, words, and syllables. From these statistics, matching server **20** may also be configured to generate a readability score by, in one embodiment, taking the average of the Flesch Kincaid Reading Ease test, the Flesch Kincaid Grade Level test, and the Gunning Fox score. Other embodiments may utilize any other combination of these or other tests to determine a readability score. In some embodiments, analyses may be used to determine the IQ of an entity, the grade level of the writing, or how nervous the entity generally is. An advantage of this embodiment may be that the system provides user **14** with a metric for determining approximate intelligence of other users. The readability score may be used, for example, in the matching process to identify potential matches.

FIGURE 19 – TINDER'S PATENT, PAGE 4

In addition to the gender-role traditionalism variable, four other variables are constructed in Tinder to measure users: "intelligence quotient (IQ), readability, nervousness, and physical attractiveness". The first three variables are calculated from the average obtained from three mathematical formulas: "Flesh Kincaid Reading Ease, Flesh Kincaid Grade Level and the Gunning Fog Score". These formulas come from the fields of linguistics and education. They measure a person's level of education (according to the U.S system) based on writing and the ease with which an audience can read and understand a text. The user, as a potential match, is therefore represented by these variables constructed that Tinder defines as relevant for dating.

[84] Although it is possible to search for a same-sex profile on Tinder, the quantification operations for such relationships are not made explicit in the patent.

[0056] In some embodiments, matching server **20** may be configured to impute a level of physical attractiveness to an entity in pool **30**. Matching server **20** may be configured to monitor how frequent an entity in pool **30** has been viewed as well as how many times that entity has been part of a result list in order to impute the level of physical attractiveness. Matching server **20** may further be configured to generate a score based on this data. Further, in some embodiments, matching server **20** may impute physical attractiveness to an entity based on the imputed physical attractiveness scores of other entities. Matching server **20** may compute an average of the imputed physical attractiveness scores of the other entities weighted by the commonality score between each of the other entities and the present entity. Empirical data indicates that people are more likely to match with people of similar attractiveness. Thus, in many embodiments, a user may obtain an advantage in that they are able to be presented with potential matches that, according to one measurement, are as attractive as the user.

FIGURE 20 – TINDER'S PATENT, PAGE 5

The fourth variable, "physical attractiveness", is calculated from the number of times a person has been on the recommendation system's result list. In other words, this is a variable to measure competiveness. Hence, users are induced to perform strategically to gain visibility but if users do not know about it, some users can be discriminated in the result list. Indeed, if some users appear more frequently in the result list because they are considered "more attractive" (because they obtain more likes) by a majority, they have a higher probability of finding a date than others that are "less attractive" (because they obtain less likes).

Finally, a "commonality" score is computed by comparing the score of physical attractiveness of two individuals to assign them an average score obtained from the comparison. This means that each individual's score is compared with the score of another individual. Then, users inherit an *average* score of the sum of the two attractiveness scores. In other words, a double measure is applied. Users are evaluated first based on the characteristics on their profiles and their behavior online, and then on the basis of their value in relation to the value obtained by their peers. It is a "collective" score that depends on the performance of users and their peers.

This double measure allows Tinder to create clusters of users according to their commonality and assign them to distinct pools. For instance, "the most average beautiful women together" in a pool. Then, Tinder creates a match by putting together individuals who are similar to each other. For instance, "a woman and a man that are in average the most beautiful" in another pool. Thus, forming matches that are equivalent with respect to the mean in physical attractiveness, IQ, readability, and nervousness.

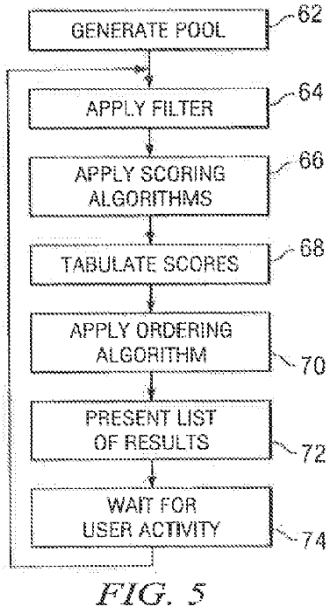
This measure of the individual based on commonality with others reflects the self-referential dynamic of the market, as established by Orléan (2015b), which is computed. Based on the speculation that the matching system makes on the market (that one user has the same value to another user that is considered similar), the system attributes an average value to a user according to what is assumed to be the value of others based on the variables and metrics defined. Thus, the system produces a "conventional belief" (Orléan, 2015b) by speculating on the value of user qualities that is based on the values speculated by others. This is distinct to a market based on supply and demand where the value is estimated according to the quantity available and the intrinsic utility of the good (here a person as a potential date).

4.3.3. Hierarchical Ordering. Profile Recommendations

Hierarchical Ordering is the organization of profiles in a hierarchical order computed for recommending the profiles in the app.

scores for each entity in pool **30**. In one embodiment, these algorithms may include analyzing the text of the profiles of the entities in pool **30** to generate a readability score, determining how attractive an entity of pool **30** is, or measuring how likely it is that user **14** will contact an entity of pool **30**. At step **68**, matching server **20** may be configured to collect all of the scores from step **66**; in one embodiment, matching server **20** may use database **26***b* to store all of these scores. At step **70**, matching server **20** may be configured to apply an ordering algorithm which will determine the order in which entities in result list **31** are presented to user **14**. In one embodiment, this ordering algorithm is based, in part, on the scoring algorithms applied at step **66**. The ordering algorithm assigns points to each entity and orders them based on these values, constructing result list **31**. An embodiment of this ordering algorithm is summarized in the following table:

FIGURE 21 – TINDER'S PATENT, PAGE 4



[0085] FIG. **5** is a flowchart illustrating one embodiment of how result list **31** may be generated. At step **62**, matching server **20** generates pool **30**, as described above. At step **64**, matching server **20** applies a filter to pool **30**, removing certain entities; in various embodiments, this filter is based on user's **14** own sex and the sex user **14** desires to be matched with. At step **66**, matching server **20** may be configured to apply algorithms to pool **30** that will generate a plurality of

FIGURE 22 – TINDER'S PATENT, PAGE 9

The use of ordering algorithms determines the position of a user in a specific order in the recommendation system's results. The order of profiles on Tinder is based on the scores previously obtained from the variables constructed. What the user sees in the GUI is different. From the affordance analysis in Chapter II it is possible to see that the profile ordering is based on the distance between two users according to their geolocation. However, I showed in the first Tinder quantification convention above that social status has a higher weight than geolocation. In addition, in Chapter III, the founders I interviewed from two applications define the recommendation of profiles by decreasing distance. According to the founders, this is a simple technique to adopt. It is also a main distinction between the two classes of dating that I presented in the affordance analysis in Chapter II. The list-view dating (first class) relies on geolocation (e.g., celibataire.ch) or a decreasing compatibility score that is displayed (e.g., OkCupid or Parship). In contrast, the match dating (second class), where Tinder is included, makes use of metrics that enable the hierarchical organization of profiles according to similarity values that are opaque in almost half of the sample. Indeed, among 29 dating apps in the sample, 14 display visible indicators (see Chapter II). If transparency is claimed in those apps, the display of metrics that measure users could inform them about the way their profiles are recommended, and

about what type of profiles they are introduced to. However, it could also induce users to perform strategically. For instance, changing their socioeconomic demographic data on the platform.

4.3.4. Discussion: A Socio-Computable Distance

Researchers have highlighted how social matching systems primarily recommend users based on similarity and proximity metrics (Mayer, Hiltz and Jones, 2015). This was particularly evident on Tinder throughout the analysis, although the specific metric they use is not specified. Nevertheless, understanding the way recommender systems rank individuals through the variable definition directly enables deconstructing their consequences. These rankings have been shown to produce homophily, therefore, minority users are negatively affected (Karimi et al., 2018). Homophily outputs on Tinder are confirmed by a qualitative research, which provokes "relational filter bubbles" (Parisi and Comunello, 2020). This finding also featured in a study on a large dataset of another dating app called Hinge (Levy, Markell and Cerf, 2019). These patterns depend on user behavior but also on the variable and metric definition, and the overall statistical conventions that are applied.

In Tinder's patent analysis I show there are three quantification practices that define the type of profile and their potential matches, as well as the way in which they are ranked according to the design of the app. First, the quantification practice of weighting specific variables for favoring a patriarchal type of dating. Second, the practice of constructing four variables to compare users: physical attractiveness, IQ, readability, and nervousness based on particular mathematical formulas defined by the company. These variables serve for matching "similarly attractive" users. Finally, the practice of computing a specific hierarchical order of profiles to recommend based on the scores computed to each user. Together, these three practices define a "socio-computable distance" on Tinder that reconfigures the probability of finding a date in a normative, reductive, and competitive way because of the methods chosen by the company. The conceptual choices qualify Tinder's matching algorithmic system as a recommendation system that is based on the ranking of users' attractiveness. Recent GUI affordances on Tinder present additional privacy settings in relation to this. In the profile section, "recommended ranking" is briefly explained as follows: "if you disable this feature, your profile will not appear when users rank their matches by recommendation."

It has been claimed that online platforms are "social spaces" and not merely tools of mediated communication (Auray, 2016). In contrast, it is argued that dating apps foster the "privatization of dating" as a practice that is "disembedded" from other social spheres, outside one's social circles in ordinary life (Bergström, 2019). In this analysis, I show how a dating app like Tinder is technically defined, which invites reconsideration of the definition of these platforms for couple formation and, more broadly, for the social dynamics that are studied within. Tinder is a ranking recommendation system that defines a type of dating dynamic that is heteronormative, and which reinforces homogamy between users. A user's socioeconomic status plays an important role in this homogamy but there is also a similarity computed through different variables that define the user's "attractiveness". At the core of this system is a new definition of a socio-computable distance that conditions dating and the couples that can be formed.

A recent demographic analysis (Potarca, 2020) of couples formed via dating platforms states that the partners belong to mixed socioeconomic status. The assumption is that dating platforms like Tinder favor a dynamic where the evaluation of users is based on the attractiveness of the profile picture, and not on sociodemographic variables. However, the types of dating apps that the couples used are unknown. The comparative analysis in Chapter II shows that the design of affordances plays an important role on the way users are evaluated in every platform. Moreover, in this analysis I show that Tinder establishes the measure of attractiveness in advance. However, this does not depend on the perceived attractiveness of the picture (although

it has an influence for liking a profile). Instead, physical attractiveness is a variable constructed on Tinder that is combined with three other variables: IQ, nervousness, and readability, which builds dynamics of dating based on different principles. Therefore, it is relevant to define the type of distance between users that Tinder is building. The notion of distance is at the core of the sociology of couple formation, but it is also a key notion in computer sciences. The notion of distance is different in both social sciences and computer sciences, however.

In computer sciences, "calculating a distance or similarity matrix is the first step in most statistical multivariate analyses" (McCune and Grace, 2002). There are myriad mathematical definitions of distances (Caillez and Kuntz, 1996), like the Jaccard distance I used in Chapter II, and averages that follow distinct conventions. In the social sciences, a social distance describes the distance between the members of a group in society; this distance is analyzed through different variables (see for instance the geometric and symbolic sense of social distance by Georg Simmel (Ethington, 1997)). The most well known quantification convention is the measure of homogamy based on socioeconomic and cultural capital. This quantification convention defines the social and spatial distance of persons in social classes, i.e., the habitus (Bourdieu, 1979). It is presented by Desrosières (1978) in a scientific article that seeks to measure the capital of different couples in order to analyze the matrimonial market according to Bourdieu's (1979) social theory of tastes that included choosing a partner. The convention still serves as a measure of homogamy of online dating users (Schmitz, 2012) in the social sciences. Homogamy is the study of the composition of couple unions based on a theoretical definition of social distance that is operationalized by a statistical measure of distance. Desrosières (1978) formulated the hypothesis that marriage is "a good measure of social distances between partners". First, each partner is defined according to variables used to quantify the socioeconomic and cultural resemblance of the couple. Secondly, two measures of distances are used to analyze the resemblance of the couple: a frequency analysis defined by Jean-Claude Deville (in French, "le produit des marges") (Desrosières, 1978, p. 99), and a correspondence analysis. These are distances still used in combination with others in machine learning (Bécue-Bertaut and Pagès, 2008). By making those choices, there is *de facto* a reduction of reality that can be interpreted by the researchers and quantified. In the same article, Desrosières (1978) justifies his choices and the methods used in detail, and presents the limitations of these methods for the understanding of couples. He explains that the limitations of the analysis are based on the choice of the methodology, the availability of variables (and at the same time the absence of other variables), the positioning of variables in a table, in rows and columns, and the absence of detailed information about the life trajectories of partners (Desrosières, 1978). Hence, the reality observed about couple formation, through the theoretical and mathematical definition of distance, is *a priori* constructed by the researcher. While the statement could seem obvious, the analysis of development practices in Chapter III showed that dating app companies do not pay attention to these choices and to the type of dating reality they are capturing from user behavior data; a reality that is initially built by the variables embedded in the GUI.

I discussed in the state of the art that the increasing power of computers' hardware presents opportunities for new quantification practices. Mackenzie (2017, p. 76) explains that machine learning changes the social definition of distance. When users are analyzed and positioned as data points in a vector space, "similarity and belonging no longer rely on resemblance or a common genesis, but on measures of proximity or distance, on flat *loci* that run as vectors through the space." The statement is odd when observing Desrosières and Bourdieu's methods in 1970 for positioning partners in a geometric space based on selected variables that represent each actor for calculating a proximity. One difference relies on the quantity of variables and input values that can now be computed (that paradoxically requires a reduction of dimensionality). Another difference relies is the possibility of analyzing fluctuant values in real-time. Moreover, I argue that the main difference relies in the choices made in practice, and the justification of those choices, for defining a reality. As Lévy (2013, p. 288) proposes, the notion of distance lies at the heart of any conception of space, which is "the attribute of the relationship between two or more realities, characterizing their degree of separation

(gap) by difference from the state of contact".[85] Therefore, the author states that it is necessary to define the concept in the situation in which it is employed, in order to avoid using it in a metaphorical sense.

Tinder's ranking recommendation system quantifies and measures qualities by means of variables describing the users, their behavior on the platform, and their relationship with others, to assign the profile a place in a geometric space, and a hierarchical position in the list of the recommendation results (displayed in the GUI). However, each user does not carry an absolute value since the value varies according to the user with whom the comparison is made, as observed in other social networks (Gerlitz and Lury, 2014). In other words, the profiles recommended to users is based on their performance and the performance of others. "Proximity" then varies according to the "performance" of the user's attractiveness in the application. A user who is regularly active in the platform, who receives many likes and who often appears in the results lists of other users, is presented in a better position than another user who rarely connects to the app. Thus, the former gets a "better" score. This further suggests that the socio-computable distance constantly evolves according to fluctuating scores. The dynamic is motivated by the goal of engaging users in the platform. However, the dynamic could be repurposed to understand users' preferences in new ways. These dynamics are relevant when contrasting the static social positions measured in the analysis of couple formation, when seeking to project the inherited social structures of partners. A dynamic analysis of preferences offers opportunities for diversity and emancipation from social determinism if the conventions of the app are reconsidered.

Finally, Tinder offers possible matches where some users have more influence than others. In particular, those who follow the patriarchal model that is favored and amplified by the system. The system does not consider different models of couples. On Tinder, the definition of distance therefore shows that the experience of dating is conditioned by its normative meaning, and that this normative meaning is prescribed by the designers of the application through specific quantification practices.

4.4. Results I: Analysis of the Machine Learning Conference. Modeling the Average User Swiping Behavior

Tinder's matching system has evolved and more details about the current techniques used in the company were presented in a machine learning conference. However, this evolution does not necessarily mean a replacement of the techniques observed in the patent. As I showed in Chapter II, machine learning systems combine sequences of operations from different software programs that interact thanks to the modularity offered by generic engineering principles. A combination of software programs, as well as the business logic behind the app, influence the behavior of the app. The presentation about Tinder's recommendation system update was given by Tinder's Chief Scientist at a machine learning conference in 2017 (Liu, 2017), and focused on the company's use of neural networks. I first summarize the justifications given by Tinder for choosing neural networks, and then define three quantification practices specific to the neural networks applied by Tinder.

Tinder combines collaborative-filtering, content-based filtering, and "TinVec", the neural-network based approach that is an abbreviation of "Tinder vectors". Tinder claims that "TinVec" is its main innovation. Neural networks is a modern machine learning method that is different from the classical logistic regression men-

[85] Lévy (2013 : 288) la notion de distance se situe au cœur de toute conception de l'espace qui est : "l'attribut de la relation entre deux ou plusieurs réalités, caractérisant leur degré de séparation (écart) par différence avec l'état de contact".

tioned in the patent. The neural networks method is now used in different platforms like Netflix and Facebook, which are also recommendation systems like Tinder. The difference lies in the variables chosen. Tinder accounts for likes, called swipes in the presentation. The mathematical model is based on the "word2vec" approach (Mikolov et al., 2013), developed for modeling natural language. The analogy is that by parsing a text into co-occurring pairs, and predicting the occurrence of one from the other, it is possible to build a structural model of language. On Tinder, TinVec models (or learns) user implicit characteristics as a function of who "swipes right" on them, and in turn models user preferences in terms of similar characteristics of different people that every user swiped right on. This distinction is key to the tractability of the approach. Users are grouped into two distinct clusters: (1) who has liked them, and thus the characteristics they exhibit, and (2) who they have liked, and thus their preferences. This clustering was already presented in the patent. It is a two-sided preference modeling. However, neural networks adds a complexity that, paradoxically, improves predictions of users' preferences (in terms of efficiency) on the one hand, but makes it impossible for humans to interpret the results on the other. In addition, the method requires more data but this is solved by minimizing the variables defined. In the presentation, the Chief Scientist explains that using neural networks allows for significant efficiency. It enables translating users mathematically into a common embedding space with only the swipe. The swipe is a binary variable related to the actions like/dislike. A user swipes left to dislike a profile, and swipes right to like a profile. This method consumes less memory in the machine as it significantly reduces the number of user behavior observations to collect, and augments the speed of the processing. Another advantage is that it enables inferring the characteristics of users from their swipes. TinVec takes swipes into account, in order to recommend similar profiles to the ones the user has previously liked. Neural networks is capable of inferring thousands of users' characteristics (e.g., hair color, type of beard) but these are only numeric values computed by the machine without any interpretable meaning for humans unless additional techniques are applied. The Chief Scientist explains the choice of TinVec due to its efficiency: "*Why [do] we want to use embeddings? One reason is that using embedded vectors in a continuous space we have many benefits. For example, we can represent entities much more efficiently, and another benefit is that we can also do calculations on them which is really useful. For example, in Tinder we have millions of users if we look at each user as an individual dimension then we would have to use millions of dimensions but in contrast, using TinVec, we can explore dimensions much more efficiently using only tens or at most hundreds of dimensions, it is a huge saving*" (Liu, 2017).

It is worth noting that the implementation of neural networks on Tinder does not invalidate the declarative phenotype variables that were analyzed in Chapter II and that are present in the patent. The SAR confirms that Tinder collects those variables too,[86] which could serve representing users in a different way in addition to how users are represented by TinVec.

Two main practices of building and implementing machine learning in the context of a private company are drawn. First, a reduced variable selection that serves modeling user preferences based on their right-swiping behavior on other profiles. Second, using averaging to predict a prototypical model of the user based on the swipes that the user received from others. These users that receive right-swipes are called "swipees", i.e., users co-swiped by other users.

[86] The variables collected by Tinder and present in my SAR file obtained from my personal Tinder's account are: active_time, how many times the user opens the app by date, qty. swipes_likes by date, qty. swipes_passes by date, qty. matches by date, qty. messages sent and received by date and the history of conversations.

4.4.1. Reduced Variable Selection. Modeling the Right-Swiping Behavior

Reduced Variable Selection is the selection of a reduced number of variables for analyzing user preferences. Tinder reduces the modeling of user preferences to their right-swiping behavior. In TinVec, the variable (swipe) collects the unit observations about users. The observations are the preferences where the only input values taken into account are the right-swipes (or likes). The choice of swipes has a standardized format; it does not require data cleaning, normalization or integrity checking from the company. Swipes are acquired at fast speed for all users as soon as they start browsing profiles after registering. Collecting swipes ignores users' variables from the profile page, and the characteristics on their pictures. Users' preferences are quantified, and at the same time defined, by means of the user's right-swiping behavior. On Tinder, a divorced 36-year old professor and an 18-year old soldier are considered identical by TinVec if they have the same right-swiping behavior. Tinder transforms dating in that it recommends potential dates based on a mechanism of right-swipe preferences that the company has invented, which reduces the possibilities of modifying and reviewing the user's preferences based on other criteria and other mechanisms.

4.4.2. Averaging. Predicting Prototypical Swipees

Averaging is using the mean to compute predictions. It builds a prototypical model of preferences to recommend a new profile in the app based on the average obtained from the previous right-swipes given in other profiles. The mean is also a choice stated in the patent, but the choice is not justified. In general, the choice depends on the values to be compared, on the problem and the goals to make sense of the results. To explain the prediction I identify two relevant mechanisms.

First, the prediction implies fitting the models, a process that in computer science's practices means "learning from the data" to cluster together similar swipees, i.e. users co-swiped by other users. After collecting the users' history of likes received, each user is represented (via what is called an "embedding") with a vector of weights that characterizes users in the matching system.[87] These weights encode mathematical values of users that are used to compute a distance between users' representations. For example, if two users have weight vectors that are close, then the users are similar because they have common characteristics (even if these characteristics cannot be described) based on the swipes they received. The main insight of the TinVec approach is that when swiper A swipes swipee B, two things are learned: not only that A likes B, but also that B is similar to other people that A has swiped or will swipe. A similarity metric is what makes it possible to predict patterns.

Secondly, for any swiper, a model of their preferences is constructed as the *mean* embedding of users they have swiped (the swipees). The system uses the mean to recommend a new user as those swipees who are in close proximity. It is a recommendation of an averaged "prototypical liked" person. In other words, potential matches are judged to be more "probable to be liked" if the distance of their weights from the past likes is low. In addition to the distance, every profile recommended to a user is near the average of other profiles previously liked as stated in the presentation; "Josh's preference is represented by the mean embedded vectors of his likes" and the formula of the arithmetic average is the following

$$L = \frac{\sum_{i=1}^{n} Pi}{n}$$

[87] See the matrix of weights in neural networks (Burrell, 2016; Mackenzie, 2017)

If using neural networks enables capturing a tacit knowledge from the swipes without describing it, humans cannot interpret the results of neural networks unless they use additional techniques. TinVec's design, which is not built from user characteristics but on modeling user preferences based on right-swipes, means it is not possible to interpret dating patterns. This obstacle hinders the possibility of understanding possible flaws in the recommendation system, as well as explaining to users *why* specific automated decisions were provided to them by the system. The problem of interpretability of the neural networks results is particularly critical to correcting discriminative results that can be produced like the patriarchal model as described in the patent. Indeed, the patriarchal model results from the selection and weight of variables given by Tinder but also by input values provided by users. If a majority of female young users with a low level of education swipe right on older male users with a higher level of education, the recommendation system continues to recommend such users. It reproduces the dominating model and it amplifies the model as it is recommended, based on the average, to other users. More generally, the way Tinder creates a prototypical model of users as "right-swipers and swipees" through the mean recalls the history of social statistics in the nineteenth century as Desrosières (2013) traced it back to Quetelet's "average man". This concept is a probabilistic problem-solving on a mass scale, calculated by the mean, that makes it possible to reveal collective patterns according to an ideal. The "algorithmic governmentality", i.e. the probabilization of digital reality representations which is based on data behaviorism, and its relationship to the normativity for computing actors as a "statistical body" (Rouvroy and Berns, 2013), does not escape averaging. Tinder takes "the center of the mass" of the points that represent the likes, which is the arithmetic mean. Therefore, it would be relevant to justify the choice and the meaning of computing preferences this way, through the aggregation of preferences as averaging embeddings.

In comparison to the previous analysis of Tinder's patents, the quantification practices of neural networks analyzed above show that this technique introduces two new challenges for building expertise in dating. The first challenge is the interpretability of user behavior. The high dimensionality offered by neural networks poses challenges for human interpretation. Indeed, the complexity of neural networks in the current state of the art does not enable humans to interpret the results that are obtained. Current research in computer science is investigating new techniques for interpreting results (Du, Liu and Hu, 2019 ; Montavon, Samek and Müller, 2018). By adopting this method, in comparison to the previous classical statistical methods as presented in the patents, Tinder makes it difficult to understand the process of a profile's recommendation in the app, and the resulting matches (why a profile is presented to another user). This is different from machine learning based on early statistical methods, like the ones described in the patents of Tinder. Secondly, the reduction of user preferences. I demonstrate this through Tinder's choice of modeling user preferences based on the right-swipe behavior. The choice not only reduces social actors' reality offline, but also users' reality online. If Tinder's matching system based on neural networks can "think" faster and with more information about the user, this is useless to humans who currently cannot access the machine's knowledge. The reduction of dimensions then becomes the humans' preferred solution to the problem of the interpretability of the machine. The dimensionality reduction, is a common practice for computer scientists (Siblini, Kuntz and Meyer, 2019). It is a paradox of current research in artificial intelligence that seeks to overcome the limits of humans with certain capacities of the machine on the one hand, and the limits of the machine with human intelligence on the other. The current problem of techniques comes from "the limits of human" interpretability, as described by the early writings of Augusta Ada King, Countess of Lovelace, who laid down the principle of modern programming from the analytical machine. Indeed, "Lovelace does not seek the simple result of calculations, but to model all things in life through mathematics, thus allowing the *weak human mind* to be able to read *the work of the Creator*" (Lacour, 2021). However, the problem also comes from the desire of wanting the machine to perform better than humans do. If it is not humanly interpretable, does it have meaning? Should we really look hard into neural networks' results to find a meaning there, thus placing the machine as the Creator itself? The results presented interrogate the production of

knowledge about couple formation more broadly. Current empirical studies conducted in psychology are trying to predict romantic attraction (Joel, Eastwick and Finkel, 2017) and couple dynamics (Joel et al., 2020) with an increasing number of variables resulting from the combination of datasets in different labs in order to use machine learning techniques. Why posit that there would be in data some kind of hidden meaning, beyond our reach, our limits, that we would need to find? From an ontological point of view, what does that tell about matchmaking, social preferences, gender domination, homophily? These are all interrogations that merit further research. These interrogations are currently subject to legal and practical issues: according to the EU's General Data Protection Regulation (GDPR), Art. 22, data subjects have the right to obtain an explanation of the automated decision-making processes made by an app over personal data.

In the brief history of quantification practices presented in the state of the art, it is shown that computing techniques for couple formation were originally introduced in matrimonial agencies founded by modern professional matchmakers. However, the professional matchmakers' expertise is based on matchmaking, in contrast to matching techniques favored by computers. This matchmaking expertise is a continuation of the practice of intermediaries in villages earning a reputation for creating alliances. To understand this matchmaking expertise that was transformed by the introduction of computers in dating apps, in the following section I analyze section the work of two matchmakers in a matrimonial agency.

4.5. Results II: Matchmaking Methods for Building Expertise

Based on the ethnographic study, I identified seven methods that matchmakers use to build expertise in matchmaking. In the following section I present each method and discuss it in comparison with the dating apps' functioning. On the one side, matchmakers foster dating. On the other, apps foster matching. The differences between apps and matchmakers shape the possibilities and limitations for a person to find a date and build emotional bonding.

4.5.1. Profiling. Hosting and Interviewing

Profiling implies an initial evaluation of the person based on specific socio-demographic criteria, physical appearance, the discussion between the person and the matchmaker. The visual and oral profiling is done by the two matchmakers at two different points: when one matchmaker hosts a new potential member[88] at the agency, and when the other matchmaker conducts an interview with the person in the form of a conversation.

One matchmaker receives the potential new member, Juliette, at the door and the other will then get to know them during the interview. Federica explains to me that in this way, she and her colleague can have different assessments of the person, one based on a physical impression and another based on a conversation that also includes visual assessments. The two will later discuss whether the person is "admitted or not" to the agency. The first mediation with the agency is a face-to-face meeting that a dating app user never has the opportunity to do with the dating app company. The agency works as a "club" where a new member must be accepted. In contrast, all dating apps accept anyone by allowing users to create a profile for free and with minimal demographic information. Some apps verify the account or the profile picture as shown in the affordances (Chapter II) and users can be reported, blocked or deleted afterwards. Dating apps are based on

[88] The matchmakers call this way the clientele of the agency.

both a first principle of inclusion when users register with the app, and a second principle of exclusion (delegated to users) according to the user's behavior online, while the agency works on a principle of inclusion and exclusion through registration with the agency.

After a short introduction where the focus is on how the person found the agency's services, the first step begins with constructing a profile. First, the matchmaker asks questions to obtain demographic data: age, marital status, origin, whether the prospective member has children, occupation, professional specialization, job title and languages spoken. At the same time, the matchmaker asks what sort of partner Juliette is looking for according to specific criteria: age and location. Here the profiling is conducted orally and face-to-face, and the data is collected manually, using a notebook, by the matchmaker. Yet, it is based on the same criteria that dating apps collect when a user constructs a profile.

During the rest of the interview, the agency's services are presented and information provided on the type of members already enrolled. Fanny explains in detail the structure of the company, the franchise system, its partners, and the share of the market they own. Their network is international with a service focused on "expats like you, based in Switzerland" says the matchmaker. The clientele ranges from 27 to 65 years old. From that age "there is a lot of work to do," she says. It is also necessary to manage the volume since the majority of people who seek this service are between 27 and 36 years old. Juliette reacts: "ah that's okay I'm in the right age range". In the agency, the visibility on the market is controlled, in contrast to dating apps where users have immediate access to profiles, in particular on the websites in the class List-View Dating (see Chapter II).

Apart from age and marital status, whether or not a prospective member is admitted to the agency depends on their motivation to establish a lasting relationship. *"Here it's serious, we often say that to men to filter, you know. We like people who are ready. Our ideal partner [their client] is someone with an education, in any discipline, a major, a master's degree, because that makes it easier to work. In fact, everyone wants that and if you have someone without education it's hard to find for that person [...] We have a big mix of nationalities, especially in this city, there are foreigners like us. They work in trading, in multinationals, public institutions, in finance, we have freelancers, doctors, lawyers, lawyers we have a lot."* The agency's choice of clientele enables them to enlist people who in theory share the same goal, which avoids a misalignment of goals between members. A study of Tinder users shows there are 13 motives for using the app, and a long-lasting relationship is only one of them (Timmermans and De Caluwé, 2017a). Dating apps are not selective according to motivational goals, they allow users to fill in a variety of goals as an optional field, which means users themselves have to manage the ambiguity of the motivations of the other person they are meeting.

The matchmaker often oscillates between the profile of the general clientele and the specific profile of Juliette to affirm that she fits with the agency's portfolio. Fanny also highlights the qualities of her clientele to draw applicants' attention to the options they might find. Fanny herself also identifies with Juliette's profile as a foreigner, sometimes using the words "*like you*", "*like us*". The matchmaker is thus building a sense of belonging to the agency based on the characteristics similar to her, the agency and the available choice. Nevertheless, the discourse is also oriented towards diversity of choice: *"we love variety for our members. The journalists are bilingual, creative, we also have writers. We try to mix between shy, extroverted, uptight people or others, more or less sporty."* The mix is made on personality criteria, occupation and languages spoken. With a dating app, the sense of belonging merely passes through the branding strategy, as in the agency, and the interfaces. In contrast, the matchmakers do this face-to-face and through personalization, through similarity with the matchmaker and through diversity with the other members. The diversity makes it possible to balance the homogeneity and heterogeneity of the market that the agency is building.

4.5.2. Value Estimation. Establishing a Contract

Value Estimation is the practice of estimating a person's value in the agency's market in light of how easy it will be to find them a partner. The estimation determines the price that the member has to pay for a 6-month service contract. It means that the prices of the service are fluctuant as they depend on the profile of the new member in respect to the market.

The last step of the interview is to discuss the service contract. Throughout the interview with Juliette, Fanny was able to estimate her value on the market based on the profiling. Thus, the matchmaker can offer the member a service according to her profile and what she is looking for. This step already shows that the matchmaker is admitting the applicant to the agency without the need to consult her partner. As Fanny mentioned before, Juliette has a common but attractive profile that is well sought after. Fanny established a six-month contract for a given amount.

The value of the member is based on the characteristics that describe them in comparison to the characteristics that are sought after in the market. If the member's characteristics correspond to what the market desires, their value decreases since they are easy to match with another person. The difficulty of matching a person increases the value of the contract. Fanny specifies: *"depending on the profile of the member and the requirements of the search, the amount can increase up. If it is really a special profile that the person is looking for, we do a manual search, if for example the member is looking for a specific job or location, for example a person who wants to settle in London."* The reference to manual work indicates that the service implies an additional task: research work that is more time-consuming. In this case, it is more difficult for the matchmaker to find a corresponding match. The so-called automatic work, also done by the matchmaker, is easier in the sense that there are already potential candidates available to create a match.

The manual work is called *head hunting*. In this case, the agency asks another agency to search for a potential match in their networks. In turn, matchmakers can also receive requests from other agencies, asking them to propose potential matches from their networks. For example, the matchmakers received a profile by e-mail from a pilot. First, the text shows the description of the pilot's profile, written by the agency according to the data collected on the person. Then, the second and third sections of the text, "*more about him*" and "*partner profile*", are reserved for internal use. The sections describe the qualities on which the match between the pilot and another person can be based: *"remains calm on all occasions, authentic, poetic, dynamic, languages spoken, he will move, willing to travel to meet. He is looking for a younger woman, with some spoken languages, without children, family life, similar character and who does not smoke, remains open to his location."* According to the matchmakers' estimation, this profile is, unlike Juliette, difficult to place in the market. Hence, the value of the contract increases.

The estimation of the value of both members is not exclusively based on supply and demand. During the interview, for instance, the matchmaker did not consult the agency's database to find out who is available or who is searching for similar characteristics. Instead, she recalls from memory which members are available and their characteristics, mainly to attract the attention of the future member: *"we have journalists, bilinguals, and creatives"* (see first method). Then, the matchmaker estimates the facility of the member's placement in the market according to the characteristics of the member, and the speculation about their value *for* the market. This is called a self-referential process in the reputation economy (Orléan, 2015a), as I explained in Chapter I. The price is established by the matchmakers' collective beliefs. This is due to the self-referential nature of the market. Indeed, the behavior of participants in the market is influenced by the market itself: the speculation about the price that the participant believes that others will pay. In the agency, the speculation is two-fold: how much work and time it will take the matchmakers to find a partner for the person

according to the profile and the market. This process makes it possible to establish the value of the service contract, that is also the value of the person in the market.

As I showed in the development practices (see Chapter III), there is a particular business model that dating apps use, based on the distinction between freemium and premium accounts. The former limits the possibilities of usage to certain functionalities in the app (e.g. on HER, searching users in other locations). Premium accounts, however, are based on single-transactions or monthly-annual subscriptions to access additional functionalities (e.g., on Tinder, seeing only profiles that liked the user profile first in order to increase the matches). However, some apps are under investigation because of user's complaints. Subscription rates change according to user demographic characteristics (ex. age on Tinder, sex on Hinge). More recently, a media article states that Tinder has fluctuant prices but the variables that influence those changes are unknown.[89] One plausible explanation is that dating apps use algorithms that adapt the prices according to the market. In other words, they implement an algorithm to automate the manual speculation made by the matchmakers. Uber already implements this: "algorithm-controlled Surge pricing" detects shifts in rider demand and driver availability, in real time, across a city.[90]

4.5.3. Normalization. Joint and Continuous Learning

Normalization is the action of shaping the members' preferences close to the norms that are being constructed between the members and the matchmakers. The member requests a person according to the characteristics available in the market and their own characteristics and norms, while the matchmaker shapes the client's preferences according to the market and the agency's norms. It is a process that enables learning together, in order to be able to match with somebody. As the matchmaker explained it, the process constructs common knowledge.

During the interview, the member reacts to the offer according to the characteristics of the clientele at the agency that the matchmaker presented. She refers to the political orientation: *"Fanny, you said that you have a lot of people in the luxury sector, but I'd like to tell you that it's a milieu that doesn't correspond to me, I'm well off economically, but not quite high enough on the ladder, I'm simpler [...] For me it's important that the person be left-wing oriented, and precisely these people in the bank or your lawyer members, they're more right-wing. That's quite important to me. I'm Catholic, but not practising, so religion is not really important."*

The matchmaker replies as if the member is in the norm: *"We're in the business of selling, we're selling your profile to the best buyer. We hate women who are looking for someone with a very high profile, for example if they are looking for a millionaire it is to take advantage of them. On the contrary, if you're normal like us [Fanny and I] it's fine, we'll look at proposals, you haven't really settled on anything [requirements] so that's good."* She continues: *"we can work together, you are a doctor and gentlemen are interested in meeting ladies with a good professional and cultural background. In addition, you have a specialization and you are in a good age [...] we can look for a man for you, depending on your objectives, I imagine you want to have children [...] We want to learn, we are quite open otherwise it will not work, we will get to know you over time, we make the connection and then we ask you for feedback, we ask how it went, if you loved it or not. We need to build knowledge with you."*

[89] "Tinder slammed over mysterious premium pricing, transparency and data use concerns" (August 2020). Retrieved from: https://mashable.com/article/tinder-plus-different-prices-age-discrimination/?europe=true

[90] "What's happening when prices surge?". Retrieved from: https://www.uber.com/us/en/marketplace/pricing/surge-pricing/

Matchmakers also regulate the members' fantasies by emphasizing the norm, as the matchmaker explains: *"because if you Juliette, you are looking for something that is not realistic, for example you are looking for a 25 year old man [9 years younger than her], we are not going to take you"*. From the perspective of a matchmaker, one of their functions is to normalize the preferences of the clientele, to facilitate couple formation according to the model of the couple that the matchmakers construct and that is shaped reciprocally by the clientele. On dating apps, the model of the couple is presented in the profile page under the section of preferences. This section contains a list of options, mainly categorical, from which the user can select to describe the person they are looking for. Usually, this section replicates the variables that are presented for self-description. As I showed in the phenotype landscape (Chapter II), the number and the categories of choices vary according to the app. The input values are also limited and normative according to the app, as I showed in the analysis of the female morphological body (Chapter II). These are explicit ways to normalize users' preferences. In principle, users can select any option they desire to build their ideal partner. Consequently, in dating apps with manual filtering tools, users are contacted, and can potentially contact, anyone they want. For example, on a dating app, one female user with dark skin explains she is always contacted by dark skinned men, even though she is interested in finding a white man (Kessous, 2011). Therefore, the dating app increases the number of rejections. In other dating apps with machine learning algorithms like Tinder, it is possible to "normalize"[91] (in the sense that is closer to the norm) preferences by the calculation of the mean of past likes, as I showed in the previous section of this chapter. However, the prototypical model of a match is not made explicit to users on interfaces, which makes it impossible for users to review their preferences and negotiate them. In contrast to the joint learning in the agency, the design of a dating app implies that users learn how the app works and what their preferences are by themselves.

4.5.4. Data Collection. Profile Creation

Data Collection is obtaining information about the member via an online form designed by the agency. While the manual data collection from the interview is used in estimating the value of the contract, this automated data collection means members can be stored in the database, and the information recalled when necessary. In particular, it is used to find a potential match or to introduce one member to another, according to selected characteristics.

During the interview, the matchmaker presents the registration procedure. Fanny explains: *"We are very different from an online service, we are discreet, we do everything confidentially, we don't do anything online, we ask you to fill in an online form to get an idea of the person, but that's all. Then we make an appointment, you have to send us some papers by email [including proof of identity, which is compulsory] and that makes the 'enrolment' concrete; the registration with us."*

The online form is a way for matchmakers to collect more information about the person and to create a profile that can be updated later by the matchmaker. It contributes towards the normalization process, in order to introduce the member to another person in an attractive way. The profile consists of a detailed description with different dimensions: physical, social, familial, and professional. The first step is to describe oneself and then the type of person one wishes to meet, like on dating apps. The online form is a tool that distinguishes between members and organizes the work of the matchmakers. It is also a tool for members to learn how to build a model of themselves and search by reference to the norm. In this agency, some variables are mandatory and there is a drop-down list like on dating apps. However, in contrast to dating apps, there

[91] I do not refer here to the techniques of normalization in computer science.

is a high quantity of variables that are free-text fields. In addition, members have to define the criteria that will guide the matchmaking, e.g., matching according to intellectual compatibility in the 'Customize your tastes' section of the profile form. On dating apps, users only have the possibility of guiding the recommendations according to the phenotype variables available on the settings page, e.g., age range, distance range. Some apps take into account genotype variables, as I show in Tinder's case study but these are not visible to users. Finally, a main difference between the agency and dating apps is that the agency uses the data collected to assist the matchmaking process in situ with the member, which makes the interpretation of preferences easier, or at least they can be negotiated and shaped together according to the market. In addition, the data serves to find an appropriate partner as quickly as possible. Indeed, if the member finds a partner, the agency no longer has to do the work, even though the member has paid for a 6-month contract. Dating apps use data to predict user behavior, but the results are difficult to interpret by humans, as I show in Chapter III. Consequently, dating apps are constrained to predict a "successful match" based on the number of messages exchanged in the messaging interactions (Bapna et al., 2016), and the exchange of a phone number via messages (Zhang and Yasseri, 2016). Apps can also create new affordances for receiving feedback post-meeting (see Chapter II). These traces are ultimately aggregated given the difference of scale in comparison with an agency. The traces are not analyzed individually (unless a product owner in a company decides to examine one specific profile), as they are in the agency.

4.5.5. Elicitation and Omission. Mediated Introduction

Elicitation and Omission is the practice of presenting or hiding characteristics of the members that were collected when a matchmaker introduces one person to another by email. The introduction is made by means of a short text that summarizes the profile of the proposed person. Before this mediated introduction, the matchmakers discuss and agree on an appropriate a match that both members have to accept so the matchmaker provides their phone numbers.

There can be a spontaneous match. The matchmaking can take place long before the completion of the questionnaire to create a profile. After seeing the new member Juliette, the matchmaker Fanny tells her colleague that Loïc is the perfect man for Juliette. The first meeting between the member and the matchmaker allows for a pre-selection. In this case, the match is made according to information immediately available in the stock of knowledge of the matchmaker.

When a member is introduced by email, they present their valuable characteristics but without a photograph. After collecting information during the interview and through the online form, together the member and the matchmaker write a short advert, sending different version to each other until the text is complete. However, the matchmaker can adapt the text later, during an introduction. The matchmaker edits the text according to the characteristics of the other person who will receive the proposal.

The introduction is a half-standardized, half-personalized text; the matchmakers decide what information to include (elicitation) or omit. After agreeing with Fanny on the suggested match, Federica proposes one person to another by email. The first lines are standardized: *"Hello Johannes, here is a person you might be interested in..."* Then there is a description of the person, copied and pasted from the database. Some of the person's characteristics are pre-selected by the matchmakers and feature in the description: age, height, location, languages, and lifestyle. If there is a particular characteristic that needs to attract attention (as it has attracted the attention of the matchmakers) then it appears at the beginning of the email. *"If there is something special, for example a woman who is very tall, we say it, it's something to stand out, otherwise we send the same email, we don't have fun changing it,"* says Federica.

The omission of certain characteristics is also relevant to the introduction. For example, Giulia has a child, but Federica did not announce this in the email, since the man she was going to introduce Giulia to was "*open to children*". The omission of a characteristic allows avoiding that the attention is guided to that characteristic as if it was negotiable. Indeed, open to children can mean wanting to have a child or accepting other people's children.

Moreover, there are disruptive moments in a member's life that prioritize characteristics to consider for matchmaking like doing yoga: *"Simon grew up in Switzerland, he's new [in the agency], he hasn't been offered matches yet, he has children, he's ambitious, and he's looking for everything in a woman; a nice career, intelligent, cultured, she has to speak two languages at least. It's not easy, but he recently discovered yoga after a burnout and he's into it. We have Rachel, but she doesn't have a great career, she's a teacher, she does Pilates or she's a yoga teacher, I think, I'll check [on the database] because I think she does Pilates for fun and not for work."* Federica does not think it is a good match, Rachel *"is not very yoga, it's not good for a first match."*

Then, the two people are sent each other's profiles to obtain a common agreement (the desire to meet) and exchange phone numbers, again through the matchmaker. The two people are invited to have a conversation by phone, and then to agree on a date. The matchmakers receive feedback afterwards. The feedback tells the matchmakers whether the two people want to start a relationship or whether they would like to meet a new person. If this is the case, it requires discussing a new face-to-face meeting with the matchmakers. At this stage, as I explain further in the last method, the member states what they liked or did not like about the other person and about the meeting to review the preferences.

In the agency, the profile text plays a major role in the matching. Although there is a standardized email written in a certain style, the email is personalized according to what the matchmaker knows about the two persons they are matching. Firstly, standardization reduces the quantity of information from the online profile to present and therefore avoids a detailed evaluation from the member. Secondly, the text is selective in respect to the characteristics that might attract the other person's attention, or that ought to be omitted, based on the matchmakers' knowledge of the members. The process in the agency favors going on a date to get to know the person face-to-face, based on selected preferences and without seeing a photograph beforehand. On dating apps, users craft a profile that is destined for a general a public, and it is their task to update it continuously, if they wish to do so, whenever they are contacting another person. In contrast to the agency, the dating app encourages users to stay on the app and exchange messages in order to get to know the person, where the photograph and the profile page provide detailed information if they are filled in (see Chapter II, the two classes of dating). There is one aspect where dating apps function to a certain extent in the same way as the agency; that is through the reciprocity of profiles (i.e., on Tinder this is obtained via the like). However, the agency favors *dating*, while the apps favor *matching*. While the agency enables engaging to go on a date with one specific profile presented by email, the app encourages reactivity to matching in the face of a high quantity of profiles to evaluate. Users in a state of alertness are conveyed to maximize the probability of matching with somebody, and not really dating somebody. Finally, the matchmakers only require a few variables to make an introduction that can lead to a date, as the attention is captured by the possibility of getting to know the other person. In contrast, although Tinder presents 14 variables on a profile (see fig x in Chapter II), Tinder's neural networks can potentially collect thousands of other characteristics about a profile, which are not interpretable to humans. Hence, it remains to explore the utility of using such a technique and collecting so much information for dating and the formation of couples.

4.5.6. Time and Quantity Management

Time and Quantity Management is to temporize the practice of dating, as well as the quantity of dates presented to a member. It also requires the adaptation of the matchmakers to the members' availability.

In opposition to the speed of matching on dating apps like Tinder where users are in reactivity mode, in the agency the matchmakers are acting with reactivity. Indeed, they claim to have a clientele that is often busy. Therefore, the matching service focuses on saving time for members. This is one of the recurring reasons for using the agency that members give: not having the time to meet people outside their professional routine. A first temporality managed by the matchmakers refers to a service they offer: a quick and flexible follow-up. In permanent reactivity in order to assist the members according to their availability, the matchmakers call their members at noon, for no more than four minutes. They first send an SMS or a message on WhatsApp to confirm the call.

A second temporality managed is the contract period, which can be extended. The contract can be paused if members are unable to meet during a given period. The suspended time is recovered later to continue receiving proposals. In the dating app corpus of my thesis, this option does not exist on dating apps. On the contrary, one developer stated that he was programming the automated renewal of subscriptions despite the fact that he did not agree with that business decision.

A final temporality managed by the agency refers to the meeting itself. Fanny and Federica try to manage the time of the meetings by introducing people every two or three weeks, which they justify as a service of "*quality*" and not of "*quantity*", in contrast to dating apps. The matchmakers wait for members to provide feedback on the match, because *"it's not about being behind them all the time. If a match is refused or if the member does not want a second match with his current match, the matchmakers wait a few days to propose another match. In this case, the member is no longer the priority."* They avoid presenting several people in parallel: *"You can't put too many things in the basket,"* says Federica. By managing the volume of proposals over time, users' frequency of evaluation is reduced, which seeks to reduce dissatisfaction and constant comparison. It also reduces the risk of running out of people. Time and quantity management in the agency is distinct to dating apps. In the latter, according to the affordances designed, the app requests more or less time connected in the app. The user decides when to open and close the app but as I showed, when a user understands the system, they acknowledge that staying on the app is important to gain visibility over the other profiles in the market that are immediately accessible to everybody. Hence, the app configures the user's time online, while the matchmakers adapt to the member's agenda and timing the frequency, and therefore the member's engagement on one date at the time.

4.5.7. Ambiguity Tolerance. Post-Meeting Feedback

Ambiguity Tolerance is the matchmakers' capability to tolerate unclear or ambiguous information when the members review their preferences after the dates. Ambiguity tolerance is defined in the literature as "the way an individual (or group) perceives and processes information about ambiguous situations or stimuli when confronted by an array of unfamiliar, complex, or incongruent clues." (Furnham and Ribchester, 1995). The concept was originally formulated by Else Frenkel-Brunswik in 1948 in the field of psychology, as "a general personality variable relevant to basic social orientation", and later more specifically as an "emotional and perceptual personality variable" (Furnham and Marks, 2013).

The matchmaker Fanny explains that *"members change their minds, we need to give a little guidance, guarantee confidentiality without giving illusions to members. It is really important, sometimes we have misunderstood the members, we have to understand the shy ones, pay attention to the interpretation, understand the signs. Some*

are very nice, they are excited, happy. We do a bit of a janitor's job, but it can also be dangerous for us". For example, a man called Malte asked to meet a woman *"between 20 and 30 years old"* after dating a woman over 30, because she did not have much time to see him again. Malte told the matchmakers that she did not have time because she has a child, which was why he wanted to find a younger woman. To manage those interpretations, the matchmakers did not search to understand further as they believed it was an implicit rejection. Instead, they adapted the new selection criteria for the next person to be introduced and did not try to explain the rejection, in order to guarantee the "confidentiality" of matching as they call it. Indeed, in internal discussions, the matchmakers believe that if the woman Malte met says she does not have time to see him again, it is not necessarily related to having a child. *"Normally, she is a motivated person,"* the matchmaker says.

Ambiguity tolerance is key in matchmaking. Matchmakers manage the ambiguity of emotions and seduction in relationships to be able to pursue their work despite uncertainty. They also manage the ambiguity's tolerance of members to comfort them when facing unclear or implicit signs of rejection from a person with whom they went on a date. Ambiguity cannot be managed by dating apps unless it is defined with limited categories for the machine's computing process in a binary language. Ambiguity is antinomic to computers because it cannot be solved according to a set of instructions with a finite number of steps that are necessary for a mathematical modeling to produce a result. Indeed, the app is programmed to provide a result, which users have learned to obtain via the design of affordances. In the development practices in Chapter III, founders and developers explain that they are contacted directly by users to request additional features in the app, or to correct bugs. It shows that users have expectations about the results that the app produces, which decreases the tolerance of ambiguity from the machine's side.

A behavior or a statement can have multiple meanings to every actor according to the situation and there is no guarantee that one can access those meanings, as Livet (1994) explains, because interpretations are undecidable. Therefore, communication implies uncertainty that has to be accepted to pursue an action based on implicit conventions that are considered common to actors. This is exactly the process that the matchmakers mediate and that is at the core of seduction, where it is not appropriate to reveal everything, but instead it is appropriate to omit certain things, and is not necessary to understand every behavior.

4.5.8. Matchmaking in Comparison to Matching

There are 10 differences between the matchmaking expertise and the functioning of dating apps based on a principle of matching.

1. The registration modality. The agency is selective in that it controls who can be a member, therefore the service is based on a principle of immediate inclusion/exclusion, while apps accept all users through free accounts and work in a dynamic of exclusion after the registration delegated to users according to their online behavior. The process of selectivity and matching is transparent in the agency. The process of matching is not transparent in the case of dating apps.
2. The agency controls the visibility on the market by selecting potential partners to meet, while in the apps users can immediately access a wide range of profiles available.
3. Despite the selectivity of the agency, the matchmakers foster diversity in the matching based on both sociodemographic variables and qualities observed. The app fosters homogamy based on the variables constructed.
4. The agency and the apps' reputation economy for estimating a person's value is based on a self-referential dynamic. They estimate the value of a person based on the speculation of their value in respect to the market. However, apps quantify and measure the value according to the variables constructed, while the agency does it by rough estimations after discussing with the person.

5. The business model is different. The agency's service is based on a six-month contract, and the apps are mainly based on the distinction between freemium and premium accounts. The agency's business model structures the service to be efficient in the given period, while in the apps the profit is made based on user retention over a longer period.
6. The agency and apps normalize the preferences for selecting a partner in different ways. On the one hand, the agency normalizes the preferences and the idealization of a partner through direct negotiation with the persons. On the other, the apps conduct the normalization through the definition of variables and their input values via GUIs.
7. In the agency, the data collection acts as a memory[92] resource for matching. In the apps, it is used for predicting matches.
8. The agency and apps perform reciprocated personalization of a match's propositions. In the former, this is conducted through revealing and omitting certain information in order to attract and maintain the attention. In the latter, a user's attention is captured to stay in the app and attract others without guidance.
9. The agency manages the timing and the quantity of a person's dates, which fosters focusing and engaging with one person at the time. The app relies on the opposite dynamic of reactivity and abundance of dates to evaluate in parallel.
10. In the agency, the matchmakers develop the skill of tolerating the ambiguity of seduction that enables reviewing preferences for pursuing their work. It also enables to them to comfort people in case of unclear rejections. This is not possible to manage on dating apps.

It remains to be known whether dating based strictly on computable quantified qualities or on human matchmaking results in couple formation. How many couples are formed and how long they stay together is a question that only longitudinal surveys can answer in the long term. A data analysis I conducted with the agency, with a sample of 1,000 members, shows that 70% of members decided to establish a relationship with a partner they found in the agency. However, dating apps are not strictly designed to form couples as the diversity of motivational goals presented in the GUIs shows. In contrast, in the agency, the matchmakers control the goal of the service in advance, through the "recruitment" process. Despite this distinction of purposes between the two services, each expertise shapes the process of dating well before achieving a goal. The process ultimately has an impact on the results that members can get from the service.

4.6. Conclusion

This chapter presented a comparative study of Tinder's matching algorithmic system operationalized by machine learning, and the expertise of matchmaking operationalized by human intermediation in a Swiss matrimonial agency. In dating apps, companies and users learn from the machine. In the agency, matchmakers and members learn about dating together.

The results show that on Tinder, the meaning of dating is constructed according to what the app's GUI is configured to capture (e.g., age, sex, swipes). In addition, it is constructed from the dimensions that result from the inferences made from those swipes and the mathematical operations applied (e.g., the mean, constructed variables, metrics, ordering). Finally, dating becomes the humans' interpretations of the machine's

[92] One could make a parallel with the history of calculation; "the stick cut served as an instrument of memory to register the paid taxes in the nineteenth century in England, and not as an instrument for arithmetic calculation. This usage was later transformed by the modern definition of "calculus"; to count (in French "*numération*") through materialized means that supported the cognitive activity." (Gardey, 2008) While, in the agency, the database and the computer serve as cognitive devices of memory for matchmaking in case the matchmakers do not have the information at hand, in dating apps these devices are acting as the main actor to provide exact accounts for matching.

outputs. Hence, matching is making sense of the machine's reality that requires a reduction of dimensionality for human interpretation. Expertise in matching simultaneously transforms the initial definition of dating as embedded in the GUI, and the users' definition of dating that is captured through user behavioral data. These mediations lead to a shift in the main actor of dating practices, from the user to the machine. Tinder's matching algorithmic system does not allow humans to answer the question "what is dating?" for users. Instead, developers or data scientists are focused on the question of what the machine can tell them about online user behavior.

In contrast, in the matrimonial agency, the results show that the meaning of dating is a negotiation between members' expectations and the matchmakers' capacity to fulfil them according to the market they have built. This negotiation is possible through a direct human mediation and a continuous process of learning together. In dating apps, the quantification and measuring of user qualities and user behavior is a process done simultaneously by companies and users. Via GUIs, users can indeed evaluate themselves and others. Paradoxically, companies and users quantify and measure different realities. The former analyzes the aggregation of data and the outputs of machine learning. The latter analyzes themselves and others according to the GUIs but based on what matters to them. In the agency, matchmakers objectify few qualities in comparison to what neural networks are capable of inferring. More importantly, matchmaking expertise is focused on reviewing the members' interpretations of their dating experiences *with* them. Although matchmakers and users do not have full access to each other's situations (matchmaking process or face-to-face meetings), they establish a human communication to learn about members' preferences and dating dynamics where technologies only assist in the process. This enables the construction of a common meaning of dating that is favored by the continuous and personalized follow-up that matchmakers provide. In addition, the construction of a meaning is conditioned by the distinct temporalities for dating defined in each service, which is dependent on the company's business model. While on dating apps, the business model is based on small fees in single transactions or monthly payments to retain the user in the app as long as possible, the agency's business model is based on one single transaction, at a higher price, so that the member leaves the service as quickly as possible.

In the following chapter, the thesis concludes with an analysis of the users' standpoint. I aim to understand the usage practices in respect to the perceived affordances and variables presented in the GUIs of dating apps.

CHAPTER V. HUMAN-MACHINE DATING

5.1. Introduction

In this chapter, I study the situated practices of dating app users to show a last interactional link to the other actors (GUIs, developers, matching algorithmic systems) in the phenomenon of online dating. In previous chapters, I provided an analysis of the interactional and embodied meaning of dating.

First, human interactions are enabled by the design of a user experience in GUIs with specific semantics that guide the action and perception of users within the reputation economy. These human interactions, as embedded in the GUI through affordances, variables, and input values, create an additional human-machine interaction nexus between end-users and the matching algorithmic system running in a dating app.

Second, I showed the embodiment of GUIs in the machine thanks to the practical translation work by developers of an abstract definition of dating into the development of a software program. The dating experience is dependent on the economic and technical standards for releasing an app in the mobile stores; these standards are set by the dominant groups, and enables a physical presence in the market and adoption by users. This economic and sociotechnical implementation of dating is what enables a matching algorithmic system. The efficiency of the machine guides the human decision to use neural networks and to calculate a mean; the graphical design of the interface guides the variable input values of neural networks; and the app stores' business models guide the data collection.

The interactions and their materialized embodiment that are a part of dating app development serve to abstract the social meaning of dating from its original sense in matchmaking expertise, to make it translatable to a machine for building a software program. However, the personal experiences of founders and developers play an important role in the definition of variables, which mean that the user representations that are embedded in the language and behavior of the machine, and later delivered to users via GUIs, are often based on stereotypes.

The aim of this chapter is to study the factual practices that enable users to build a common sense knowledge about online dating through their interaction with GUIs and other users, in both online and offline situations. Based on an interview study[93] with 40 participants of 26 different dating apps, the results present four methods that make it possible to establish communication with the machine and other humans thanks to the user's adoption, ignorance and redefinition of the affordances and variables offered by dating apps. The users' adoption of the actions designed by the app induces a machine-like behavior that users transpose to offline interactions for evaluating others. However, human interactions enable users to understand the actions of the machine and others beyond the conventional references built by the app. The capacity of humans to reclaim control of their actions ultimately enables users to reject a machine-like behavior that is systematic and normalized, and to leave the app as soon as possible, in order to begin dating offline. The material presented in this chapter is unpublished.

[93] The interviews excerpts are presented in the original language (English or French) of the interviewee

5.2. The Study of Online Dating User Practices

In this chapter I formulated the following research question:

(RQ8) How do users make sense of online dating in a reciprocated mediation between GUIs and other users?

To address RQ8, I conducted an interview study with 40 participants that use dating apps in Switzerland. In the sample there are 26 different dating apps used by the participants. Empirically, by taking the role of a learner, I engage in an offline setting with the participants while they use a dating app, in order to explore with them the contingencies that come with their practices in online dating. This method of inquiry is in alignment with Garfinkel's (1984) ethnomethodology, where social practices are a continuous achievement carried out through actions that are understood *in situ*.

From the user practices observed, I define four methods supported by the literature that users put in place to establish a human-machine communication based on what they learn in interaction with the machine and other users. On the one hand, the methods enable communication between users and the machine, where users learn to adopt the machine-like behavior of the app in order to verify the facticity of other users' profiles and the app behavior, as well as for optimizing their time and the tasks they are required to perform online. These methods, in part conditioned by the business model of the app, have a particular impact on the user interactions online and their encounters offline. On the other hand, the methods enable human communication where users learn not to follow every action that the machine suggests, to review the implicit sense of online practices, and to favor offline encounters over investing time online.

The empirical evidence of this study shows that dating apps contribute to creating a divide between humans and the machine, offline and online, men and women, and that this distinction has consequences for the way users assume they have to evaluate themselves and others to engage in dating. GUIs concretize beliefs about which factors are important in finding a date, through the metrics and quantification tools that are made conventional and delivered to users. Hence, users are distracted from the joint practice of dating to become experts in the app that measures them and at the same time enables them to measure others at distance. If users remain inexperienced on the app, they do not gain visibility in the app's recommendation results.

In the following sections, I first present a state of the art related to user practices in online dating that are produced in interaction with particular affordances and variables of GUIs, as well as with the underlying algorithmic systems. Second, I present the methods of the study where I detail the participant recruitment, the sample, and the interview procedure and analysis. Third, in the results sections I present a user's "life" journey in online dating that summarizes the observations and provides a better understanding of the interview analysis. Then, I define and discuss the four methods for making sense of dating. Fourth, I develop two discussions based on the results: one proposes a redefinition of the conventions of online dating by reviewing the process of defining such conventions; the other discusses the social stakes of the human-machine communication that users learn in online dating. Finally, I conclude the chapter, and at the same time this research. A final general conclusion of the thesis, presenting the contributions of my research and the perspectives for the study of online dating, follows this chapter.

5.2.1. State of the Art: User Dating Practices with GUIs

"The tricky part in designing [the matching algorithm] was figuring out how to take something mysterious, human attraction, and break it into components that a computer can work with. The first thing we needed to match people up was data, something for the algorithm to work with. The best way to get data quickly from people is to just ask for it."

Christian Rudder, dating app OkCupid founder. [94]

Social interactions in dating apps are shaped by the design conventions that app publishers produce, but actors develop diverse means to find a date. Dating apps are said to be spaces of "data cultures" (Albury et al., 2017) where users are the necessary laborers of this data production (Pasquinelli, 2019). For instance, in the study of Facebook's classification system for ad targeting, scholars show there is a translation (i.e., transformation) of user behavioral data into categories that classify users through a collective work between the company, algorithms, advertisers, and users. Indeed, users provide "digital-trace signals" as "explicit expressions" of interests (e.g., 'likes' on a page) that inform algorithms how to sort the users via inferences for category imputation (Cotter et al., 2021). Dating apps define variables (e.g., bra size on AdultFriendFinder; HIV status on Grindr), and users provide algorithmic input values (36B; positive) that classify the users and provide the information for the app to function. Albury et al. (2017, p. 6) highlight that "user practices, business models and app functionality co-evolve". Although the app harvests data about user behavior data to improve and to monetize the system, users learn to play the app in order to improve their chances of finding a potential partner (Ibid.).

This co-production is key to critical data and algorithm studies. More broadly, it contributes to the study of the Big Data phenomenon that furthers the fallacy of capturing users' full reality based on traces (Lewis, 2015), without taking into account the actors' perspective to understand what they consider as their reality. Dating platforms claim to be able to explain users' unconscious preferences in choosing a partner, whereas studies show that online dating practices are dependent on individual life trajectories (Hsiao and Dillahunt, 2017b) and are experienced across platforms, as well as contextualized with offline practices (Hsiao and Dillahunt, 2017a). Apps rank users via GUIs that enable data collection. In a retroactive manner, users shape the information that platforms compute, through the ways the users engage with the app when they evaluate themselves and other users.

The way the GUIs are designed, users are required to adhere to/conform to standardized structures in the ways they must describe who they are and present themselves to others. At the same time, these GUIs enable users to evaluate others and find a potential date. Consequently, these structures contribute to a "sexual datafication" by "codif[ying] users' desires into a visual, structural, and linguistic order", while directing the audience's gaze (Saunders, 2020). This is a "coded gaze": views that are embedded and propagated by coding systems that make users recognizable to the app and enable individuals to be understood in relation to how they are seen by others (Cotter et al., 2021). More broadly, dating apps form what Eva Illouz (2020) calls "scopic capitalism": a visual economic logic constituted by the beauty, fashion, sports, and media industries, where women's freedom is particularly affected in contrast to men's. For Illouz (2020), women are devalued via image production for self-presentation; their bodies are sexualized and they are reduced to, and consumed as, merchandise. More specifically, in her analysis of pornographic sites, Saunders (2020) explores the sexual datafication that the industry has created. This datafication consists of classification practices via a hyper-categorization of mainly the female body, women's behavior, and race. The inscription of this codification in dating apps' GUI through categories has been shown in Chapter II.

When the phenomenon of online dating is analyzed from the standpoint of app producers, there is the assumption that the economic logic of the dating industry formats the digital representation of actors as "statistical bodies", which reduces the individual to a set of quantifiable numerical descriptors (Rouvroy, 2013).

[94] Inside OKCupid: The math of online dating - Christian Rudder (Feb. 2013). Retrieved from https://ed.ted.com/lessons/inside-okcupid-the-math-of-online-dating-christian-rudder#review.

Yet, it is assumed that the industry programs user behavior by digitalizing and making profit from viewers' desires (Saunders, 2020). However, despite the fact that dating app users enter into a social world built by the app conventions, they appropriate dating apps in different ways.

Previous studies on online dating, in psychology, sociology and HCI, have contributed to the study of GUIs, with a particular emphasis on profile pages and on the effects they have on user behavior. In particular, scholars shed light on self-presentation and attractiveness-evaluation practices, where we can see how actors take advantage – or not – of dating app structures. Some actors manipulate profile fields to embellish their portrait, e.g., by lying about their age (Hancock, Toma and Ellison, 2007); others do not fill in the information and prefer to converse (Zytko et al., 2018). Gender profile categories enable users to clarify their identity before entering into contact with another user (Fernandez and Birnholtz, 2019). Within an environment where there is high uncertainty about the other person, actors rely on the profile page to increase trust about the interlocutor's identity (Gibbs, Ellison and Lai, 2011) or, on the contrary, to protect the their own privacy by not providing too much information. This gives the user a sense of control over the other person's gaze (Sannon, Bazarova and Cosley, 2018).

As users gain experience on the app, they realize that specific categorical variables, e.g., sporting activities, are often selected by users to craft an ideal self. They also find new practices to work around the limitations of the platform for self-description (Ellison, Heino and Gibbs, 2006). Other scholars insist that, in general, self-description pages are ignored by actors (Zytko, Grandhi and Jones, 2018, 2014). Whereas, in the case of the Grinder app, other scholars confirm that the information provided on the profile pages is mentioned during online conversations in order to achieve a goal or complete missing information (Licoppe, Rivière and Morel, 2016). In the case of three different apps for men seeking men, a study claims profile categories are reused later by the users in the free-text field for self-description. These categorical variables in the profile are used to define masculinity in a hegemonic, normative way (Miller, 2018). The variables are also mobilized offline during the face-to-face meetings by Meetic users (Kessous, 2011), which suggests the variables predefined by apps serve to establish a contact and go beyond the online environment. Another researcher (Potarca, 2020) claims heterosexual apps do not have a negative effect on the formation of couples. Instead, they foster couples with stronger intentions that those formed without the use of dating apps, as mate choices are focused on physical attraction through pictures, which means users ignore demographic and socio-economic variables

These previous studies show that users engage actively with GUIs, where they gain experience in seducing others online, which diminishes the "data-supply labor task", i.e., to provide input values for matching algorithmic systems, imposed by the app. Some user practices are influenced by the variables defined in the profile forms, but some of these variables are ignored. Moreover, users do not always trust how other users present themselves, as users learn that seduction is a staging performance where they "should" look attractive to find a date. However, these studies do not explore whether the practices that lead to gaining experience in the app influences the way users make sense of online dating. If gaining experience in using the app increases a user's trust of other users, it also retains users in the app, which diverges from the principle of shifting to an offline date.

Beyond the profile forms, other studies in online dating have begun addressing users' perception on the platforms' algorithmic systems, and the influence of this perception on dating practices. The degree to which designs provide more, or less, personalized results affects how users understand the system and their feeling of control and satisfaction when evaluating a potential partner. To users, algorithmic recommendation systems serve as external validators for selecting a partner (Tong, Hancock and Slatcher, 2016).

Following a rough classification between manual filtering and automatic personalized systems, a recent study (Sharabi, 2020) shows that believing in the capability of algorithms to choose a compatible partner has

positive effects on the outcomes of users' first dates offline, regardless of the algorithm itself. It increases users' intimacy disclosure, which helps relational bonding. The study acknowledges that one limitation is that matching systems might vary from one app to another. It examines users' understanding of algorithms as a mathematical formula for finding matches. The work did not evaluate the actual matching system of the platforms that participants were using.

Studies into the way recommendation systems within dating apps are actually used show that users put in place practices to grasp information about the system while improving their experiences. For instance, Tinder users swipe not only to search but also to learn, to "decode" profiles, through the filters and the features available on the app (Ward, 2016). During the same process of profile evaluation, users learn about the system outputs. For instance, one study (David and Cambre, 2016) about Tinder usage shows that the app controls the number of viewable profiles according to the subscription. "All interviewees knew that by changing the settings from 'searching men and women' to 'searching only men' or 'searching only women', a new cache of profiles became available". Without exploring them, the authors state that "other issues arise when users are unsure how the app works or when the protocols or structure of the app is changed without notice" (David and Cambre, 2016). An empirical study that created an app similar for simulating the recommendation system's results of Tinder shows that user behavior is analyzed to promote paid subscriptions by managing the order of profiles and user satisfaction (Courtois and Timmermans, 2018). This confirms that Tinder users are generally aware of the existence of some automated system, that they can interpret it correctly from their experiences and that they adapt their behavior accordingly. From what is afforded by the app, users develop "algorithmic imaginaries" (Parisi and Comunello, 2020), i.e., interpretations about how the system works. These imaginaries are: (1) an effective reinforcement of homophily (obtaining results similar to the user), (2) generic understanding based on geographical proximity, (3) systematic exploration of the mechanics by modifying the profile information. These imaginaries are created in part by the opacity of matching algorithmic systems, that are protected by the companies. However, when apps make the system's logic more transparent, users adapt their behavior to the quantification practices that are presented. In the analysis of the Chinese dating app Blued, Wang (2020) stresses that the conception of the app is problematic because it shapes how users datafy and expose sexuality within restricted categories and metrics by default; this process produces an "algorithmic sociality", i.e., how user experiences are based on predefined algorithmic choices.

My research extends this state of the art by analyzing how users make sense of online dating within the app in direct mediation with the affordances and variables of the system, based on an offline setting to observe user practices in situ. I contribute to the analysis of social stakes when users become experts in both using dating apps and seducing others.

5.3. Methods

5.3.1. Participant Recruitment

Participants were recruited in the French-speaking part of Switzerland (with only two exceptions from the German-speaking part) through my personal website, via flyers posted at two universities and in public spaces such as supermarkets and city center bars. A female profile account was created on different dating apps; the account description indicated that it was for research purposes, in order to recruit interviewees. This approach enabled me to avoid recruiting a majority of users in higher education on the university campus. The recruitment and analysis was guided by a framework of sufficient diversity based on dating apps used, sex, age, and subscription type. There were three reasons why this diversity was only partially

achieved. First, it was not easy to reach users from different apps by posting announcements because the majority of dating app users favor a small number of apps; the most popular ones. Therefore, creating a profile on different apps was useful to diversify the sample and the types of app used. Second, the topic of online dating requires discussing intimate personal stories, that not everyone is willing to share. While men contacted me spontaneously to participate in the study, fewer women expressed their interest. Therefore, I had to actively search for women who used dating apps, in order to balance the sample. Third, by recruiting participants in the places I know and by creating a profile on dating apps with my personal information, users older than 40 are a minority in the sample. However, users from the first two age groups, between 18 and 29 years old (50.2%), and between 30 and 39 years old (34.1%) were recruited. These two age groups are the biggest users of dating apps in Switzerland (Potarca, 2020)[95]. Further studies could be dedicated to specific age ranges that have dedicated dating apps (e.g., OurTime for users older than 50). Finally, it was more difficult to find users who have a paid account in dating apps. The majority of users, for instance in the Match group, have free accounts (out of an estimated 57 million Tinder users worldwide, only 6 million users have a paid account). In general, apps offer a free account by default. Free accounts have limitations. Users in my sample actively refused paying for a dating service. As socioeconomic status was not relevant to this research, I did not collect other demographic information about the users. This further protected the users' identities.

5.3.2. Participant Sample Construction

The participant sample (Table 1) was composed of 40 participants (25 male, 15 female).[96] 29 participants sought a member of the opposite sex, 11 sought the same sex, and three sought both. The mean age was 32; 20 (min.) and 66 (max.). 13 users had a premium account, 27 users had never paid for a subscription or feature on the app, which affects how the systems works. There were 26 different dating apps used by the participants. Simultaneously using or trying multiple apps (max. 5) was a recurrent practice. The mean was two apps; the four main apps were Tinder (23 participants), Planetromeo (7), Parship (2) and Celibataire.ch (2).[97] Despite the interest in recruiting users from different dating apps, the majority of participants in the sample used Tinder due to its popularity.[98]

[95] See supplementary material of the article. Sociodemographic descriptive statistics describe a sample of N=3,245. The full descriptive statistics of the national survey's sample are not public yet, therefore one cannot see the Swiss representative sample by sex and age.

[96] It was particularly difficult to reach women that wanted to speak about their experiences which requires further study.

[97] Celibataire.ch is a dating website popular in the French-speaking part of Switzerland and is very similar to OkCupid: one of the most popular dating apps worldwide; as a reference, to date WHO? OkCupid or celibataire.ch? has 10 million downloads in the Google Play Store (https://wiki.personaldata.io/wiki/Item:Q3555). Like OkCupid, celibataire.ch is based on a questionnaire with a high number of questions to compute a score between two profiles. For the sake of familiarity, examples from OkCupid will be given here; they were also used by this research participant sample.

[98] Participants declared using mainly Tinder as it is the app where they can find most users. As a general reference, Tinder's average subscribers worldwide were 6 million in Q1 2020 as reported by the Match Group (https://s22.q4cdn.com/279430125/files/doc_financials/2020/q1/MTCH-1Q-2020-Earnings-Release_Final.pdf). Tinder is present in 190 countries and is the most downloaded app in northern Europe and the United States, with an estimated 57 million users with free and paid accounts worldwide. Several sources confirm a majority of younger users between 18 and 30 years old and a bigger ratio of men over women (https://www.businessofapps.com/data/tinder-statistics/#2). According to Tyson et al., 2016, there majority of users are heterosexual; in a sample of 480,000 profiles in New York and London, 12% of male Tinder users identify as gay or bisexual, while this is the case in only 0.01% of female profiles. Statistics were not found for Switzerland.

TABLE 7 – LIST OF PARTICIPANTS AND DATING APP USAGE INFORMATION

ID	Account type	Seeking sex	Sex	Age	App usage region	Main app usage frequency	Main app used	N. apps used	Outcome	Registration year
User1	Freemium	Both	Male	20	Urban	Every month	OkCupid	1	Less than 5 dates	2017
User2	Freemium	Female	Male	32	Urban	Every night	Tinder	4	More than 5 dates	2016
User3	Freemium	Female	Male	23	Urban	Every day, several times	Tinder	3	Couple	2014
User4	Freemium	Male	Male	26	Urban	Every night	Planetromeo	4	Couple	2012
User5	Freemium	Female	Male	27	Urban	Twice a week	Tinder	3	Less than 5 dates	2016
User6	Freemium	Female	Male	20	Urban	Every day, several times	Tinder	3	More than 5 dates	2015
User7	Freemium	Female	Male	21	Urban	Every day	Tinder	1	No face-to-face meeting	2016
User8	Freemium	Female	Male	22	Urban	Every day	Tinder	1	No face-to-face meeting	2016
User9	Premium	Female	Male	47	Urban	Every night	Tinder	2	More than 5 dates	2018
User10	Freemium	Female	Male	31	Urban	Every day	Tinder	2	Couple	2015
User11	Freemium	Male	Female	24	Urban	Every day, several times	Tinder	2	More than 5 dates	2017
User12	Freemium	Male	Female	66	Urban	Every 2 or 3 days	Celibataire	3	Couple	2016
User13	Premium	Female	Male	34	Urban	Every day	Tinder	2	More than 5 dates	2013
User14	Premium	Male	Female	35	Urban	Non applicable	Tinder	2	Non applicable	2019
User15	Freemium	Male	Female	20	Suburban	Every night	Tinder	1	Less than 5 dates	2018
User16	Premium	Male	Female	30	Suburban	Every 2 or 3 days	Parship	3	Less than 5 dates	2013
User17	Freemium	Male	Male	31	Urban	Every day	Planetromeo	2	More than 5 dates	2016
User18	Premium	Male	Male	29	Urban	Every day, several times	Planetromeo	5	More than 5 dates	2013
User19	Freemium	Male	Male	30	Urban	Every night	Planetromeo	1	More than 5 dates	2010
User20	Freemium	Male	Male	38	Not provided	Not provided	Planetromeo	1	Couple	2008
User21	Premium	Female	Male	31	Urban	Every 2 or 3 days	Celibataire	1	Less than 5 dates	2019
User22	Freemium	Male	Female	25	Urban	Every day, several times	Tinder	3	More than 5 dates	2016
User23	Freemium	Male	Male	44	Urban	Every day, several times	Planetromeo	2	Couple	2004
User24	Premium	Male	Male	27	Urban	Every day, several times	Scruff	3	Less than 5 dates	2014
User25	Premium	Male	Male	59	Urban	Every month	Planetromeo	1	Couple	2017
User26	Freemium	Male	Male	24	Urban	Every day, several times	Tinder	3	More than 5 dates	2016

ID	Account type	Seeking sex	Sex	Age	App usage region	Main app usage frequency	Main app used	N. apps used	Outcome	Registration year
User27	Freemium	Male	Female	26	Urban	Every day, several times	Badoo	1	Less than 5 dates	2019
User28	Premium	Female	Male	52	Not provided	Every 2 or 3 days	Adult-Friend-Finder	3	No face-to-face meeting	2019
User29	Freemium	Male	Female	31	Urban	Every month	Tinder	4	More than 5 dates	2014
User30	Freemium	Female	Male	33	Urban	Every month	Tinder	3	More than 5 dates	2015
User31	Freemium	Female	Female	34	Urban	Every night	Tinder	2	Less than 5 dates	2019
User32	Premium	Male	Female	36	Urban	Every day	Parship	2	Less than 5 dates	2019
User33	Premium	Female	Male	25	Urban	Every day, several times	Tinder	3	More than 5 dates	2017
User34	Freemium	Female	Female	28	Urban	Every 2 or 3 days	Tinder	3	More than 5 dates	2016
User35	Freemium	Male	Female	43	Urban	Every night	Tinder	3	More than 5 dates	2013
User36	Freemium	Female	Male	37	Urban	Every day	Tinder	2	More than 5 dates	2016
User37	Freemium	Both	Female	34	Suburban	Twice a week	Tinder	1	More than 5 dates	2015
User38	Freemium	Both	Female	31	Urban	Every day	Bumble	2	More than 5 dates	2020
User39	Premium	Male	Female	41	Urban	Every day	Tinder	3	More than 5 dates	2017
User40	Premium	Female	Male	32	Suburban	Every day, several times	Adopteunmec	2	More than 5 dates	2018

5.3.3. Consent and Ethics

The study adhered to ethical procedures and to a data management plan concerning personal data that was approved by the EPFL Human Research Ethics Committee (HREC), No. 007-2018/22.02.2018. Participants gave their oral and written consent for the research. Their names are pseudonymized in the file transcriptions and in this interview analysis.

5.3.4. Interview Procedure

Semi-structured face-to-face interviews were conducted and audio-recorded by the researcher between November 2018 and June 2020. Recordings ranged in length from 26'31" (min.) to 1'44'22" (max.), the mean is 45'18. The transcriptions were made by a professional transcriber and myself. The interview protocol focused on the participants' usage of the app and their understanding of the system. The participants were asked to use the app during the interview while I adopted the role of a learner. For instance, they were asked to show how to create a profile, browse profiles, edit a profile, and contact a user (see more details in Chapter I, Methods of Inquiry).

5.3.5. Interview Analysis

Data were collected from 40 interviews. The data were analyzed using an inductive content analysis according to the grounded theory (Glaser and Strauss, 2009), extracting descriptive micro-codes (i.e., small units as words in a sentence) from the information retrieved and classifying the arising user practices into conceptually meaningful themes (see Tables 8 and 9). To see themes emerge, I analyzed every interview and coded every action using "In Vivo" methodology (Miles, Huberman and Saldaña, 2020) with the software NVivo 12. This coding methodology uses the participants' own words. I favored verbs and gerunds that immediate identification of an action. When a second user recalled the same action, the action was attached to the first code. The code of the first user was kept for representing the similar actions of other users. The analysis followed three coding cycles.

In the first coding cycle, all the actions mentioned by users during the interviews were coded without following any particular order. In order to avoid justifications or moral judgements in the speech of the participants, the creation of codes under In Vivo methodology enabled me to capture the course of action when users showed me how they used the app. When the actions were all coded, I proceeded to a control and cleaning step. More specifically, I verified that no codes were doubled, and merged those that conveyed the same actions.

In the second coding cycle, general themes were created in capital letters a priori to organize a typical user experience when a user first registers on a dating app: CREATING A PROFILE, BROWSING, MESSAGING, and MEETING. Creating such themes enabled me to find transversal problematics, despite interviewees using different platforms. Initially, I framed the analysis as online activities only (creating a profile, browsing, and messaging). However, when analyzing the interviews, it emerged that the face-to-face meetings played an important role in relation to users' online dating experiences. Therefore, I added the theme MEETING and kept the related actions for the analysis.

In addition to these a priori themes, during the first coding cycle I also added additional transversal themes. First, a clear distinction emerged between the actions performed by the user with the app, and the actions related to user interactions with other users. Therefore, I divided the actions into two major themes: USER-MACHINE, and USERS. With the USER-MACHINE actions, a new divide emerged between the compulsory actions of the app (e.g., filling in the mandatory fields in the profile form), and the optional ones (e.g., adding a landscape picture to suggest an interest in nature). This divide results in two new themes: MANDATORY COMPLETING, and FACULTATIVE COMPLETING. Concerning the user interactions (the second theme USERS), actions highlighted by the interviewees did not follow the typical user experience defined a priori. For example, it was not necessary to keep the step CREATING A PROFILE. However, I kept the other three steps described in the USER-MACHINE (browsing, messaging, meeting). For each step, what mattered to users was through which means they could interact with another person. I then added new themes to reflect the major design conventions of the app through which the users interacted with others (e.g., PICTURE, LIKE, MATCHING, SETTINGS, etc.). There are eight design conventions for browsing, nine for messaging, and one for meeting related to the online experience, i.e., PROFILE. The codes of the first coding cycle, which are actions, were attached to every related theme. For instance, if the user talked about liking a profile while browsing results, the code created was labelled "liking a profile" and was attached to the theme "BROWSING". This second coding cycle allowed me to identify the most recurrent actions across platforms for every theme.

The major theme USER-MACHINE contains 175 codes. The major theme USERS contains 207 codes. Given the extensive list of codes obtained, a final coding cycle was done to extract the two most frequent actions for every theme. Only the actions recalled by one person were not considered.

Finally, the most frequent actions were regrouped and defined as "methods" that enable users to make sense of online dating. Two general methods (Documentary Method and Typification) were defined according to the conceptual framework of ethnomethodology (presented in Chapter I) and two "local" new methods of online dating were defined (Reactivity and Ambiguity Tolerance). The definitions are supported by the literature review about affordances (in Chapter II). The methods were analyzed, verified, and updated with a second researcher until we reached a consensus. The methods were finally discussed with a dating app user who was contacted to corroborate the methods. The participant has been registered on dating apps for four years. I wanted to verify that the methods corresponded to real practices given her experience. The participant also helped to clarify the definitions according to her experiences on dating apps. Feedback from participants is used in qualitative data analysis in order to evaluate the major finding, and is known as "member checking" (Miles, Huberman and Saldaña, 2020, p. 303).

I do not claim that the sample is representative of user practices or the user population in a given app (this would be impossible to achieve, as dating apps do not give official statistics about their usage). The practices I identified do not pretend to show that users have one typical behavior. On the contrary, users combine multiple practices, sometimes contradictory, and can change them constantly according to every situation (i.e., a new profile they discover when browsing, a new person they met offline). My goal was to identify the methods that are transversal to platforms in order to gain a broader understanding of online dating as an affective practical reasoning and reality.

In further studies, the codes can be reviewed by researchers, and discussed with users in focus groups to update or extend them. Given the high quantity of codes, I provide the full list of codes upon request. Moreover, the participant sample can be enlarged to analyze whether sociodemographic data (location, education level, age, gender identity) influence the type of recommendation results, and the resulting interaction with the app. As I have shown in Chapter II, this type of data is requested in the majority of apps in the sample, and according to the Tinder patent analysis, they have an impact on the recommendations. Researchers (Fernandez and Birnholtz, 2019) have shown that transgender users have particular practices of self-disclosure in dating apps. Although I tried to recruit other gender identities through dedicated dating apps in order to include them in my sample, I could not reach any people who met this criterion.

TABLE 8 – LIST OF CODES FOR THE MAIN THEME USERS

Code	Frequency	Method
USERS	-	
1. BROWSING	-	
1.1 PICTURE	-	
-Sometimes I select by the description, sometimes by the picture	17	Reactivity -Hesitation
-Looking only at the pictures to go faster	7	Reactivity- Swiping
1.2 LIKE	-	
-I Like to see If somebody likes me back	7	Reactivity- Swiping
-Liking everybody to augment chances with women	5	Reactivity- Swiping

Code	Fre-quency	Method
USERS	-	
1.3 MATCHING	-	
-Cruising Friday, comparing and competing	8	Reactivity - Peer-testing
-Filtering after the match	5	Typification - Elimina-tion
1.4 SETTINGS	-	
-I don't search too far away	8	Typification - Measure Distance
-I increase it when there are no more people	6	Typification - Measure Distance
1.5 QUESTIONS	-	
-People who belong to a specific type	19	Typification- Elicitation
-Eliminating immediately	12	Typification - Elimina-tion
1.6 BLOCKING OR REMOVING	-	
-Reporting because the other user is too beautiful to like me	6	Reactivity – Fake Profile Verification
1.7 DESCRIPTION	-	
-Being attracted to users with less information	3	Reactivity- Swiping
-If they do not have a description I say no directly	3	Typification - Elimina-tion
1.8 METRICS	-	
-Looking for the little difference	4	Documentary Method - External Validation
-It is nice to analyze with the percentage	2	Documentary Method - External Validation
2. MESSAGING	-	
2.1 NOTIFICATIONS	-	
-Notifications do not work sometimes so I see the message too late	2	Reactivity- Conversa-tion

Code	Frequency	Method
USERS	-	
-Writing after receiving the notification	2	Reactivity- Conversation
2.2 PROFILE	-	
-Looking for more specific profile information to personalize the message	11	Documentary Method – Personalize Message
2.3 FLAME	-	
-I send a flame	3	Reactivity- Swiping
2.4 HIDE	-	
-Hiding myself if it is bothering me	4	Reactivity -Jamming
-I check who is online	4	Reactivity- Conversation
2.5 TEXT	-	
-Fact conversation is not knowing the other person	15	Documentary Method – Offline Verification
-Engaging in the conversation	12	Reactivity- Communicative Synchronicity
2.6 THE QUESTION	-	
-I try not to set expectations just to see how it goes	8	Ambiguity Tolerance
-It's like a game, when swiping	7	Reactivity - Swiping
2.7 DELETING	-	
-I delete the person or the person disappears	6	Typification- Elimination
-I never report, I block the person	2	Typification- Elimination
2.8 CROSS-PLATFORM	-	
-I give my number quickly but do not save all the contacts	7	Reactivity -Quick Shifting
2.9 Meeting In Real Life (IRL)	-	

Code	Fre-quency	Method
USERS	-	
-Meeting quickly to avoid wrong impressions	13	Documentary Method – Offline Verification
2.10 DEACTIVATING ACCOUNT	-	
-Deactivating and reactivating the account	2	Reactivity -Jamming
3. MEETING	-	
3.1 PROFILE	-	
-It's not matching offline	11	Documentary Method – Offline Verification
-Looking for more specific profile info online before a new meeting	6	Documentary Method – Offline Verification

TABLE 9 – LIST OF CODES FOR THE MAIN THEME USER-MACHINE

Code	Frequency	Method
USER-MACHINE	-	
1. CREATING A PROFILE	-	
1.1 MANDATORY	-	
-Describing my view of the world to others	11	Typification - Elicitation
-You have to fill in a questionnaire	3	Typification -Elicitation
1.2 FACULTATIVE	-	
-Not answering if it is not a discriminating factor	5	Typification - Non-Action
-Not writing anything	4	Typification - Non-Action
2. BROWSING	-	
2.1MANDATORY	-	
-The app selects the profiles for me	6	Documentary Method - External Validation
-Answering to see the other questions with colors	4	Typification - Elicitation

Code	Frequency	Method
USER-MACHINE	-	
2.2 FACULTATIVE	-	
-Identifying the new profiles	6	Reactivity- Conversation
-I checked how the algorithm works	6	Documentary Method - External Validation
2.3 IGNORING	-	
-I do not know how to do that or how it works	10	Typification - Non-action
-Not paying	9	Typification - Non-action
3. MESSAGING	-	
3.1 MANDATORY	-	
-Messages are not refreshing	4	Typification - Non-action
-We are obliged to like	3	Reactivity - Swiping
4. CROSS-PLATFORM	-	
-Increasing matches	8	Reactivity -Swiping
-Simpler interface	7	Reactivity - Swiping

5.4. Results

From the interview analysis, four methods were defined to present the way users make sense of online dating. The methods were drawn from the two most frequent actions of each theme as justified in the methodology section (see most frequent practices in Tables 8 and 9).

In this section, I begin by summarizing the observation of user practices in the form of a "life story" of a person using dating apps. This approach facilitates an understanding of users' practices as experienced by my interview participants, in contrast to the dating app conventions analyzed in Chapter II, which suggest that actions are pre-conceived. Dating app companies define a conceptual model of the end-user with specific affordances and variables that frame the user experience. However, users shape the user experience with their own resources and personal situations. After presenting the story, I detail and define the four methods. Finally, I discuss the results and conclude the chapter.

5.5. User Life-Story: Giulia is Dating

Before presenting the methods for making sense of online dating, in this section I summarize the observations that I made across the interviews with 40 participants in a biographic story of a user. The story provides a better understanding of the interview analysis results. The events and names in the story are fictitious.

However, the story is inspired by real-life situations extracted from the interviews, and it refers to real design conventions in different dating apps that have been analyzed. Affordances and variables from different platforms are combined into "the dating app" of the story. The story describes the "life" of a person (called Giulia) through her dating experience, which involves her user experience online *with* the app, as well as the contextualization of the practice in her offline social and personal situations. In the storytelling, the methods for making sense of online dating that result from the interview analysis are presented in parenthesis. These methods are defined and presented in the next section. The aim of the story is for the reader to "experience" the online dating phenomenon as a user, and to develop an understanding of the dating experience that I encountered in my research.

Dating App Profile Page

Giulia, 35

You crossed her twice yesterday near the city center.

Occupation: <empty>

"Enjoying life and  . Not into threesomes, guys swipe left."

FIGURE 23 – GIULIA'S DATING APP PROFILE PAGE

Giulia has been single for four years. She wants to meet different people outside her network. All her friends are already in relationships, some of them with children, and Giulia does not wish to date any of the people she already knows. She does not have much time to go out or to meet new people, as her time is filled with work, yoga, running, and volunteering. One day she decides to sign up to a dating app at a colleague's suggestion: *"you should try it, everyone is on there now, I know somebody who found a partner on a dating app. They have been together for years now and they are expecting a baby!"*

Alone on a Friday night, Giulia decides to install a dating app, just to see who is there and to pass the time. She signs up to a dating app and, after two minutes, she has an account with an automated login via her Facebook account. She is discovering how the dating app works and immediately answering the questions that the app presents to her: *"would you strongly prefer to date someone of your own skin color / racial background?", "are you ready to settle down and get married right now?", "do you like to argue?", "complete: I spend a lot of time thinking about…"* Then she decides that, with so many questions to answer, she wants to choose the ones that best describe her worldview, in accordance with the way she wants to direct the gaze on herself, and be perceived by others (*Elicitation*).

After completing her profile, Giulia starts browsing and is excited to see new faces. But she cannot see the other person's information on their profile. The app says: *"Not enough data. Answer more match questions to unlock traits"*. So she decides to answer additional questions (*Elicitation*), and in particular, those with an assigned color which, if she answers them, reveal the other person's answer too. Later, she realizes that some answering some questions can make it less likely that she will be contacted by other users. She decides not to answer to some questions; there are so many that she does not even take the time to read any further questions (*Non-Action*).

The app is colorful, with many buttons, icons, pop-ups, stars and new faces. Giulia receives a message: "Hey Giulia, you just missed a match, pay 2.99 CHF and see all the profiles that liked you already, with an additional Boost you will be on TOP". She ignores the message, as she does not know what a "boost" is (Non-action). She keeps browsing profiles and finds an interesting girl: Pauline. The girl has pink hair, seems a bit artistic, and Giulia thinks they look similar. She wants to send a message and taps on different parts of the

screen, but she cannot work out how to send a message. A new pop-up appears: "Start liking and increase your matches. Swipe left to dislike, swipe right to like". Giulia's follows the app's instructions and swipes right on Pauline's profile. A new profile appears on the screen, and another one, and another one, as though the options are never-ending. So many attractive people, it's like a game, she thinks, while she keeps swiping, yes, yes, yes, yes, no, no, no, yes, yes, no (Reactivity).

Giulia is curious about how the app works and how she is getting those results. She does some research on the internet and finds out there is a recommendation algorithm, whatever that means (*Documentary Method*). Giulia returns to the app day after day and keeps swiping. The app is very simple to use but there are no more profiles. She wants to try a new app, as there are not many women on this app who are in her location. She downloads a new app. She takes the time to read the profiles in detail and she discovers her personality type and her compatibility with another profile. According to the app, she is instinctive and empathic. She recognizes herself in the result (*External Validation*). Finally, she starts to understand the apps but she has not started interacting with users yet. A pop-up appears: *"It's a match. Pauline liked you back. Message her now"*. Excited, Giulia writes Pauline a message: *"Hi Pauline, great picture, nice to meet you. Did you have a nice day?"* Pauline does not answer but Giulia gets more and more matches, including many profiles that she did not remember liking. She discards the matches that she does not really like by clicking "unmatch" next to the profile (*Elimination*). She wants to check if Pauline has answered but Pauline no longer appears on the discussion list in the messaging window (*Elimination*). She starts messaging four other people so she is very busy. Giulia really likes a new girl and wants to write her a personalized message of introduction, so she checks the girl's profile to find out more about her (*Documentary Method*). A man starts sending her a lot of messages on the platform; Giulia does not how he managed to contact her, as she only wanted to meet girls and chose "women only" in the app settings. She blocks him without reporting him (*Elimination*) and decides to hide her online status in the app (*Jamming*). She does not want to get distracted; she is finally having an engaged conversation with a woman (*Communicative Synchronicity*). They get to know each other more and more every day through their messages.

During a night out, friends start asking Giulia how dating is going. She replies that she is messaging a nice girl, and that there are so many good-looking people on the app that she is sure she will find somebody. A friend asks if they can see Giulia's profile, and two other friends join them in browsing profiles. One friend likes some profiles for her and another girl says that she does not find as many good profiles on her own account; Giulia and her friend compare each other's results (*Peer-testing*). Giulia realizes that she gets the same type of person on this dating app: they all choose to answer the same questions if they are feminists (*Typification*). After receiving advice about how to improve her results with a better profile picture and description, Giulia leaves. She continues swiping on the way home, in the metro. She tries to hold her phone in such a way as to prevent people from seeing her swiping. She checks the app's settings and sees that her search radius is set at maximum 200 kilometers away, meaning that she is in Lausanne but might be seeing profiles from as far away as Basel. She does not want to travel so far to meet somebody, or to be in a long-distance relationship after so many years of being single. She reduces the kilometers to 15 (*Measure Distance*). She starts browsing new profiles and slowing down the swiping rhythm so that she can see more details in the profiles. She receives a notification to say that somebody has sent her a message; she writes back immediately (*Reactivity*). She goes back to browsing; sometimes she finds a description she likes, such as Nicky's *"rather quiche with nettles and sport than McDo/TV. Some salsa to get out of the comfort zone, some garden for comfort"*. Sometimes she finds a nice picture, with somebody who has a dog (*Hesitation*). She does not think that she has a clear preference about a type of person. The only thing she cannot stand is smoking. Even if the person writes "social smoker" in their profile, Giulia says NO directly (*Elimination*). She is invited on two or three dates but nothing very interesting happens. One person with whom she did not "match" offline, said on the app that she was 32 but in reality she looked like she was 45. Equally, she smokes but did not say so in her profile (*Documentary Method*), so Giulia is very disappointed.

After so many matches and messages, Giulia is getting tired of being online, so she asks somebody with whom she has just matched: *"are you up for a drink tonight?"* The other person replies: *"sure! A bar in the city center? Here is my phone number, it's easier to chat on WhatsApp"* (*Quick Shifting*). One hour before the meeting, Giulia receives a message: *"Hey, I have an unexpected meeting at work, I don't think I can make it tonight, I am really sorry. Let's reschedule, write you soon"*. Giulia is disappointed, as she was already getting ready to go out. She puts on her pajamas again, and decides to open the app to find another person who might be more motivated to really go on a date. The messages are abundant on the app. The first message says: *"Hey Giulia, what are you looking for here?"* so she screams: *"Again, the question"*. She does not want to be in a category; she remembers her last date saying she wanted a long-term relationship, and she wanted that too but it did not work at all as planned. To say that she wants a hook-up is not true either. It is just that she does not want to set expectations with somebody she does not know yet. She prefers to go on a date and see how it goes. Otherwise, the situation may turn against her… Finally, she answers: *"I look for what I can get."* (*Ambiguity Tolerance*).

The two girls had three dates in a week. Giulia is happy and wants to see her exclusively. Giulia deletes the app (a turning point in online dating). But one day, at work, a colleague suddenly asks her: *"what's the name of the girl you were dating? Do you still see each other?"* Giulia says, *"yes, Anick is her name, why?"* Her colleague shows Giulia her own phone, with Anick's profile displayed. Anick matched with Giulia's colleague on a dating app that day. Giulia is very angry and calls Anick to ask why she still has a dating app installed. Anick replies she only reactivates the app from time to time, "to check out who is there for fun; nothing serious you know" (*Reactivity*).

5.6. Methods of Human-Machine Dating

This section presents the user practices for building a factual sense of online dating that were presented in the Giulia's dating story in parentheses. From the practices identified in the interview analysis I define four main methods that regroup those practices. The methods are: documentary method; typification; reactivity; ambiguity tolerance. Note that each code in the data analysis is considered one user practice, and each method can have one or multiple codes associated. For the frequency of each practice and codes, see Tables 8 and 9. I define each method according to the observations in the study. The definitions are supported by the literature in online dating. For each practice I detail the user's reviewing process of their actions that takes place when communicating with the machine and other users. The reviewing process in certain practices rely on the design conventions in the GUI, but actions are also reviewed without those explicit conventions, through a direct communication with users online or offline. To review the actions means to identify conventions during the interaction for finding a mutual tolerance that enables pursuing the communication. When the mutual tolerance is achieved is possible to establish a human-machine communication I develop in the discussion section. This human-machine communication is what enables users to understand the machine so the app works to their benefit, and to understand the users to go on a date.

5.6.1. Documentary Method

Documentary method, in dating apps, involves searching for factual data from different sources, and linking the data to an entity (the user, the app), to build a sense of the interaction that is happening, to find relevant aspects of the user's biography, or the potential relationship between users.

The documentary method was first described by Karl Manheim (1952), Alfred Schutz (1964) and Harold Garfinkel (1967). "The method *presumes*[99] the facticity of the social world while simultaneously *creating* it." (p. 170) Scholars have considered the documentary method as a practice on its own for accounting events. Ziewitz (2017, p. 3) explains the documentary method of interpretation by means of a contemporary case, which facilitates the comprehension of the theory:

> "In Garfinkel's (1967: 78) words, the method consists of treating an actual appearance as 'the document of,' or as 'pointing to,' as 'standing on behalf of' a presupposed underlying pattern. Not only is the underlying pattern derived from its individual documentary evidences, but the individual documentary evidences, in their turn are interpreted on the basis of 'what is known' about the underlying pattern. Each is used to elaborate the other. For example, instances of discrimination in automated video surveillance might be attributed to ''biased'' algorithms. By accounting for the phenomenon (discrimination) through an underlying structure (algorithms), we make visible this structure and simultaneously provide another observation that can be used to elaborate this very structure. By treating instances of discrimination as ''the document of'' algorithms, we therefore generate the resources necessary to explain them. While this kind of reasoning is ubiquitous in everyday life, it has been especially effective in the social sciences (Button et al., 2015:80). *Taking observable features of the world as indications of an underlying entity allows the analyst to turn homologous patterns into theoretically sound accounts.*"

The documentary method enables users to personalize the first message sent to start a conversation, to validate the evaluation of a match and perform "better" according to the app's algorithmic system, as well as to verify the offline reality alone or with other dating app users.

Message Personalization

According to a statistical study of online user behavior (Bergström, 2017), writing the first message is mainly a male practice in Meetic. In our sample, ten male users declared "having to" start the conversation, in contrast to one female user. Indeed, male users assume the task of sending the first messages and acknowledge that they do not receive many answers, which leads them to confirm their belief that there are more men than women (which is impossible for users to know as apps do not provide those statistics). Consequently, male users feel as though they are in competition with each other. This speculation leads male users to personalize the messages that they send, in order to stand out from their male peers. The male users draw on the information in the female users' profiles in order to personalize the messages. As User9 states:

> *"Ouais, avant d'écrire un message ce que je fais c'est que je regarde les réponses aux questions et le profil pour écrire quelque chose d'original sinon j'aurais pas de réponses. C'est horrible parce que tu te mets sur… C'est fatiguant, sérieusement, c'est fatiguant. Je l'ai fait plein de fois. Tu connais pas, il faut que tu trouves quelque chose d'original sur son profil. Tu cherches."*

One female user remarks different male messaging practices that she identified as systematic. User15 says:

> *"malgré qu'il y ait un profil, la personne essaie de te poser les questions pour te découvrir et pas de se reposer sur ton profil. Je sais pas comment dire. Ou il utilise ton profil pour te poser des*

[99] My emphasis from the original quote

> *questions, ce qui m'est arrivé, ou alors on te pose d'autres questions. Mais quand on utilise ton profil pour te dire qu'on te connaît déjà, moi ça m'agace très vite."*

A female user identified a seemingly standardized personal message and rejects this copy-paste message practice. User32 says:

> *"c'est tellement bête ce qu'il a écrit ! Il a écrit : 'Derrière ton image floutée, je distingue une belle femme ténébreuse. Laisse-moi deviner ta couleur préférée, je pense que c'est le bleu.' Ça c'est des trucs copié/collé juste pour que la personne réponde. Je réponds même pas quoi."*

Four male users declared copy-pasting the first message because they learned is an exhausting task to document every person to personalize the high quantity of messages they have to send. The copy-pasting strategy is also adopted when users lack of references to personalize the message on apps like Tinder, where there are no extensive questionnaires like on OkCupid celibataire.ch or Parship. In contrast to male users, female users learned that this is a systematic practice of male users that they reject.

When the user is very interested in a person on the app, they often gather data from a person's profile in order to personalize a message. User1 explains:

> *"Donc ce que je fais, je vais taper un message, c'est par exemple je vais lui dire par exemple [il écrit le message] 'Hibou ! comment va ta vie ?' et ensuite, je sais pas, je vais lui parler un ti peu de ce qui m'a touché dans son profil ou je vais lui envoyer un poème, faire quelque chose comme ça parce que ça, c'est à moi de faire évidemment, c'est pas courant du tout, mais dans le sens où moi par exemple, si je me mets à la place de quelqu'un qui reçoit dix mille messages par jour j'ai pas envie de recevoir un message avec marqué 'coucou ça va ?' quoi, c'est pas possible. Donc du coup peut être que si j'ai vraiment la flemme totale et je dois par exemple demain je repars aux U.S. par exemple, et je dois envoyer un message à cent personnes parce que je sais que c'est des personnes intéressantes peut être que je vais faire juste un 'copy-paste' d'un message un peu drôle, un peu poétique mais qui n'est pas vraiment très personnalisé, mais si par exemple demain, il y a une personne à Lausanne qui est une personne magnifique et que je sais que WOW avec ce profil c'est génial, c'est quelqu'un que j'ai envie de rencontrer je vais peut-être lui faire un message très personnalisé en répondant un peu à tout ce qu'elle a mis sur son profil, etc., et puis voilà."*

Thanks to the reciprocity of perspectives, the user seeks to attract another person by standing out from others, while optimizing his user experience.

The "reciprocity of perspectives" (Leiter, p. 174) is an interpretive procedure formulated in ethnomethodology. It is a person's assumption that they can see from the other person's perspective. Moreover, it is the assumption that each person's experiences are assumed to be congruent. Differences are therefore ignored, to achieve a common understanding. "When discrepancies arise they [enable using] those differences as a schema of interpretation for understanding each other" (Leiter, p. 174). In this case, the user assumes the other person's experience to be congruent with his experience, although it is not possible to verify from the platform at this stage if there are actually differences between the assumptions and reality.

Paradoxically, when the user adopts the perspective of another person, he adopts the practice of personalization for sending a message that he would like to receive from others. However, when he adopts the machine-like behavior of sending many messages using copy-paste, he abandons the perspective of the other person to adopt a new human-machine perspective and optimize his time online.

External Validation

> *"Tu as pas accès à son questionnaire [sur Parship]. Toi, tu as juste après un onglet où c'est écrit 'moi et lui' et puis tu as des courbes d'après certains aspects du style : Est-ce que tu es instinctive ? Ou rationnelle ? Ou je sais pas quoi, ils l'ont mentionné. Et puis tu as ton score à toi et son score à lui. Ou : est-ce que tu es plus dans les sentiments ? Est-ce que tu as de l'empathie ? Est-ce que tu as une part féminine/masculine ? Quel pourcentage sur un curseur, pis tu vois juste ton résultat et le sien. Mais, à part ça, moi, quand j'ai lu le questionnaire je me disais : 'ça me correspond à fond'. Comme l'astrologie, pis c'est absurde. Je dis pas le contraire."* User32

A study (Tong, Hancock and Slatcher, 2016) shows that profile recommendations provided by an algorithmic system serve as an "external validation" to users. This external validation reduces feelings of control but it gives users a sense of validation for their matching decisions. This is confirmed by my interviews where users rely on metrics visible in the GUI that play the role of an external validator for evaluating possible dates.

However, the app provides affirmations that are unforgeable (in French "infalsifiable"), as User32 explained, like the horoscope. This is a supposed facticity provided by the app that the user recognizes, she believes in the app as an external validator of her representation and that one of another person she is interacting with for making sense of a potential relationship. Therefore, the app concretizes the beliefs of the user via the GUI and its affordances.

One app for heterosexual that presents several indicators about the matching algorithmic system is Adopteunmec. It presents indicators for evaluating a person's attractiveness, the online behavior of the opposite sex, as well as the profile of same-sex users presented as "rivals". User29 (female) explains:

> *"Je suis depuis pas longtemps sur le site. Quand tu discutes avec lui et tu vois ses points qui augmentent et puis il est là : ' Mais t'es trop la femme de ma vie, t'es incroyable.' Et en fait tu sais clairement qu'il est en train de te mentir parce que, quand ses points augmentent, ça veut dire qu'il discute avec d'autres filles. En fait c'est ça le système, de ce que j'ai compris. Le système de points, c'est qu'il y a des profils qui l'aiment lui, ça augmente ses points. Tu lui parles, ça augmente ses points [...] Le négatif pour moi c'était les points qui montaient ou tout ça parce qu'après tu analyses trop ! Les rivales ça peut être intéressant parce que tu vois un peu ses goûts en particulier. Si il avait un peu tout le monde ou des choses comme ça."*

My observations confirm the analysis of the Chinese Blued dating app (Wang, 2020), where the author stresses that sexuality is datafied by the app and exposed accordingly by the users. This datafication is possible through restricted categories (e.g., tags for body type), scales (e.g., from 1 to 10, high vs. low) and metrics (e.g., the *yanzhi* algorithm to measure attractiveness from a person's face). These categories are conceived by the app and produce an "algorithmic sociality"; i.e., users interact with others based on predefined algorithmic choices (Wang, 2020).

The metrics are made visible to users, providing transparency about how the platform ranks its users. However, this is counterproductive as it exacerbates competition and surveillance between users. In other studies, geolocation is a main affordance that is analyzed on dating apps, which causes practices of surveillance (Ma, Sun and Naaman, 2017). My observations show that surveillance is also applied to online performance.

One user searched information about "the app's algorithm", which enabled him to make sense of his online dating experience. User3:

> *"Je crois que je me démarquais pas beaucoup d'autres, après j'ai vu le ranking de Tinder et comment l'algo fonctionne derrière, je faisais pas du tout la bonne chose pour avoir un bon score. Après il y a plein d'articles là-dessus, je sais pas à quel point c'est véridique mais ce qu'ils expliquent c'est qu'en fait par ex. j'avais tendance à mettre beaucoup de filles à droite, fin à dire oui à beaucoup de filles, et apparemment il faut être, il y a une fourchette ou il faut être en termes de oui et non qui permet d'avoir un bon score, il faut toujours engager la conversation, il m'est arrivé de voir la personne parfois on regarde le profil, on regarde le plus intéressant, un morceau de musique, un truc dans la description qui risque d'intéresser, après s'il y a une fille qui a une seule photo qui n'a rien sur la description, ah elle est mignonne oui mais après je me dis qu'est-ce que je vais pouvoir lui dire, donc je dis rien, j'envoie pas des messages, ça il faut pas faire, il faut répondre rapidement."*

The user learns to review his actions according to the information acquired about the system, which interrogates his own human behavior. Indeed, he tests his knowledge about what to do in a given situation with a girl, according to the machine-like behavior he is supposed to adopt to secure a better ranking.

Offline Verification

The documentary method enables users to compare the profile information with the person during a face-to-face meeting. User11:

> *"Je dirai que c'est toujours trompeur les photos. Alors, au début, le problème c'est qu'on voit ces photos et qu'on se fait une idée après dans notre tête avec juste, je ne sais pas, trois photos. Et que, en général, quand on voit la personne, elle ne ressemble quand même pas à ce qu'on s'était imaginé parce que c'est juste des photos. [...] En plus, on ne sait pas depuis combien de temps elles sont ces photos. Si c'est des photos qui datent du jour d'avant ou bien d'il y a trois ans. Des fois, on ne sait pas trop. Et c'est vrai que ça, ça m'a quand même souvent fait. Juste que j'ai tendance à me faire tellement d'idées dans ma tête et que même, du coup, je les façonne un petit peu ces idées. Je me dis : 'Moi, j'aimerais bien que ce soit comme ça.' Sans me l'avouer et du coup, quand tu vois la personne, ce n'est pas ça. Sans qu'il y ait des gros changements mais juste pas ce que tu avais imaginé."*

The profile page provides the saliences for building an image, and as I showed in the analysis of variables and input values (Chapter II), this image is normalized by design. Consequently, the profile introduces a new cognitive device for the user, about dating with another person (the one that is projected in the profile image of the machine vs the person offline). The app provides explicit visual facts about what can be imagined. Some users complain in the interviews about meeting a person who is older than they declared in their profile, or older than they looked in their picture. However, the divergence can also be experienced as positive. User11 recalled one date where she found the other person pleasant despite what she imagined: *"Même celui que j'ai vu en dernier, quand je l'ai vu je m'attendais pas à ça. Je l'aurais pas décrit comme ça mais ça m'a quand même plu tu vois."*

A user also rejects when a user presents an offline behavior that corresponds exactly to the online behavior. User4:

> *"Ouais, il y avait un mec avec qui on s'est beaucoup écrit et franchement on s'entendait bien à l'écrit tu vois et on s'est vus dans un bar et c'était la personne la plus ennuyeuse du monde en fait, non, il est sympa parce que je le vois encore de temps en temps et ça me dérange pas de lui parler mais en fait par écrit c'était un comportement qui passait encore assez bien mais à l'oral c'était*

> *hyper chiant. Il y a quand même une différence entre, il devrait y avoir une grande différence entre la façon d'écrire et de parler et pour moi quand tu écris tu feras beaucoup plus d'attention et tu essayes là de faire des jolies phrases sauf que lui il produisait ça aussi dans la vraie vie."*

Consequently, users learn to review their own representations and the actions of users by finding a balance between what is similarly/diversely expected online and offline.

The information that is acquired online not only serves to evaluate a person, but also to justify a separation offline. User12:

> *"La meilleure rencontre c'était en mai 2014. C'était sur Célibataire et, la particularité de Célibataire, c'est qu'on peut faire un quiz [...] C'est-à-dire que chacun peut choisir les questions qu'il veut, qui lui sont importantes. Donc, moi, par exemple, j'avais « Est-ce que vous êtes capable de préparer un repas pour l'autre ? » ou « Est-ce que, pour vous, c'est important une relation fusionnelle ? » Pour moi, c'est pas important, je veux surtout pas. C'était la seule réponse qui n'était pas la même parce que lui il cherchait une relation fusionnelle. Et je pense que c'est là qu'il y a eu des difficultés justement après. Donc ce quiz est intéressant parce qu'on va chercher les questions qui nous sont importantes par exemple : « Est-ce que vous fumez ? », « Est-ce que vous buvez de l'alcool ? » Quelqu'un qui ne fume pas ou qui ne boit pas, il ne l'aurait pas rencontré. Et puis « Est-ce que vous aimez le Cenovis[100] ? » par exemple c'est une question. Moi, j'aime ça. Je suis Française mais j'aime le Cenovis. Pour lui c'était important, c'est une forme d'intégration, et voilà."*

In the above situation, the user learned to review her offline reality, her past relationship, with the online information provided by the design conventions of the app.

Peer-Testing

Finally, the documentary method enables users to understand the work performed by the app with fellow users. It consists in crosschecking the results of two users using the same app. User4:

> *"Tu vois souvent on va boire des verres avec des amis, je crois que c'était moi qui a installé ça le Cruising Friday, c'était le vendredi et on faisait du cruising, de la drague et c'était aller sur Tinder et faire de la drague, du coup ouais là on allait sur Tinder on regardait nos matchs de la semaine et on utilisait Tinder sur le moment, souvent j'étais étonné parce que quand tu es sur Tinder et tu es avec des potes qui sont aussi sur Tinder tu te mets à liker des gens et en fait tu te rends compte que sur le téléphone de ton pote il y a un mec qui t'intéresse et que tu trouves jamais chez toi et je me disais ah peut être qu'il est parti à Genève du coup je l'ai jamais trouvé par sa géolocalisation."*

A study (Bergström, 2019) qualifies the online dating phenomenon as the "privatization" of encounters which is disembedded from social practices offline. This could be the case with dating websites that require the user to be in a dedicated personal space and online via a computer. However, online dating practices are transformed by the portability affordances of mobile dating apps, where social interactions take place differently from those in the offline environment. For instance, comparing dating app results with one's peers is a common social practice among users of dating apps, confirmed by previous studies about Tinder.

[100] "Cenovis is a dark brown food paste to spread it on a slice of buttered bread popular in Switzerland (particularly Romandie)." Wikipedia definition Cenovis (2021). Retrieved from: https://en.wikipedia.org/wiki/Cenovis.

Tinder users swipe not only to search but to also learn to "decode" profiles through the filters and the affordances available on the app (Ward, 2016). During the same process of profile evaluation through swiping, users learn about the system outputs alone and with other users. For instance, one study (David and Cambre, 2016) about Tinder usage shows that the app controls the number of viewable profiles according to the subscription (paid or free). "All interviewees knew that by changing the settings from 'searching men and women' to 'searching only men' or 'searching only women', a new cache of profiles became available." In addition, "other issues arise when users are unsure how the app works or when the protocols or structure of the app is changed without notice. […] The standard free model [of Tinder] began to limit matches. For instance, during an interview, while simultaneously *tindering*, both interviewer and interviewee decided to check whether they had the same number of propositions (profiles presented/offered) by setting the same parameters of sex, age, and distance. Interestingly, while in the same physical place, they received different propositions" (David and Cambre, 2016).

Moreover, it has been observed that users of Tinder and OkCupid were particularly active in cultivating a meta understanding of the app, via experimentation, data collection and cooperation with others in order to use it more effectively through online discussions (Masden and Edwards, 2015). This fact contrasts with recent analysis in the studies of "algorithmic awareness" (Gran, Booth and Bucher, 2020) where users of other recommendation platforms, e.g. for music and films, are unaware of the platforms' underlying logic.

In that sense, (mis)understandings with the machine in online dating enable learning about the machine's outputs with others offline. However, users do not have the possibility of reviewing their actions because they cannot access to the information about how the matching algorithmic system works.

5.6.2. Typification

Typification, in dating apps, enable users to classify themselves and to classify other users in order to make a selection or elimination according to the app conventions.

"Typification" enables members of society to experience and make sense of the social world. Ethnomethodologists have shown that common-sense knowledge is constructed in part by "the stock of knowledge at hand, [which] consists of social types or idealizations of people, objects, and events that serve as points of inference and action" (Leiter, 1980, p. 5). Everyday life typifications are potentially equivocal and have multiple meanings. Knowledge has situated meanings: there is no neat and logical ordered storehouse of information and typifications as the sense is context dependent. A stock of knowledge is heterogeneous (Leiter, 1980, p. 6).

Typification enables elicitation when creating a profile, non-action to avoid being classified, elimination of other users, and measure distance between users.

Elicitation

Typification enables users choosing a particular category provided by the app for classifying themselves in the self-presentation process (according to the phenotype variables, see Chapter II). It is a declarative form that means projecting an image to display to others. It is also an action for being seen and being selected. Elicitation enables users confirming who the user is and who they are not according to a class.

On OkCupid, 15 questions are mandatory during the registration process. However, there are many prompted questions (more than 5,000 available in a search engine on the app) with predefined answers for matching, from which the user can choose to create a profile. User1 says:

> *"[OkCupid appelle ça] 'Aspirations' mais tu vois il y a plein de questions possibles, tu vois, tu peux dire 'One day I would like to' et ça c'est les intitulés tu vois, moi j'avais choisi de faire 'What I am doing with my life' mais ça correspond finalement toujours à l'aspiration donc là j'avais écrit un ti peu sur les codes, sur les films, etc., les talents 'I want to be better at' mais à chaque fois en fait l'intitulé ça décrit quand même une position qu'on a face au monde, c'est-à-dire que si je choisis un intitulé par rapport à un autre c'est parce que euh j'aimerais plus formuler ça d'une certaine façon, j'aimerais poser ce regard sur moi euh donc voilà."*

Through this practice of elicitation the user learns to select information from a range options in order to present an image to other users. This image is determined by the predefined images that the app creates.

Tinder has fewer phenotype variables for self-presentation (see Chapter II) but sociodemographic information can be key to present oneself. User23 explains how he chooses to elicit an occupation in order for him to avoid being classified under another occupation, as a form of confirming who he is not. User23:

> *"Les photos je pense. Ça reste l'âge, les photos, je pense que ça c'est pas anodin non plus. Le fait que je me présente comme personnel de l'Université de Lausanne, ça veut dire que je ne suis pas maçon. C'est triste à dire. Moi aussi, je vois des fois, je me dis, je me projette et je me dis : « Non mais, moi, avec un plombier, il a beau être joli mais ça va pas le faire. » Donc c'est pas anodin non plus que, même que Tinder permette l'affichage de ce genre de choses. Alors moi j'ai juste mis que j'étais étudiant à l'Université de xxx mais les gens peuvent vraiment mettre leur métier, leur entreprise. Donc si je veux quelqu'un de chez Nestlé ben voilà."*

In contrast to other observations (Potarca, 2020 ; Zytko, Grandhi and Jones, 2018), not all variables are ignored in the profile, as users learn to select the ones that matter, with the goal of filtering certain others. Elicitation is a practice that users learn to adopt to build a reputation and make this reputation visible to other users. In the excerpt above, one can also observe that the user learns what the machine is programmed to tell him to do via the affordances and variables. Indeed, the declarative phenotype variable in the profile page enables the user to acknowledge that self-presentation is a dual process of being visible and being selected.

Despite the high quantity of "match questions" offered in OkCupid, User1 learns which categories are conventional in forming specific types of profiles:

> *"Anarchiste, politique, féministe, végane, ça c'est [respiration profonde] fou, extrême droite ou tout ce qui est politique, capitalisme aussi, ça se répète tout le temps, tu vois voilà, « overflow *** the bourgeoise, *** patriarchy », ça c'est vraiment, ça revient tout le temps, généralement il y a quand même un style de personnalité sur OkCupid qui est assez, bon, « procrastination » c'est pareil, et puis, parce que tu vois même les questions qu'ils posent c'est « If I were to be sent to jail I will be arrested for » et donc tu vois on peut sélectionner en fait quels sont les intitulés sur OkCupid du coup il y a pas mal des gens qui sont un peu militants du coup ils mettent typiquement « If I were ment to be sent to jail... » c'est quand même des gens qui appartient à un type un peu spécifique […] Il y en a de plus conventionnels, il y a des moins conventionnels."*

The app codifies self-presentation practices that become conventional via keywords (which are categorical variables) that users learn to assemble to form a type of profile. However, users learn to identify patterns based on the tendencies observed and to classify others according to their personal categories ("a bit militant") of personality types available in their stock of knowledge.

In apps, such as Tinder, that do not contain extensive questionnaires, as OkCupid does, User6 infers profile types from the picture, according to saliences that matter to him:

> *"Les gens qui me ressemblent mentalement ont aussi des traits physiques ou vestimentaires qui me ressemblent donc je faisais un peu prêt comme ça. Par exemple moi j'écoute beaucoup de métal donc cheveux longs pour les garçons, cheveux courts pour les filles avec des piercings j'imagine qu'elles sont intéressées par ça, c'est des cliches mais des fois ça marche."*

The user simultaneously profiles by similarity ("listening to metal music") and distinction ("short hair for women") according to his own profile. Ultimately, he classifies himself and the potential couple as a meta-category of combinations based on his experience. In a machine-learning experiment (Jekel and Haftka, 2018), pictures from Tinder were collected for predicting interest (i.e., a 'like') in new user profiles based on past 'likes' given. The classification models were constructed and tested in either 120 or 1280 input dimensions extracted from another dataset outside Tinder for identifying faces.[101] The experiment shows that the machine assumes that a user likes a profile according to a high number of previously defined facial features; each one is given a numerical value that makes it possible to compute a distance from a new profile identified in a given matrix for computing a prediction.[102] In contrast to this measure of user preferences, I show that actors select the features that build a sense with their social world and previous experiences. Actors can rely on categories given in the app, but they assemble them to infer a type of profile that makes sense to them, both online and offline, and that is renewed in every situation. In other words, the actor's meaning of her-his preferences is situated.

Non-Action

Typification enable users to not performing an action or activity despite the app affordances. It can derive from a lack of understanding or from an active rejection of the affordance.

First, a user highlights their lack of knowledge about certain affordances.

> *User29: "[ces hashtags sur Adoptunmec] je les connais pas. Et je suis vraiment pas hashtag."*
>
> *Researcher: "et les notes, les badges….?"*
>
> *User29: "Quoi ?! Ah non, non. Mais moi les notes, les hashtags, les trucs comme ça : je sais pas."*

Secondly, a user limits her actions in the app to what is mandatory. Consequently, when completing her profile, she does not undertake any additional actions in the app. User32:

> *"Ouais. J'ai pas mis grand-chose en fait. Bon là j'ai pas écrit. J'ai juste mis : 'Je vais écrire'. [Rire] Bon, ça c'est le résumé que tu mets. Donc, ça, c'est les infos obligatoires sinon tu peux pas valider. Tu peux mettre tout ça. Là moi j'ai rien écrit. Là j'ai rien écrit. Rien écrit. [Fait défiler l'écran] Là tu dois mettre trois mots obligatoires sur vingt et pas plus."*

Finally, many users do not wish to pay for a dating service. For a user, declining to pay is a way of contesting the business model. User25: *"Non. Non, non. Non, vraiment ces grands groupes qui se font de la thune sur le désespoir des gens, je vais pas payer pour"*. For another person, there is a stigma attached to paying for dating. User31: *"Maybe when I'm really desperate I will, but I'm not now. I want to focus on other stuff."*

[101] This is a process called "ground-truthing" in programming practices, see (Jaton, 2020).
[102] For an explanation about distance matrix, see (Burrell, 2016)

For another user, paying means delegating the action of finding a date to the app; a task that the user thinks he should do but that he does not want to do. User5:

> *"Ils veulent te faire payer pour tout, genre 'cette personne veut te connaitre, il faut payer [pour voir le profil]'. Payer c'est une perte de l'argent, si tu mets de l'effort tu peux tout faire un compte gratuit mais je sais que je ne mets pas d'effort, je n'ai pas des bonnes photos, c'est égal pour moi."*

This user also considers that paying is not necessary, as he has learned that the advantages that the app claims to offer do not provide guarantees for finding a match: the user believes that paying to gain access to a new profile that the app would otherwise block, is a waste of money. Consequently, he ignores the app's instructions. The transaction of paying for the service enables some users to reconsider what matters in dating: to communicate with other humans and go on a date, instead of consuming profiles.

Users learn that by not declaring, with purpose, specific information as suggested by the app allows the user to avoid being classified in a category that will disqualify them as a potential partner. I have shown in Chapter IV that this is a practice of human matchmaking, that users also apply in online dating. As DeSingly (1984) shows in the case of personal advertisements in the press, in which actors also present themselves to others through specific categories, personal reputation is constructed by omitting certain qualities, which enables actors to build the value of their capital.

On Bumble, User13 shows how he completed his profile by omitting disqualifying information according to his experience:

> *"As you can see, I can put in my job, or fill in other info, which I don't... Height is important to all girls as always; it can help to know how tall you are. Smoking, I started again [...] Dogs, I don't care about them, so I don't answer about dogs. Politics, religion, stars, and kids. [I don't fill in the zodiac] because I'm Scorpio, and a lot of people hate Scorpios."*

Users learn to "resist" to classifications and standards (Bowker and Star, 2000) that do not converge with the user's "stock of knowledge at hand" for projecting an attractive image. Common knowledge about online dating might come from both online and offline experiences, but it is relevant to the action that this knowledge is immediately available for the actor to be able to omit certain characteristics adapted to their reality.

Elimination

Typification enables users eliminating some type of profiles based on the app's conventions.

The "Match Dating" experience, based on liking and disliking profiles, facilitates the elimination according to saliences in the profile. Given the number of profiles that users evaluate in a short time, users tend to favor elimination over choosing. User21 :

> *"Je pense que c'est très classiste, après je pense juste la photo : comment est-ce qu'elle est prise, comment est-ce qu'elle est floue ou pas floue. Donc je pense que le choix de la photo, c'est pas anodin. Enfin, des photos. Des fois, on voit une catégorie entre guillemets [d'hommes] où mes copines disent : « Oh non, mon dieu ! » Ils ont trois photos. Une à torse nu au fitness, une devant la voiture, pis une autre avec leur chien. Souvent de combat. Ça j'ai l'impression que ça fait pas du tout partie de mon monde par exemple. Ou des gens qui ont des descriptions un peu très sexistes, j'ai l'impression qu'ils font pas partie de mon monde. Je n'ai pas envie de rentrer en contact avec eux. Ça supprime déjà un certain nombre d'hommes. Après, dès le départ, dans la conversation aussi. Souvent il y a pas mal d'hommes qui mettent leur métier. Des fois, quand il y a le métier*

> *qui est écrit tout d'un coup j'ai l'impression que […] J'essaie de ne pas le faire mais je le fais quand même, malheureusement. Je me dis : « Ok, il est…. » Je sais pas, par exemple, la dernière fois j'ai vu un qui disait qu'il était trader de matières premières. Et ben non, directement c'est non. Parce que je sais qu'on ne va pas partager certaines choses. […] Mais j'élimine beaucoup, beaucoup, beaucoup, beaucoup. Je pense que ça c'est un peu, j'ai l'impression que mes amis masculins qui vont, eux ils font plutôt ils likent tout sauf certaines choses. Moi, je regarde bien sur la photo si ça me plaît physiquement. Si il me plaît je vais encore regarder le profil et pis il faut vraiment qu'il y ait pas tous les éléments qui me plaisent pas pour que je le like."*

In my sample, ten men were in the habit of liking a large number of profiles to augment their chances, or only looking at the pictures to like profiles faster because in the past they had not received too many matches. Only two women did the same. Female users view this practice as typical of male users, while male users assume that women have their own selectivity practice. The two-way assumptions about each gender have a self-fulfilling effect. However, they ignore the difficulties that each other faces. On the one hand, a woman can receive a lot of matches and messages, therefore she has to eliminate. On the other hand, first, the app design generally places men at a disadvantage, as they are the ones who have to pay for the service. Second, there is an unbalanced ratio of men over women on certain apps. Among the ten male participants that like a large number of profiles, two explained that they adopted this practice because of OkCupid's affordances. This app has an implicit match system like Tinder. OkCupid does not allow users to send messages to others before liking the profile; after sending a like, the user has the option of sending a message but has to wait for the other person to like him back. Without a reciprocal like, the user cannot see the profile again to start a conversation. At the same time, OkCupid, like many other apps, blocks visibility on likes, meaning that users cannot see who likes them first. Consequently, users like to augment their chances of developing online interactions. Four other men explained that they also adopted this practice of mass liking on Tinder based on the lack of reciprocity. Mass liking is a result of men's experiences of receiving few matches or not receiving messages from women to start the conversation. This is not a practice experienced by heterosexual men only: one homosexual woman mentioned encountering the same experience on Tinder as there are few gay women.

Users "eliminate profiles" based on different saliences besides the picture: information on the profile description, the lack of information, the content of a message, as well as the user's answers to a questionnaire that is visible between two users. To access the questionnaire of another user on celibataire.ch, the user has to take a quiz and answer the same questions as the other person. The answers to the questions are given by default by the app, which allows the users to compare their answers. When the answers are visible, a user evaluates whether or not they want to contact that person. As User12 explains:

> *"Pour moi, sur ce site-là [celibataire.ch], c'est ce que j'ai beaucoup aimé ce quiz. Parce que, d'abord, vous choisissez les questions, donc vous choisissez ce qui est important pour vous et ça élimine beaucoup de choses. Par exemple, pour moi, quelqu'un qui n'aimerait pas le jazz, j'éliminerais tout de suite ou bien quelqu'un qui passe son temps devant la télévision pour moi c'est éliminé tout de suite. Des choses comme ça."*

Instead of choosing a potential partner, the user chooses the questions of the machine in order to eliminate a potential partner. The elimination practice involves removing the user from sight, without necessarily blocking the person or saying it explicitly.

Elimination can take different forms. For instance, not contacting the other person, or when, after obtaining a match, the person decides to unmatch the users so that their conversations disappear from the messaging list in the app, as I showed in the previous method. Elimination is also not answering, a practice called

"ghosting", and deleting the conversation according to the content of the first message, as one user explains in the app PlanetRomeo. User22:

> *"Je ne réponds plus. Mais je ne bloque jamais. Parce qu'il y a des fonctions pour bloquer. Je ne bloque jamais parce que, même si je croise quelqu'un dans la rue ou à une table de café et puis que j'ai pas envie de discuter avec, je vais pas tracer les gens. Je vais juste ne plus répondre. Ou alors je dis: « On ne recherche pas la même chose. » Alors si les gens sont polis et me répondent: « Ah ouais, je cherche ceci ou cela. » Je peux dire: « Écoute, ce n'est pas moi, ou c'est pas ce que je cherche. Mais merci à toi et belle soirée. » Là je réponds parce que j'estime que ça fait partie de l'éducation et de la relation qu'on a avec les gens. C'est pas parce qu'il y a un côté virtuel qu'on doit plus avoir les mêmes comportements. Mais, si les gens il n'y a même pas de: « Salut. », « Tu baises ? T'es actif ? T'as un photo de ta queue ? » Moi je ne peux pas répondre à des gens qui ne sont pas respectueux. Je mets supprimer le message. Comme ça dans les messages reçus, je supprime. Je réponds même plus parce que, si quelqu'un t'insulte sur un parking, tu ne vas pas lui dire: « Au revoir, bon après-midi. Merci de m'avoir insulté. » Sans aucune raison. Je me dis que si les gens ne se comportent pas poliment, il y a aucune raison. Je m'adapte aussi aux gens. Je vois aussi dans la manière d'écrire: « Salut, tu vas bien ? » Les premières conversations tu vois tout de suite, ça fait une espèce de tri fantastique."*

This user makes a comparison between his online and offline behavior. Even though he treats both environments as though they have the same implicit conventions, users' online actions are facilitated by the explicit conventions of the app. These conventions are "to delete" and "to sort out", which are fundamentally distinct from meeting someone offline. However, the distinction the user makes enables him, when convenient, to bring his offline experience to the app.

Measure Distance

Typification enables users to measure a distance between themselves and others. In online dating, it is both a Cartesian measure (as provided by the app geolocation affordance), and a symbolic estimation of the distance that is acceptable to a user for browsing profiles. User1:

> *"au début je sais pas, je cherchais des gens parmi toute la France et je me suis dit 'ah c'est trop cool j'ai des gens avec qui discuter tout le temps' et puis à la fin je cherchais vraiment que des gens dans Lausanne, ou à Annecy ou dans les endroits où j'habite, parce que ça me paraissait euh bref voilà ça ne m'intéressait pas, sauf qu'à Lausanne je sais pas, tu as une dizaine des personnes maximum et donc du coup euh bah finalement ça fait que donc c'est plus intéressant donc c'est un peu mon point de vue qui a changé dans le sens au début j'étais partant pour tout, je me suis dit 'trop cool, je vais voyager, je vais rencontrer des gens' et en fait, je me suis rendu compte que c'était pas si ouf que ça donc du coup j'ai raffiné, raffiné, raffiné, raffiné, jusqu'à ce que finalement l'intérêt diminue drastiquement au fur et à mesure du temps."*

This user expresses the excitement of discovering users far away, but after a certain amount of time on the app, he reviewed his practice by reducing the distance because of the effort that long-distance requires (more conversations online and more time spent traveling).

5.6.3. Reactivity

"*Reactivity* captures the user's attention in the platform by a state of alertness" (Boullier, 2019a). This alertness is based on the reaction to novelty. It produces excitement for users, which induces them to stay in the

app. Apps build novelty so that it becomes a salience. As a result, through a combination of technical and textual forms, the app leads the users to new profiles for them to contact. According to Auray (2013), this is a designed "opportunistic reactivity" that does not enable a curious exploration. Curiosity invokes an openness to discovering things by chance, and not by following pre-designed reactions to stimuli.

Users are mainly captured during the swiping, and the conversation. However, there are specific practices that enable users reviewing the actions imposed by the machine to quit the reactivity. These are hesitation and jamming. Finally, male users stay alert performing a verification task to identify fake profiles.

Swiping

Reactivity increases significantly when browsing profiles through the swipe gesture designed by Tinder (see Class 2 in Chapter II, "Match dating"). The gesture enables a rapid evaluation of profiles, with a simple finger gesture to indicate a like or dislike. User9 explains:

> *"Moi je regarde les photos, je balaye, mon premier filtre c'est physique. Je regarde même pas le texte. C'est quand la personne me plaît que je regarde le texte, sinon non. Bon, des fois, quand la personne me plaît je regarde même pas le texte pour aller vite."*

Swiping creates a desire to spend more time on the platform in order to see more profiles, at a fast rate. Users refer to this practice as "a game", rather than as "dating". Swiping at speed increases reactivity which in turn induces an automated behavior (stimuli-response), that one user identified as a disassociation of the physical gesture from cognitive reflexivity. As user10 states:

> *"I am a little bit selective [...] I mean, normally you want to get rid of it as soon as possible because [...] the girls are more picky than the boys [...] But if I see something that's, if my mind can tell my finger okay don't do this, normally I stop, but it depends."*

This practice shows that reactivity is not a form of rational decision-making, as the app assumes when defining declared preferences according to a user's swiping behavior (see Chapter IV). The observation confirms a study describing user swiping practices on Tinder as "involuntary reflexes" made by mistake or without analyzing the choices (David and Cambre, 2016).

This reactivity does not enable users to memorize what profiles they have browsed, and especially when users swipe right on all profiles to augment their chances of matching. This was a strategic practice recalled by heterosexual and homosexual men, as well as gay women, who identify as a minority on Tinder.

Consequently, users become quick at checking profiles where the saliences recalled in the interviews are saliences "out of the norm", as one user explains. On Tinder, User6 is attracted to another user who presents herself in the picture without relying on information:

> *"She only had two pictures of herself, they were pictures where she didn't show off herself, they were pictures where she was making fun of herself and I thought it was very funny, totally deliberate not to have to show off her physical appearance, it worked."*

The swiping design frames the action of browsing through reactivity. The user's gaze and attention are captured by novelty, and not just the prospect of finding a date, which is in part induced by their confrontation with self-presentation standardization via predefined profile forms. Therefore, although users browse, they stay alert so as to not miss "the opportunity" of finding a date.

Hesitation

Using the swiping affordance and variables given by the app, users do not perform actions systematically by classifying others, nor do they have clear preference criteria for choosing others via predefined categories. Instead, they review their preferences and practices based on what is attractive according to the situation, and any salience can make them change their opinion. Hesitation, a state of indeterminacy and of doubt, enables users to review their actions.

User21 illustrates this hesitation when swiping:

> *"Après, pour le swipe, pour choisir, ça me posait de nouveau des questions. Est-ce que je devrais pas choisir quelqu'un qui me correspond ? Que j'ai l'impression qui me correspond parce que c'est pas grand-chose sur les photos et la description. On peut pas vraiment exactement savoir. Est-ce que je devrais quand même choisir quelqu'un qui me correspond plus et peut-être, comme ça, ça pourrait marcher ? Mais au final, la découverte apporte plus pour moi, pour l'instant."*

User11 illustrates this hesitation according to different saliences identifiable either in the personal description, or on the physical evaluation:

> *"Ben, là, par exemple, j'aurai directement mis non. Après, je regarde souvent la description parce que je trouve que c'est quand même intéressant parce que quelqu'un où, juste physiquement j'aurais dit non, sa description ça peut me faire changer d'avis. Ou quelqu'un où, physiquement j'aurais dit oui, la description ça peut aussi me faire changer d'avis. Après, je regarde les photos, et puis je dis oui ou non."*

Hesitation is at the center of pragmatic sociology. In the landmark text *On Justification* (Boltanski and Thévenot, 2006), the authors claim that social actors should be understood by the plurality of their actions that, sometimes in contradiction, are manifested by disruptive moments such as hesitation for building a judgment. Hence, hesitations mark a misalignment with the meaning of the interaction as expressed by the machine, and translated by the actor in situ.

Humans in particular have the capacity for hesitation. However, hesitation also emerges in mediation with the machine that enables communication with other humans. This mediated communication between humans leads to speculation about the other humans, which increases the moments of hesitation. In an offline communication environment, two humans review their actions in immediate interaction, while on the dating apps there is both communicative synchronicity and delayed communication. Users constantly receive information via the app's affordances; as I have shown, the profile page constitutes an important resource for knowing about the other person in a preliminary step where there is not yet any communication. In this case, when browsing profiles, the hesitation emerges from a type of human interpretive procedure formulated as the "et cetera principle" (Leiter, p. 174). This principle is comprised of two assumptions depending on the person's position. On the one hand, "the speaker assumes that the hearer can fill in the unstated but intended meanings in the talk despite deliberate or presumed vagueness due to acquired routine practices (the et cetera assumption)". On the other hand, "the hearer assumes that the speaker will say something at a later point in the conversation that will clarify the ambiguous expression (retrospective and prospective sense of occurrence)" (Leiter, p. 174).

In online dating, when a user creates a profile, the user assumes that the other user can fill in the unstated meaning (for instance, when presenting a profile picture posing with a dog). This is the et cetera assumption. The user who sees the picture can assume that the user presenting the picture will say or do something at a later point to clarify the ambiguous expression. This is the retrospective and prospective sense of occurrence. However, given the reactivity of online dating, this possibility of fulfilling the meaning is disabled as users

have to match first, and they pass quickly from one picture to another. In addition, as elimination does not leave room for negotiation, the elimination practices that users adopt make it impossible to clarify the meaning of the picture.

Premium Account for Choosing

Users also learn that by paying a premium account they can refrain the state of alertness induced by the app. A male user adopts the opposite behavior to swiping right. He swipes left to select the matches he wants to invest time in over messaging. In contrast to users looking to increase their matches, this user wants to avoid being overloaded. He is swiping mostly left for three main reasons. First, to avoid *unmatching*; that is eliminating users. Second, to avoid starting new conversations. Thirdly, to spend less time browsing on the app.

Firstly, the user avoids unmatching. In this practice, the user is ambivalent between what the app can analyze from his behavior online, which could give him a bad score, and what the other user could feel about the unmatching, because being unmatched is something that he has already experienced before.

> *Researcher: "I have heard that some men just swipe right."*
>
> *User13: "No, I am more swiping left, left, left, because I think if I unmatch too much without a reason, and, I mean, every unmatching is kind of painful, an ache, I have been unmatched before, so, somehow you don't take it personally but, in some situations you take it personally so I try not to unmatch too much, because I think that if Tinder is a little bit smart, they'd want to improve the experience, they will downgrade me as an unmatcher so I'd rather not unmatch too much."*

Secondly, the user is selective when liking as he considers it an effort to start new conversations.

> *"And then, since I know the pain of writing, and the time I need to be in the app, I have this thing, I swipe to the right, Oh, no, it's really a match! I didn't really want a match, now I don't know what to write, because the person is somehow boring, you do not know how to start talking with her, she looks already boring, she is looking at the mirror, showing her abs and her body, so you think what should I write to her?"*

The user can be selective because he has a premium account, which guarantees him matches. However, after obtaining the matches he recognizes there are still steps to complete before dating, like the conversation, which is time-consuming and leads him to, finally, reduce the amount of time he spends on the app.

> *User13: "But I have more success with Tinder Boost, with Tinder Boost you will have all of a sudden, twenty, twenty five matches in half an hour, but outside of the boost if you don't pay they don't show you anymore. I think it's a huge benefit, especially with Tinder Gold you don't have to swipe, all you see are only those that already liked you."*
>
> *Researcher: "That's why you are more selective because you already know they liked you."*
>
> *User13: "It's sometimes swiping as well, I know another app as well, which I prefer using, it's called Bumble, in this one I don't have a premium account [...] Bumble is much smaller which is very convenient, so you swipe, and at some point you run out of people very quickly."*

The contrasting practices of premium accounts and freemium accounts shows that a dating app's business model predefines users' exploration practices. Premium users can choose matches, therefore the matches are not a novelty for them. Instead, the novelty comes when they manage to establish a conversation with somebody afterwards. Freemium users have to like and wait in a state of uncertainty. Therefore, a match is a novelty, at least in the beginning until they also realize before going on a date it is necessary to have a

conversation. The practices defined in both account types are time-consuming for users, but they produce different types of excitement.

Conversation

The reactions guided by the app conventions in the messaging stage can be illustrated with a user of the dating platform Planetromeo. This app belongs to the "List-View Dating" Class (see Chapter II). In Planetromeo, profiles can be contacted immediately without necessarily communicating an interest. Therefore, the app makes it possible to find users via specific categories, buttons, and colors that organize the information, and enables users to react accordingly. User25 explains:

> *"On Planetromeo, as I have a rather small distance around my city, it shows only a small portion of the people, so you can see that it is often the same people who are there. Because I also often use on Planetromeo the feature of... depending on the newness of the people. There, I see the new accounts that are created and the more I go down, the more I see that it's the same people, and you see the little white symbol there, that means that I've already written to the person or that he's already written to me, so according to that, I know that I've already written to people, and the more I go up, the more new people there are. And usually there's a little "New" logo if they've been there for a day or two."*

This reactivity designed by default induce users to adopt strategies to optimize the time in the platform for starting a conversation with the "new" profiles. User17, who also uses Planetromeo, says:

> *"D'abord je regarde les messages reçus et y réponds ou continue en conversation. Sinon sans messages reçus ensuite je regarde les utilisateurs à proximité de ma localisation puis consulte les profils qui m'attirent, photos, descriptions, etc. et j'entre en contact avec un tag et un message, toujours avec la même phrase d'accroche: 'coucou tit loup, moi c'est Paul, tu vas bien ? :)'. "*

Another user on the Bumble app recognizes the strategy of always asking the same questions. He replies by imitating the strategy. *User37 :*

> *"après tout ça c'est des questions qui me saoulent, tout le temps les mêmes questions. Alors je sais pas si c'est parce qu'elles ne savent pas engager les conversations mais c'est tout le temps les mêmes questions. Moi je fais tout le temps des copier-coller honnêtement pour répondre. C'est par exemple : "Tu fais quoi dans la vie ?" j'ai un truc genre, je sais pas, un truc type, mais si j'ai déjà répondu à une fille je fais copier-coller. Tout le temps les mêmes questions."*

Quick Shifting

The reactivity increases the desire of staying available and alert to new messages. Therefore, users make a quick shifting to other messaging platforms. Previous studies in online dating show is a common practice "to move to and extend relationships to other platforms before meeting face-to-face". "These platforms [include] Facebook, Instagram, and Snapchat. Participants also connected via the phone" (Hsiao and Dillahunt, 2017a).[103]

[103] The study does not call the practice Quick Shifting; I created the naming convention but the study is relevant as it highlights this practice of moving and continuing the relationship outside the dating platform, which I used as a definition.

> *User16: "Quite often I would give my phone number just for WhatsApp because it makes the contact easier."*
>
> *Researcher: "How does it make contact easier?"*
>
> *User16: "If I get a message now, it does not automatically show up [in the dating app], I have to log in to check the messages. But if you have WhatsApp then it just comes automatically, so you don't always have to be distracted by other things; you can just talk directly to the person. If you're online, then other people can see your profile and send you messages."*

The user reflects a desire to be up to date with the notifications, which is produced by the state of alertness induced by the app. Consequently, the user review his practice and knows that to stay up to date it is better to quickly shift to another app where the rapid synchronicity of message notification works.

Jamming

Users do not want to stay in a state of alertness permanently. Therefore, they learn jamming their online activity in order to stay focus. "Jamming is a disconnective action for jamming network signals like the transmission of messages" (Mannell, 2019).

First, when a user performs an active search online, jamming is useful in order to avoid being disturbed by others who request to chat. In apps like celibataire.ch, where it is not necessary to match before contacting somebody, the affordance "hide" enables users to present themselves as "not online" to chat, and therefore to disappear from another person's results list, which facilitates staying focused. User12:

> *"Il y avait un site mais je sais pas lequel c'était où quand on voyait que vous étiez en ligne, on pouvait vous demander de chatter. Alors, quelques fois, je répondais mais la plupart du temps j'avais pas envie parce que je voulais chercher et pas forcément chatter avec le premier qui se présentait. Alors voilà, il y avait... je sais plus… C'est Badoo où, dès qu'il y a quelque chose, dès que vous êtes en ligne, vous voyez les gens qui sont en ligne aussi. Ça dépend des moments. Des fois, la vie, comme ça, pourquoi pas. Ça dépend et puis si ça me dérange je me cache. Je reste cachée. [Je ne] veux pas de chat ou je sais pas. Ou bien je réponds pas et puis voilà."*

Finally, deactivating and activating the app allows a user to pause browsing profiles, as users consider this task time-consuming. It also means they can stop browsing when they start dating, without necessarily deleting the app, so that all the messages exchanged and matches with other profiles are not lost in case the user returns to the app at a later date.

Communicative Synchronicity

The reactivity makes users desire to engage in a conversation when they realize that obtaining matches does not allow going on a date. "Communicative Synchronicity is defined as the user's expectation of synchronized mediated communication" (Wu and Ward, 2020).

A user defines it as a key "momentum" online in order to shift to an offline date. User13*:*

> *"There are just two or three conversion steps.[104] First you have to match, then you have to write, then you have to meet, and, the really bad experience is that Tinder says 'you have matches' but in reality, the conversation is not flowing or you don't have time to write back, and the other person seems insulted because you did not write back for two days. You quickly lose the momentum. I think it's a shame that this is so based on texting, both are somewhat attracted to each other, and would be interested to meet, not necessarily to hook up but just meet, and then one of them is disappointed and you wonder why. I have not used Tinder for two weeks, three weeks, just because I am tired of texting [...] and I don't care about how somebody's weekend was if I don't know them."*

This user learned that this so-called momentum is designed by the app. Therefore, he interrogates the design because it retains him in the app, instead of spending actual time dating offline.

In contrast to "checklist" conversations, a user finds the communicative synchronicity relevant in order to get to know the person by tackling different topics. It is a crucial test before deciding to go on a date offline. *"From the content that we chat about I felt our life was not the same circle, or yeah, not the same type, so I just said 'bye'"* (User10).

Fake Profile Verification

Reactivity can also emerge when performing an error-verification task. In particular, by heterosexual male users who remain alert in order to identify fake profiles. These users try to work out if a profile meets the requirements for a real person in order to distinguish it from the fake profiles that have to be eliminated.

User5 explains his error verification of fake profiles on Tinder. He reacts to the pictures used, any missing information, the frequency of matching with a certain type of profile, and the behavioral dynamics of the conversation:

> *"It's easy to know the fake profiles, they put pictures of models or super professionally edited, or they have no description or just a picture. Normally you always match with them and then they send you a URL. I'm not stupid and I don't click. You talk to people as if they were normal profiles, without filters, they talk normally but they start the conversation always with "hello", you follow the conversation to make you trust them for 3 days, I don't give them too much attention because they don't answer right away and suddenly they say hey I don't use this app, we're doing a hangout call, then you know it's a fraud."*

Another user applies error verification in a different way. User5 seeks to identify "real women" by reacting to saliences of normality drawn from his personal experience:

> *"If the girl is not well groomed at all she is genuine, that's a good way to know if it's real. In fact they are the ones who often answer you, also the fat ones, the fat ones always give you like and talk to you first and follow the conversation."*

[104] "Conversion" is a step in the user experience design that guides the user to a specific goal predefined by the app. This user is a designer, that is why he knows key concepts in design, which provides him with a better understanding of the general logic of the app, which ultimately has an effect on his own user experience in dating apps.

Consequently, women can be rejected by mistake due to men's mistrust of dating app profiles and the stereotypes they draw from online behavior. User15 experienced the problem of being classified as a fake profile because she did not behave as the man expected a "real" woman would:

> *"If I didn't answer quickly enough, he would say: 'But you're a fake profile!' I was more attacked by pseudo-psychoanalysis, telling me what I really wanted in life, and what my words were hiding."*

Reactivity shows a coupling between users and the machine where users browse in a way that is programmed by the app conventions. This way, the user evaluates and compares profiles based on the "novelty" of being a newly registered profile, or a profile one. Users can also define a set of rules for classifying and eliminating profiles. This practice fosters the classification of women into binary categories (real or fake), as well as classification of male and female behavior (selective or not selective), that can affect users' experiences online based on mistrust.

5.6.4. Ambiguity Tolerance

Ambiguity Tolerance is the capacity to tolerate unclear information and situations. It was originally qualified by Else Frenkel-Brunswik as a perceptual and emotional "variable relevant to basic social orientation" (Furnham and Marks, 2013). I also identified this method in the human matchmaking at the matrimonial agency (see Chapter IV).

In online dating, users assume that because they are registered on a dating app there is an implicit goal (whatever that goal is). Indeed, scholars have qualified online dating as a personal engagement in a "project" (Kessous, 2011), and users systematize the practice of questioning the other user about their goal in the app, as observed in Grindr (Licoppe, Rivière and Morel, 2016).

However, in my study I observed that users learn through experience that there is no guarantee that their initial goal will be achieved according to a plan. Consequently, users review the plan in permanence and avoid answering to the question what are you looking for. User11 :

> *"Alors, des fois, il y a la question classique: 'Tu recherches quoi sur Tinder ?' Donc ça c'est vrai que des gens me l'ont déjà posée, moi je l'ai posée à des gens. Après, c'est plus la façon des gens qu'ils ont de répondre. Un petit peu vague, tu sais. 'Moi, je recherche ce qui me tombe dessus'. Tu vois? C'est ce que moi je dis pour pas me mettre dans une catégorie."*

This user rejects defining a goal in advance that classifies her. Consequently, the user's answer is ambiguous and at the same time, she expects other users to tolerate the ambiguity of her answer.

Users learn that the outcome of the dating practice can change in the course of the action. It is difficult for a human to predict this change in a way that a machine intends to. Therefore, humans use ambiguity, an inherent human capability, to deflect other users' attention away from an answer with an exact goal. This practice enables users to overcome the machine-like goal implicitly imposed by the app (to find somebody).

However, there are two other intertwined human-machine practices in the second part of the verbatim. User11:

> *"Après, aussi, c'est arrivé il y a pas longtemps, un gars qui m'a dit: « Ça te dit de venir voir un film chez moi ? » On sait tous ce que ça sous-entend. Malgré que j'aie dit non, il me dit: « Pourquoi ? » J'ai envie de dire c'est ce qui devrait être bien avec cette appli c'est qu'on devrait pouvoir*

> *prendre les « non » facilement parce que c'est tellement superficiel qu'on devrait pas s'attacher. Qu'est-ce que tu t'en fiches qu'une fille elle te dise non ? C'est comme quand tu dragues dans une boite et qu'elle te dit non. C'est vrai que, des fois, il y en a qui insistent mais je trouve que les gens ont parfois tendance à s'accrocher en disant: « Pourquoi ? » Enfin ouais… c'est vrai que des fois c'est pas sincère. C'est un truc que je reproche."*

First, a human practice: User11 believes that the question ("do you want to watch a film tonight?") alludes to a clear goal ("having sex"). Here she is making use of an interpretive behavior: the "normal forms" that "instruct each member to assume and to expect that the other will emit utterances that are recognizable, intelligible, understandable, and embedded within a body of tacit common knowledge" (Leiter, p. 174). This tacit common knowledge is built between users in interaction with the machine, but the knowledge does not refer to an explicit convention of the app which means that the machine cannot capture it (unless a designer decides to analyze that information and provide it as input to the machine). Instead, the knowledge is acquired by users and assumed to be true for the others. It is taken for granted but not validated. This speculative assumption is what makes it difficult for a machine to capture the knowledge, as users themselves do not have any guarantee that this knowledge is correct.

Finally, User11 adopts the machine-like behavior (without providing this information as input to the machine). The user qualifies online dating as "superficial": it facilitates quick eliminations without the necessity of providing justifications. She makes a comparison with offline situations:

> *"Even though I said no, he says, 'Why?' I feel like saying that's what should be good about this app is that we should be able to take the 'no's' easily because it's so superficial that we shouldn't get attached. What do you care if a girl says no to you? It's like when you go to a club and she says no."*

5.7. Discussion: A Redefinition of Online Dating Conventions

Online dating as a social practice is performed by means of explicit and implicit conventions. In contrast to the view that platforms are private spaces, I have shown that online dating is a social practice by means of the affordances in Chapter II (e.g., cross-platform connectivity, messaging in groups, public photo display), and also through the user methods for making sense of dating (e.g., peer-testing) that favor socialization and build dating as a collective practice. Specifically, the profile page defines dating as a public practice, instead of an intimate experience, to be evaluated by the app and by others. Online dating induces a publicization of the user by default. In addition, users look for information and share their experiences both online and offline to improve the results of the app, and to learn to seduce others, which builds a common sense knowledge particular to online dating. Finally, the dating practice is anchored in geolocation and sociodemographic variables for matching users in a network that extends beyond offline settings, but is still close in a socio-computable distance (see Chapter IV), which means that online dating is based on connections of neighborhood and inherited past preferences.

Yet, the definition of implicit and explicit conventions merits a discussion that is relevant for both social scientists and computer scientists. Indeed, they are both interested in deconstructing norms, values, and emotions that are based in part in conventions to understand social behavior, and that ultimately make this behavior quantifiable, For instance, with the aim of conducting a sociological study of couple formation, or designing reciprocated recommendation systems.

First, I posit that online dating relies on conventions made explicit by design. Indeed, the user experience is based on the dating app company's conceptual model of the perceptions of an end-user. This conceptual

model is translated into affordances and variables that guide the interaction and the attention of users for finding a date. These affordances and variables that are presented via GUIs to users are thus, explicit conventions. If some conventions are more prevalent across platforms, as I showed in the combination of affordances that produce two distinct classes of "List-View Dating" and "Match-Dating" (see Chapter II), every app defines conventions that all users have to accept from the moment they register with the app. In the phenotype variable landscape (Chapter II), I showed how apps create types of users according to the definition of variables of every app in the profile page. The design of a GUI is indeed, considered as "the means for communicating a design model to the user" (McGrenere and Ho, 2000). Although these design conventions are driven by the dynamics of imitation, counter-imitation, and adaptation imposed by the software industry, as I showed in Chapter III, the conceptual model that is translated into the GUI makes explicit the design conventions defined by the app companies.

The GUI affordances provide possibilities and limitations of actions that enable users to discuss with others, but they mainly serve to evaluate attractiveness and the performance of users, as I showed with the analysis of affordances and the method of external validation in this chapter. Indeed, dating apps are equipped with quantification tools for measuring oneself and others. Following Desrosières (2014), conventions are agreements on "objects and methods for defining and coding the object, the individual, or the phenomenon, to be measured. Measures result from these conventions, and they are by definition normative as they seek to put in equivalence qualities for the quantification and comparison" (Desrosières, 2014). However, this definition of conventions is adapted to the case of governmental institutions. For instance, when statisticians or politicians agree on which variables to use in an analysis of employees and employers, they also define the measure of unemployment, and the survey, as a tool to measure unemployment. Employees and employers later receive the results of the institutional study in which they participated.

In dating apps, the establishment of conventions is different. Companies decide to measure user behavior on the app, for example with machine learning methods, but they also deliver objects (i.e., the variable like), and tools (i.e., a questionnaire to conduct a personality test) so users can measure themselves and others. Users can also directly modify the evaluation of which they are the subject. It is a benchmarking strategy but different from other situations, where an authority measures and compares the performance of actors. Here, the users have to evaluate themselves and can modify the results of the evaluation by their actions on the tools delivered to them, like in the more general phenomenon of "quantified self", but applied here to affective relationships. Consequently, the objects and methods of quantification decided within a dating company are transformed into explicit and materialized conventions and delivered to users via GUIs for online dating. Norman (1999) explains, "when designing a graphical screen layout, designers greatly rely on conventional interpretations of the symbols and placement. Much of the discussion about the use of affordances is really addressing conventions," (Norman, 1999, p. 40). However, if designers interpret conventions they also reinsert the convention in society by translating it into a material object like the GUI that users integrate in their daily practices.

Consequently, in online dating, the quantification conventions made explicit in the GUI act as prior knowledge for users: what personal qualities and events have to be measured, what to perceive and what to do in order to perform better in certain apps in a heteronormative way (see Chapter II). More broadly, the knowledge constructed by apps is an idealization of a person, as it is presupposed that to seduce one has to look attractive. These conventions are defined as they are presupposed, by the companies, to have value for a desired outcome that is, in principle, computable. Indeed, the affordances and variables facilitate the running of matching algorithmic systems in a software program to automate the profile recommendations. As I showed in Chapter IV, the conventions for computing user interactions are guided in principle by the possibilities offered by the current techniques like neural networks, in combination with the design con-

straints of the GUIs (i.e., swipe gesture for capturing likes). Hence, the analysis of the establishment of conventions within a company, in alignment with Desrosières' (2014) proposition, could provide benefits for reconsidering the way user characteristics and preferences are designed by technical constraints and by the dynamics of the dating industry.

My interest is focused on the definition of conventions as benchmarks that facilitate the pursuit of an action in online dating. Given that variables, certain metrics, and methods for quantification are made explicit to users in the GUIs, it is relevant to analyze how these affect the user experience, and the establishment of affective relationships more broadly. Whatever the discussions and practices in companies that precede the resulting measures of attractiveness, users now have explicit conventions at hand in dating apps. In other words, companies provide conventions in the app for users to do the quantification work of evaluating. Even if some methods are invisible to users, for instance the matching algorithmic system, users provide inputs by swiping, and these swipes allow the system to compute quantifiable results for measuring preferences. The way actions are measured by the machine depends not only on how the conventions were decided, but also on the way users interact with them in online and offline situations. To understand user interactions, the definition of implicit conventions is also useful.

Boltanski and Thévenot (2006) define conventions as common benchmarks (in French "référentiels") that enable actors to participate in a collective action. These common references, that can be explicit or implicit, enable actors to understand each other and to cooperate based on principles and values that guide the coordination of their actions.

Livet (1994), however, analyzes the collective action from a more elementary level of human behavior. According to Livet (1994), to find a "mutual tolerance" between social actors that enables them to pursue the action and hence, to communicate, actors rely on *implicit* conventions, which are *discontinuities* of human behavior. These discontinuities act as saliences, which are *regular* movements of the body in contact with the environment in human behavior, to indicate the intention to communicate. Through these regular saliences made by one actor, it is possible for another actor to identify *decidable* references to pursue an action. The identification of these decidable references is key, as interpretations of the intentions of the actors in a situation have the property to be *undecidable*; that is, they do not provide guarantees about what the other thinks or feels about the action in the moment. This does not mean that the actor does not care about others, but in order to pursue an action with that person, the actor has to refer to a decidable reference to be able to pursue an action and avoid falling into infinite interpretations. In other words, to stop "overthinking". To Livet (1994), identifying decidable benchmarks is a necessary step for a collective action because conventions are collective *beliefs*. Livet builds his theory from implicit conventions (p. 235): "Implicit conventions are discontinuities immanent to collective action […]. It is sufficient that [actors] produce [discontinuities] through their interactions, perceive it and then intentionally use it as a reference for the evolution of collective action. These benchmarks are therefore the collective decidable substitutes for the individual intentions underlying collective action, intentions whose guarantees are however indeterminate. These references can only function if collective action continues" (see Chapter I for more details about this theory). Identifying those discontinuities enables humans to review actions, and therefore to learn to communicate. For instance, in a situation where two persons are walking side by side, an implicit convention would be that one person identifies a hand movement of the other person as an intention to communicate that that person wants to hold the hand of the other. It is thanks to the repetition of that situation throughout life that one is able to identify the hand movements as a convention (regular discontinuities) for holding each other's hands when encountering a new situation. Such situation and behavior would be easily computable for a machine, whereby a certain hand movement is the input, that leads to the output of extending the hand and holding the hand of the other person.

In contrast to implicit conventions, explicit conventions, according to Livet (1994), act as a *supposed* common framework arising from established agreements, e.g., writing or speech acts. But these explicit conventions remain a *belief,* as each individual can produce different representations about their collective meanings. Conventions emerge from the search for guarantees; these are cognitive benchmarks that provide a collective frame of interpretation when exteriorized. The core feature of Livet's theory is that on the one hand, human interpretations (in the mind) are undecidable as they rely on collective conventions, as beliefs, that cannot be verified by actors. Hence, interpretations about the intentional actions of others do not provide any guarantee. On the other hand, human actions (via the body in the environment) are decidable and make it possible to review an action. Therefore, it is the latter that enables a mutual tolerance for a collective action.

Livet (1994) does not consider social actors as purely rational agents as in the actor model in economic theory. Instead, Livet's (1994) theory is influenced by mathematical logic, from where the undecidable and decidable conditions of human actions that he defines are derived. In that sense, Livet's (1994) theory of communication is based on an algorithmic principle fitting Thévenot's (2006) theory of action. Livet and Thévenot collective theorization leads to a new theory of emotions and cognition (Livet and Thévenot, 2003). The theories developed separately by the authors (orders of worth, regimes of action, and the virtual community) are thus complementary since they seek to explain collective action by means of decidable reference benchmarks. Indeed, in order to coordinate the collective action, actors must follow a common reference that will allow the action to continue (as a sequence of instructions) is in line with the criterion of decidability in Livet's (1994) theory. However, because conventions are a supposed and shared framework of reference, actors can speculate to pursue the action and continuously readjust to the new action. Empirical studies are needed to test the generality of Livet's theories on action. However, the theory is relevant in the context of online dating, where the actions of actors are based on an algorithmic principle defined by the language of the machine. In the app, the design of affordances makes it possible to generate decidable actions that guide the individual with continuous and discreet semantics (variables) that can be measured and counted. These actions are intertwined with emotions "because we feel emotions when being evaluated, then we are capable of evaluating others" (Livet and Thévenot, 2003, p. 422).

Authors (Livet and Thévenot, 2003, p. 424) extend the process of communication initially formulated by Livet (1994) by postulating that to review and to pursue an action is not merely a cognitive operation, as the operation is always initiated by an emotion of being evaluated. This is relevant in a collective action, in contrast to an individual action where the actor is only creating a personal appreciation of the situation.

I will show the relevance and limitations of this cognitive-emotional theory in the case of online dating. In dating apps, actors' affective encounters linked to emotions are idealized by the images constructed by the conceptual model in the GUI, and the ones shaped by users. These images are verified permanently by the actions of users online, as well as during the offline interactions. Dating is therefore a practice of prospective and retrospective interpretations: who is the person I want to meet, and what is the relationship I desire, and who is the person I met, or I did not meet, and what is the relationship I obtained, or not, in contrast to the initial desires.

However, I showed that users' interpretations about dating are framed by the reference, or the explicit conventions, of the app. The language and behavior of the machine are antinomic to emotions. The app's design pretends to provide guarantees about the intuition of others by guiding their actions. The app guides, and therefore blocks users from retaking the individual and joint action for bonding. I showed that users find ways to overcome the limits of the machine by searching for additional information about the matching system and about other users, by contrasting the online reality with the offline reality, and by comparing their results with other users. However, users do not have access to updating the machine (beyond sending

traces of user behavior), in the sense of establishing a new communication that makes sense to them with others. That is why they seek to leave the app, not necessarily because they have found what they were looking for, but because there are limitations to exploring in the app.

As explained, the theory of collective action is based in the condition of decidability. This theory could lead to an analysis to find new ways for communicating in dating apps. However, this condition does not allow us to fully reflect on the case of online dating because, as showed, dating app users do not systematically follow an action (see the methods of typification/non-action, and ambiguity tolerance). I posit that in dating practices actors rely on conventions but some achieve a mutual tolerance when they learn to tolerate ambiguity. Indeed, they learn there are no guarantees in establishing a plan to engage in a relationship and that they need to constantly review the plan. Although dating app practices can lead users to problematic situations, such as distinguishing between fake and real profiles, dating techniques (what to do, what to say) are intertwined with ambiguity, where it is important to abandon certainty, or "to let go" while remaining in an intermediate state of alertness to find. In this sense, it is necessary to redefine dating apps under a new regime of exploration as defined by Auray (2016), where curiosity enables an intermediate level of perception and interaction to facilitate discovery.

Otherwise, users fall into the divide of machine versus humans. Online dating creates a divide between the machine and the other users that provokes a two-fold interpretive process for humans: what is the machine doing and saying; what are the other users doing and saying. Indeed, user practices are focused in reviewing on the one side, the actions of the machine and on the other, the actions of other users. Consequently, users establish a human-machine communication. This human-machine communication is what enables users to understand the machine so the app works to their benefit, and to understand the users to go on a date.

On the one hand, this divide induces users to adopt the machine-like behavior, see for instance: reactivity-elimination, documentary method- external validation, typification-elicitation. If these practices enable users to build an expertise on the usage of dating apps, they make difficult to establish a communication with humans to go on a date as users recognize and reject this machine-like behavior.

On the other hand, this divide induces users to take the control of the machine. Indeed, there are practices where users are reluctant to adopt the behavior of the machine, see for instance: reactivity-hesitation/jamming, typification/non-action, documentary method-peer-testing, and ambiguity tolerance. By reviewing the actions of the machine in interaction with other users, humans can master their dating experience without depending on how the app works. However, these practices could disqualify users in the competitiveness dynamic that is designed by the app. I discuss this human-machine communication in the following section.

5.8. Discussion: Human-Machine Communication

Online dating platforms are systematizing the facticity of dating through quantification practices, leading to a computational affective experience between users and the machine. Dating apps create a factual dating practice, which presumes the meaning of dating, and at the same time, construct this practice through their presumptions. This construction of facticity is possible via the explicit conventions that the app established (e.g., affordances, variables, input values, and metrics). The quantification of dating practices is conditioned by the machine capabilities, as I showed in the study of development practices. Users are not merely consumers of a computational dating experience; they shape, modify, and test the knowledge constructed by the machine. However, they also adopt this knowledge and it has an influence on their offline experiences. Although users can shape and modify the social order that is produced by the app, the model of reference is given *a priori* by the app, which limits and influences what actors can derive from it.

The human-machine communication that takes place between users and GUIs, as well as offline with other humans, is different from the one involved in the initial definition of dating that is computed. Developers are guided by the business interests of the company, and the technical constraints of the machine. In contrast, users elucidate both the possibilities and limitations for establishing relationships in apps, as presented in the methods that they develop when online dating.

When using dating apps, users establish a triadic communication that requires them to behave in a half-machine, half-human manner to find a date. This communication requires a human-machine learning throughout different practices. However, it also creates a dichotomy between the machine (by the design of a conceptual model in dating apps that users are required to adopt), and the other humans (by the opportunity that the app offers to interact with other users via GUIs that can be later met offline). This divide ultimately leads users to consider dating via apps as similar to "in real life", even though they recognize online and offline are environments fundamentally different.

Dating apps involve a specific kind of human-machine communication that is triadic, in contrast to other recommendation platforms (like Netflix or Amazon that are business-to-consumer platforms) or products such as a printer. In Lucy Suchman's (2007) analysis of the human-machine communication, Suchman shows the different (mis)understandings of the machine and the user within a dyadic human-machine communication. On the one hand, the designer presents and relies on the intended model of the end-user that is coded in the machine and displayed to the user on the interface. On the other hand, the user is supposed to know how to use the machine according to the model designed. The affordances enable the user to know some actions. Additionally, the user encounters problems or uses the app in a way that was not planned in the design. Therefore, the user makes sense of the machine within an interaction *in situ* with the machine and with other humans. These interactions cannot be performed by the printer.

On dating apps, the full reality of users cannot be captured by the machine, like with the printer, and there are also (mis)understandings that renew the pre-defined plan. However, on dating apps, the communication is different, because the service that the product intends to provide is other humans that are also using the machine simultaneously with the same purpose. This is a different scenario from customer-to-customer platforms such as Airbnb and Uber, where end-users have a distinct role (host/guest; driver/rider) while being both "customers" and "employees", of the app company.

The dating app presents firstly, an intended user through a conceptual model that defines the possible actions (via affordances) with the machine, and secondly, the "physical" representation (via variables) of the user (that registers in the app) and of other users (that can be browsed for finding a date). In that sense, human-machine communication in dating apps is triadic: a user communicates with both the machine and other humans online. This triadic human-machine communication creates a tension. There is the model created by the designer, the model shaped by the user when creating a profile, and the models of other users that can also present themselves and their preferences (what type of user they want to meet; see the method of external validation). Consequently, users have to learn to communicate with both the machine and other users, but they make sense of each actor differently as the situations with one or another are not the same.

First, when users learn to communicate with the machine, they adopt the machine's language and behavior, that is the possibilities of actions and the semantics of the app. Users learn to adopt this language and behavior via the GUI conventions that define the practices of online dating for users: to represent themselves, to browse, and to discuss with other users. Without this machine-communication, users simply cannot use the service and meet other users. In this first communication with the machine, the app decreases the uncertainty about other users by framing the user experience and the information that describes the person (see the documentary method). However, the reduction of uncertainty is just an appearance. By framing what to do and what to say, the app creates the belief that the information provided by the app provides

guarantees about dating. The explicit conventions of the app only enable the establishment of a communication with the machine, in order to pursue the online activity with others, but these conventions do not provide guarantees about the interactions with other humans. Therefore, dating requires a second type of communication with humans.

The dating apps, in their actual design, do not define a dating practice "like in real life" despite the intention to do so by increasing the quantification practices for representing humans and their practices offline. The app distinction between environments, actors, and their sex, creates implicit conventions in contradiction: how to behave online or how to behave offline, how to behave like a real profile or what is the behavior of a fake profile, how to behave like a man and how to behave like a woman. See methods of reactivity and elimination. In addition, the opacity of dating app algorithmic systems maintains the legitimacy of the system as an external validator for dating, while the transparency of some quantification practices via GUIs serves to reinforce individual beliefs by making them factual in the platform. Consequently, the app tells the user on what speculate, and makes the user believe that there are guarantees. However, by the ability that the machine provides to establish a communication with other users, users can learn to stop the speculations created by the app.

Secondly, the interactions with users enable to test the machine: the predefined user model. Because of the standardization of apps, users recognize that the user representations are normalized. That is why users seek the originality out of the norm. See method of reactivity. The interactions with several people in parallel (the accumulation of experiences) enable users to test the images constructed of others by two means; during the conversations online; during the face-to-face meetings. See method quick shifting.

Users do not learn to get to know others online through the profiles. The profile serves decreasing the uncertainty about others. The acquisition of information via profiles mainly enables establishing a communication with the machine to pursue the online activity with others. See the documentary method. Users learn to know others mainly during the conversation online and when meeting offline. See the method of communicative synchronicity.

When users learn that there is a predefined model, then they start requesting to meet offline. In this case, the distinction between the humans (other users) and the machine is necessary to leave the app. The problem arises when users start systematizing the dating experience by following the possibilities of actions offered by the machine, or trusting too much the user representation as modeled by the machine to obtain guarantees about the humans. Then, they enter in conflict with the practice of getting to know who the person really is. For instance, by applying a checklist criterion about the user, by comparing the two identities online and offline, and by eliminating massively potential dates.

The apps could therefore take an advantage of redefining a new social space without trying to replicate an experience inspired from what it exists, or what is known because users are accurate in distinguishing online from offline dating. Paradoxically, this distinction is what enables them to leave the app. To define the app as a medium and not as a social space to habit is useful for finding somebody, and leave the app. It is also useful to avoid establishing "a relationship with the platform"; through user interactions online that do not lead to any output offline.

In the contrary, when users are not accurate in making a clear distinction between the online and offline environments they produce a back-and-forth integration of knowledge from each environment that creates a tension about what to do online, and what to do offline. See method of ambiguity tolerance and elimination. Consequently, they bring the knowledge of one environment to another. In this back-and-forth movement, users have to test their knowledge permanently because the environments are being renewed in parallel but differently. Indeed, on the one hand, the online dating experience is being renewed with software updates

and automate recommendation system results from the companies. Therefore, users have to develop skills to adopt the technique. In addition, users access to a multiplicity of other profiles to test for establishing a conversation. On the other hand, the offline dating experience is being renewed when meeting a new person. Therefore, users have to update their knowledge in respect to past experiences, and the new situation encountered.

Affording a quick shift to offline-dating is crucial when creating a dating app, in contrast to video games, or online shopping for example. This affordance of quick shifting is in contradiction with the current business model of apps that seek to retain users. Therefore, companies could gain in redefining a business model that is not dependent on the Apple and Google mobile stores that leads this condition of user retention to make profit (see Chapter III).

In the current design of apps, users gain in learning that there are no guarantees about the others and about the images and behavior that the machine produces. Otherwise, they will not leave the app. If they trust the app by relying on the user representations of the machine, they risk staying captured in reactivity in the app under the grip of the affordances designed to retain them. In the contrary, when users learn there are no guarantees and decide to engage in an offline meeting by leaving the actions and the user models of the app, users enable themselves to explore in the sense of Auray (2016) "as a hazardous curiosity".

Currently, the apps use affordances and variables to build an "organized research" (Auray, 2013). An experience that serves to capture the user's attention in different "attentional regimes" but mainly in "reactivity" (Boullier, 2020). By guiding the users in seemingly explorations, they find themselves immersed in a "regime of plan" (Thévenot, 2006) for finding something (without any precise goal). The design of an exploration as an organized research has an important effect on the user behavior as it makes users feel like "at home" when they are captured in reactivity. Consequently, they engage in a "regime of familiarity" (Thévenot, 2006) with the app and not with other users, that makes difficult to leave the app. This interrogates more broadly how to redefine internet as a new social space without the dominance of certain groups. The current scenario of online experiences, as designed by dating apps, is far from being an "habitele" (Boullier, 2019a).

The human-machine learning enables communicating with the app, and at the same time with other users. If the machine-communication is necessary to use the service that the app is offering to users, it can also retain users as they become experts of the platform. The expertise is counterproductive for human dating, but it is productive for user online engagement, or in other words, to establish a relationship between the app and the user. Indeed, when building an expertise on the app, users behave like the machine and are induced to trust its image. Only if the machine-communication is abandoned to privilege the human-communication, then users will be able to engage in a relationship of any kind.

5.9. Conclusion

This chapter presented a qualitative and comparative study of user practices from which I defined four methods for making sense of dating supported by the literature. The methods enable understanding how users build a practical knowledge about dating in interaction with the machine and other users. The methods are: documentary method, typification, reactivity, and tolerance ambiguity.

The results show that the meaning of dating is guided by the affordances and variables of the GUI, which concretize the collective beliefs about what is attractive. However, these conventions are reviewed throughout the accumulation of experiences of users in online and offline interactions that can lead to a back-and-forth of knowledge from one environment to another one. Users learn to master the dating app in order to

augment their chances of matching and receiving an answer from others, but they also learn to readjust their actions for spending less time online and going on a date.

These methods finally lead me to discuss first; the definition of conventions for a better repurpose in respect with dating practices, and secondly, the human-machine communication process that takes places in online dating. In the following, I conclude with a presentation of the main contributions of this dissertation, a reflection on the empirical evidence, and perspectives for future research.

Conclusion

The present work makes three contributions—theoretical, empirical, and societal—to the fields of software and algorithmic studies regarding the analysis of relational dynamics structured and shaped by social and computing systems.

Contributions

First, this thesis introduced and applied a novel combination of sociological concepts that here serve as a common theoretical background for social and computer sciences in the applied study of online dating practices. The concepts were adopted from actor-network theory, media studies, the economy of conventions, pragmatic sociology, and ethnomethodology. They allowed for the analysis of the phenomenon from four intertwined and complementary standpoints: Graphical User Interfaces (GUIs), developers, matching algorithmic system, and users; and thus, enabled me to conceptualize the human-machine communication learning processes that are transforming modern quantification practices of self-evaluation and finding a date. This conceptual toolbox may serve as a resourceful communicational model for future investigations in practices of dating apps, and social networks. To overcome the anthropocentrism and technological determinism that persists in the modern conception of artificial intelligence, I provide an alternative approach to the study of human-machine interactions through dynamics of human and non-human actors in situ, in relation with their environments both online and offline that build a pragmatic common-sense knowledge of their reality. While considering the agency of both human and non-human actors in online dating, this thesis provided a rigorous study of their relations that demonstrates the reciprocal influence they have on each other.

Secondly, I proposed a comparative methodological framework for the analysis of GUIs, their development practices and uses, by combining qualitative and quantitative methods from social sciences and data science. The resulting comparative analysis sheds light on the replications, across app structures, which enable the dating industry to capture the users' attention. The industry is standardized based on the economic and sociotechnical factors of dominating groups that limit the possibilities of new actors to propose both new technologies and a new definition of dating. Moreover, I showed how the different environments, means, and practices of each actor for learning in action transform the users' engagement with a platform, and their interaction with potential matches under a dynamic of competitiveness. On the one hand, this thesis provides empirical evidence of dating app development practices. The results show the similarities of dating app development practices with general practices of engineering. These practices help understanding the relevance of the implementation of user experiences within the constraints of the machine's efficiency. On the other hand, this dissertation underlines the role played by the affordances and variables in a plurality of Francophone and Anglophone dating apps. These affordances and variables provide a partial view on proprietary algorithms for further study of matching systems using those variables to operationalize recommendation outputs. Moreover, it provides visibility on how mate choice preferences are structured for the study of couple formation dynamics taking place within those data structures. To the best of my knowledge, this is the first empirical and comparative research on dating apps from a plurality of perspectives.

Finally, this thesis contributed to shed light on major implications of technology development for social life. Technological companies, developers, and users engage in a collective dynamic for testing and reviewing social practices online at fast speed. Currently mediated communication mainly enables immediacy and reactivity in interactions but not processes of negotiation of agreements and preferences between actors. These processes are made more difficult and opaque as observed in the analysis of user practices when searching and measuring a potential match online, as well as in the analysis of the conceptual choices of matching algorithmic systems. The accelerated quest to develop and release platforms on the market based on a trial-error dynamic interrogates the long-term durability of the technological industry. This industry stands today on pillars of uncertainty and mistrust that actors learn to tolerate. However, social actors are fast adopters,

but also fast rejectors of technologies as they quickly recognize the limitations of apps despite the design of affordances that intend to capture users in a state of alertness.

Conclusions

In this thesis, I conceptualized a human-machine communication process that provides an understanding on how the phenomenon of online dating transforms modern practices of building affective relationships no matter what the goal of the actors is. The results show that online dating is an arena for collective and continuous experimentation where actors do not necessarily have a strategic predefined plan. Instead, the facility of creating and using online platforms enables actors to create, adopt, and test practices in a trial-and-error dynamic where they learn to review their actions with others. However, some shared conventions interrogate their social relevance for communication skills in affective relationships as they are mainly privileged by their availability at hand and their computational efficiency.

This research conducted a sociological analysis of more than 20 dating app GUIs, programming practices of nine founders, and developers working in a dating company, as well as 40 users of dating platforms in Switzerland.

I showed that the modern quantification practices of dating redefine human attractiveness and its competition measures within the reputation economy that enable capturing the attention of users with respect to an average idealized self. In addition, affordances and variables engage users within interactions that increase and accelerate the practices of dating: presenting the self, defining preferences, evaluating choices, measuring personal qualities, eliminating choices, engaging in and maintaining conversations.

To operationalize a dating experience online, developers play a major role of translators between human experiences and its representation in the machine's language when developing dating apps. Developers have the capacity of understanding both the human behavior and the technical constraints of software programming for implementing a user experience that is meaningful and implementable. However, their practical knowledge is diminished under the economic demands of the dating industry, the current usage of agile development methodologies, and the constraints of the apps' market governed by dominating groups that foster the imitation or counter-imitation of their standards, which ultimately reinforces their positioning and makes difficult the production of original inventions.

The reputation economy is now equipped with cognitive devices like GUIs for measuring the self and their interactions that drive collective beliefs about what is attractiveness, and how to evaluate the performance of attractiveness. The data collection and processing of the resulting user behavior online is facilitated by current techniques like neural networks. However, I showed that these techniques deviate the attention of dating app companies to the results of the machine. Indeed, companies move away from studying the actual interactions of end-users with the apps in order to privilege representation of users and dating experiences in a reduced and efficient way for the computer. Later, the companies' attention is captured by the algorithmic outputs of the machine, when looking for interpretations of user behavioral data that they struggle to find. Hence, matching algorithmic systems do not enable building expertise in matchmaking as my ethnographic study in a Swiss matrimonial agency showed. In this matrimonial agency, matchmaking is built through means of direct and personalized negotiation of preferences between the matchmakers and their clientele, where the temporality of the service and its business model play a major role. This is fundamentally different to the high frequency reactivity designed in dating apps.

My work presents an understanding of user practices to show that through the mediation of GUIs, humans learn to review their actions, both online and offline, based on conventional beliefs that are shaped by the GUIs guiding their attention and interaction. Consequently, users build expertise on mastering dating apps

to capture the attention of other actors. This expertise favors a fast evaluation of profiles within a state of alertness by systematizing practices. However, users also proved in my study to be fast learners where moments of hesitation and tolerance ambiguity enabled them to interrogate the algorithmic behavior induced by the apps. Users identify other user's malicious behavior, malfunctions of the app, they adopt or ignore the design conventions of the app, they quickly shift to other platforms, and reduce the time spent in the app to switch to an encounter offline.

Discussing and redefining the social and computational conventions of online dating offers possible actions for building a common-sense knowledge between engineering and social experts where the human-machine communication processes are focused on being efficient, as well as on being cooperative.

Research Perspectives

The study of dating app development and user practices presents shortcomings related to the modern computational meaning of data and algorithmic interactions between humans on learning for both computing systems and social actors. Two lines of future research are drawn:

Data epistemology. Data produced in online dating is mostly of a personal and sensitive type (e.g. gender identity, HIV status, breast size). While individuals use it to describe and evaluate themselves, it is through the collection and use of data, including sharing and reselling that the dating industry builds its economy. This state of affairs raises questions, especially as the practices in this area remain opaque. Future research would contribute to questioning the social meaning of data as actual information about the reality of actors, as well as with empirical studies of how data are defined, aggregated, collected, distributed and protected. A promising direction for future research is to define new economic models that replace the current data advertising economy on which online platforms depend and to reconsider the promises of Big Data for capturing the social reality. A new social meaning of data could bring computing systems closer to end-users for redefining the data harvesting practices and to what purposes statistical predictions are meaningful for social dynamics.

Cooperative Human-Computer Learning. Current human-machine interaction poses new challenges for dating and socialization, there is potential for novel research to investigate on how new communication connections can be re-established with cooperative learning practices to build shared knowledge. Current research is focused on complementing the skills of the humans and the machine or on replacing the expertise of one actor by another. However, an objective could be to create practical situations where there is a concrete negotiation between the makers of the platforms, the machine, and the end-users because each actor builds a different knowledge on their interaction. It is possible to build a new meaning together according to its appropriateness for both humans and machines, while considering the constraints of the technological state of the art for reducing costly and meaningless operations (e.g., power of computers, the reality reduction proper to mathematical modeling, the requirement of new techniques to interpret the often-uninterpretable machine learning techniques). Then, actors would learn how to favor the establishment of affective relationships instead of how to match constructed preferences based on algorithmic practices.

Annex

TABLE 10 – LIST OF VARIABLES CODED: DATA COLLECTION II

No.	Variable Coded
1	behavior in difficult times of the other
2	behavior in discomfort
3	behavior to calm down
4	behavior when buying a gift
5	animals
6	sports preferences and practice
7	bust size
8	circumcision
9	eye color
10	hair color
11	hair length
12	hair style
13	height
14	male pilosity
15	penis size
16	silhouette
17	weight
18	I'm up for a IRL activity
19	PlayStation Network
20	accept NSFW (Not safe for work) images
21	conditions to leave a comment
22	cybersexe experience
23	facebook login
24	gender identity visibility
25	google connect
26	how can AdultFriendFinder help you change your life?
27	instagram login
28	link partner's profile
29	login status
30	mail address
31	members in the region
32	no discussion today checkbox
33	personal interests not visible for others
34	personal website
35	phone number
36	profile picture
37	profile visibility according to sex
38	pseudonym
39	see active members
40	sex preferences visible for other users
41	share profile
42	spotify songs
43	texter type

No.	Variable Coded
44	twitter connect
45	videos
46	webcam
47	when to delete the app
48	xbox live
49	feeling of gender inclusion
50	gender identity
51	gendered pronouns
52	sexual orientation
53	age perceived
54	ambitions
55	desires
56	dreams realisation
57	negative qualities
58	personal assets
59	personal goals
60	personal pride
61	personal projection
62	personal quote
63	punctuality
64	qualities
65	self-description
66	skills
67	HIV status
68	allergies
69	last test date
70	sexually transmitted diseases
71	tracking dates for HIV tests
72	daily organisation
73	knowledge
74	learning topics
75	acceptance of your partner's sexually transmitted diseases
76	behavior in dislike of physical appearance
77	behavior in dislike of the other's behavior
78	behavior when facing somebody attractive
79	closeness in friendships
80	common dreams
81	common passions and activities
82	common vision
83	compatibility type
84	couple ambitions
85	dating plans
86	definition of roles
87	dislikes about partner's environment

No.	Variable Coded
88	expectations
89	family exchanges
90	family opinion on partner's choice
91	family ties
92	features for sexual partner
93	feeling of being the woman of his life
94	heartbreak reactions
95	ideal fantasy partner
96	importance of sexuality
97	important things in relationships
98	jealousy degree
99	keeping mystery
100	level of romance
101	making decisions together
102	meaning of love
103	open sex communication importance
104	overcoming past relationships
105	past relationships description
106	positiveness in couple's problem solving
107	projections during couple activities
108	public opinions about the others
109	reasons for being alone
110	reasons for seeking a partner
111	sharing personal thoughts for bonding
112	tastes about others
113	tender gestures
114	competition
115	life balance
116	working skills appreciation
117	working time
118	empathy
119	ensure balanced diet for children
120	limits for children
121	taking care of him and showing tenderness
122	body features
123	bra cup size
124	day dressing style
125	dressing style
126	fashion and beauty
127	glasses or contact lenses
128	look satisfaction
129	nigh dressing style
130	perception of physical appearance
131	personal features
132	underwear

No.	Variable Coded
133	desire for children
134	hangout friends
135	moving desire
136	number of children desired
137	projects in couple
138	relationship willingness
139	seeking for
140	amusing things
141	bad mood
142	seriousness
143	bed practices
144	body parts that are erogenous zones
145	bondage gear
146	celebrity fantasy
147	describing favorite place of sexual encounter
148	desire and justification of sex toys usage
149	desire intensity
150	desire of food in sex game
151	desire of new sexual experiences
152	dirty talk preferences
153	fantasies
154	favorite sexual encounter
155	fetish clothes
156	fetish practices
157	food in sex game
158	frequency and usage of sex toys
159	number of sexual partners
160	oral sex pleasure
161	past experience with erotic videos and pictures
162	place of fantasy
163	regular sexual activities
164	role-playing scenes fantasies
165	sex dirty practices
166	sex position preferences
167	sex protection practices
168	sex toys
169	sexual excitation (body)
170	sexual excitation (personality)
171	size importance
172	swingers
173	types of sexual activities providing pleasure
174	usage of food in sex game
175	behavior in the presence of others wanting to help
176	behavior towards somebody's behavior unappreci-ated

No.	Variable Coded
177	behavior when contradicted
178	behavior when offended
179	behavior when somebody talking by phone aside without caring
180	challenges
181	communication overshare
182	compatibility
183	degree of socialisation
184	discussions
185	ease of communication
186	TV / series
187	age
188	birthdate
189	birthplace
190	books
191	cinema
192	city
193	civil status
194	company name
195	cooking practice
196	country
197	department
198	diet
199	distance
200	distates
201	drinking alcohol
202	family name
203	feelings when listening to music
204	food tastes
205	going out
206	graduation year
207	handicrafts
208	having children
209	hobbies
210	instruments
211	level of education
212	lifestyle
213	living arrangements
214	music
215	nationality
216	number of children living with
217	occupation status (student or employee)
218	origins
219	painting
220	pleasure places

No.	Variable Coded
221	postal code
222	profession
223	reasons for loving a song
224	region
225	religion
226	religion practice
227	revenues
228	sex
229	smoking
230	social games and parties
231	spoken languages
232	tastes
233	title
234	transportation means
235	university name
236	vacations style
237	vices or drugs
238	adaptation
239	attentive to others
240	autonomy
241	behavior for taking important decisions
242	behavior in the presence of others expending too much on something wanted
243	behavior in the presence of others in the case of annoyance
244	behavior towards somebody mad at
245	believe on the goodness of humans
246	conception of a good relationship
247	conception of harmonious relationship
248	conformism
249	controversial opinions
250	convictions
251	debates
252	discount coupons usage
253	diversity
254	emotivity
255	excitement facility
256	fears
257	fidelity conception
258	financial ambitions
259	financial foresight
260	foresight
261	forgiveness
262	freedom
263	gifts
264	ideal fake sick day

No.	Variable Coded
265	if loving this is wrong, i don't want to be right
266	important things
267	intuitions
268	life appraisal
269	love conception
270	luxury conception
271	mastery
272	meaning of marriage
273	meaning of religion
274	money conception
275	musts
276	mysticism
277	never have i ever
278	one thing i'll never do again
279	opinion about sodomy
280	opinion on sexual connotation advertisement
281	order
282	out of limits types of sexual activities
283	perfect day
284	personal interests
285	personal opinions
286	personal philosophy
287	personal satisfaction
288	personal thoughts
289	philosophy
290	political leanings
291	possessions (material or not)
292	principles guiding existence
293	reaction about a dream failure
294	realm of the imagination
295	riskiness
296	risks
297	rules compliance
298	security
299	sexe importance in life
300	sharing personal thoughts in terms of veracity
301	shopping habits
302	social causes
303	social initiatives
304	something I'll never do
305	something that is not-negotiable for me is
306	spontaneity
307	to cheer me up
308	traditions
309	universal cause

No.	Variable Coded
310	values importance
311	view on habits
312	vision of free time with children
313	vision of parent-child relationship
314	what do you do when your phone dies
315	what would you do if you won the lottery
316	when I have nothing to do
317	worst idea

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Note 5,5/6

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Mémoire « Analyse de la qualité du service administratif offert à l'école de Sociologie de l'Université de Zulia (LUZ) », méthodes quantitatives appliquées à partir des données d'enquêtes par questionnaire.
Note 20/20

EXPÉRIENCES PROFESSIONNELLES

JAN. 2016 – FÉV. 2017

Cheffe de Projets Web | **IPSEITE SA. Innovation Park, Lausanne**

▪ Travail de conception (workflow, design interface et déploiement technique) d'une nouvelle plateforme de remise de contenu digital et contrôle automatisé, adoptée par Nestlé Nespresso et le groupe SEB.
▪ Coordination de l'équipe de développement et design en interne et en sous-traitance.
▪ Estimation et administration du budget alloué au travail de développement.
▪ Médiation des pôles commercial et technique pour la définition du cahier des charges avec la clientèle et des spécificités techniques pour le développement des logiciels.
▪ Rédaction de la documentation technique.
▪ Priorisation et tests des fonctionnalités et dysfonctionnements pour le lancement-prod du logiciel.
▪ Coordination du support technique.
▪ Digital asset management: Mise en place des ontologies, arborescences et structuration des métadonnées.

JAN. 2016 – AVRIL 2017

Consultante | **Darwin Digital, Lausanne**

▪ Médiation des pôles commercial et technique.
▪ Documentation et justification des choix de conception d'architecture des deux projets :
(i) application mobile pour automatiser le processus d'évaluation médicale de la douleur avec la reconnaissance faciale et l'IA,
(ii) hardware et logiciel pour l'analyse d'images lors de la conduite automobile.

FÉV. 2015 – DÉC. 2015

Assistante de Cheffe de Projets | **IPSEITE SA, Lausanne**

MAI 2014 – FÉV. 2015

Contrôleuse Qualité | **IPSEITE SA, Lausanne**

▪ Formation des responsables marketing à la prise en main des plateformes développées.
▪ Formation d'agences créatives en Suisse et en France au téléversement et indexation de contenu en ligne. Veille à l'adéquation des médias au cahier des charges techniques du client.
▪ Rédaction des guides d'utilisation des différentes applications.
▪ Indexation des contenus médias dans CUMULUS Canto et dans Adobe Experience Manager.

1. PUBLICATIONS ET COMMUNICATIONS

Revue internationale

2021

Pidoux Jessica, Kuntz Pascale et Gatica-Perez Daniel, “Declarative variables in online dating: a mixed-method analysis of a mimetic-distinctive mechanism”, *ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW).*

Chapitre d’ouvrage

2019

Pidoux Jessica, « Toi et moi, une distance calculée. Les pratiques de quantification algorithmiques sur Tinder. » in Yann Calbérac, Olivier Lazzarotti, Jacques Lévy & Michel Lussault (dir.), *Carte d’identités. L’espace au singulier*, Paris, Hermann.

Conférence internationale avec actes

2018

Pidoux Jessica, “Matching methods: new approaches for the study of the online dating phenomena.” Short paper in the proceedings of the *Eighth Conference of Japanese Association for Digital Humanities (JADH2018) Leveraging Open data.*

Conférences invitées ou avec sélection sur résumé

JUIN 2021

“Analyse des variables déclaratives de la rencontre en ligne et des pratiques de développement. Congress of the Swiss Sociological Association on June 28-30, 2021 under the theme Social Justice in Times of Uncertainty

DÉC. 2020

« Les représentations des corps féminins dans les applications de rencontres affectives », *Séminaire Pratiques, discours et représentations de la norme*, en collaboration avec P. Kuntz, Université de Nantes, France.

JUIN 2019

Rencontre doctorale « Le numérique : pour quelle humanité ? »

Séminaire de deux jours sur sélection de dossiers. Institut d’Etudes Avancées de Nantes, France.

“Dating mediations in a matrimonial agency”, Panel STS and Social Media, *Conférence Nordic Science and Technology Studies*, Université de Tampere, Suède.

SEPT. 2017

« Les métriques de la rencontre en ligne. Une sociologie du matching algorithmique », *Journée Études Numériques* avec l’intervention de D. Cardon et F. Moretti, Université de Lausanne, Suisse.

« Modélisation formelle et catégorisation des features de la recontre en ligne », *Journée d’études Infrastructures Informationnelles* organisée par F. Jaton avec l’intervention de G. C. Bowker, Université de Lausanne, Suisse.

JUILLET 2017

« Toi et moi, une distance quantifiée. Les algorithmes du matching sur les sites de rencontres », *Colloque de Cerisy Carte d’identités. L’espace au singulier* organisé par Y. Calbérac, O. Lazzarotti, J. Lévy et M. Lussault. Cerisy, France.

JAN. 2017

École d’hiver Digital Methods « Data Infrastructures: Database Stories, Dumps and Query Driven Narratives » sous la direction du Professeur Richard Rogers. Projet réalisé « Code Historiography ». Université d’Amsterdam, Pays-Bas. 6 crédits.

1.1 DISTINCTION

AVRIL 2020

Lauréate du prix « Hackathon VersusVirus » de la Confédération Suisse pour le projet "Social Contouring".

1.2 MÉDIATION ET VULGARISATION SCIENTIFIQUE

Europe

- France. Podcast Détour vers le futur en partenariat avec l'INA, le CNRS et Campus FM "Coup de foudre en ligne ? ou quand le grand amour matche grâce aux applis de rencontre et réseaux sociaux" (Mars 2021)
- Royaume-Uni. Article magazine VICE UK, "Five Reasons You Should Delete Hinge" (Nov 2020)
- Belgique. Emission de télévision à la Radio Télévision Belge Francophone (RTBF), l'Internet Show (Déc 2020)
- Allemagne. Article magazine SPEX, «Wen „Leute wie wir" wohl gut finden» (Déc 2019)

Suisse

Presse

- Sélectionnée comme personnalité distinguée par LeTemps #FORUMDES100 "Jessica Pidoux, l'algorithme de Tinder dans la peau" (Fév. 2020)
- RTS, "Pour Tinder, un homme éduqué est désirable, une femme non" (Mai 2019)
- Contribution à l'enquête menée par Le Temps « Traquer son ombre numérique » dirigée par F. Delafoi et P. Ronga. Invité Paul-Olivier Dehaye qui a contribué à l'analyse de l'affaire de Cambridge Analytique (The great hack).

Radio

- Podcast VOUS rediffusé par SwissAir, « #9 Jessica Pidoux, ou le mystère des algorithmes de Tinder » (Août 2020)
- RTS, Vacarme « Tinder 3/5 Dans le ventre de l'appli » (Juin 2020)
- Rougefm, Les applications de rencontres (Oct 2020)
- RTS, Vertigo: "Tinder en temps de Covid-19" (Avril 2020)
- Avis d'experts « On en parle. "Les dessous de l'algorithme de Tinder » (2019)

Télévision

- RTS, "L'intime au temps du numérique" (Nov. 2019)

1.3 EXPERTISE

DEPUIS OCT. 2020

Rapportrice de conférence | de *ACM "CHI" Conference on Human Factors in Computing Systems*

2. ENSEIGNEMENT

2.1 ENSEIGNEMENTS DISPENSÉS EN TANT QU'ASSISTANTE

Assistante du Professeur Dominique Boullier
(**Centre d'études européennes, Sciences Po, Paris, France**)

2018 – 2 SEMESTRES

Master en Humanités Digitales, EPFL. Cours « **Quantification of User Experience** » (5 crédits). *Ce cours livrait des ressources conceptuelles issues de la sociologie et de l'anthropologie, ainsi que des méthodologies pour gérer un processus de conception centré sur l'utilisateur.trice. Les méthodes étaient appliquées chez des entreprises selon un protocole planifié en cours.*

2017, 2018 - 2 SEMESTRES

Bachelors et Masters, toutes les disciplines, EPFL. Cours SHS « **Enjeux socio-politiques du numérique** » (6 crédits). *Ce cours apportait un cadre théorique sociologique et favorisait le débat pour développer un regard critique, justifié et comparé sur une diversité d'innovations technologiques avec des méthodes qualitatives. Les ingénieur.es apprenaient sur les politiques d'innovation pour faire des choix responsables en matière de conception des infrastructures qui modèlent les usages sociaux.*

2.2 CONTRIBUTIONS

- Préparation du contenu hebdomadaire et cours dispensés occasionnellement.
- Mise en contact avec des entreprises et suivi des travaux individuels et collectifs empiriques.
- Retours écrits et oraux personnalisés aux étudiant.e.s lors des séances mensuelles programmées.
- Élaboration d'un plan de lecture avec présentation, notes écrites, et évaluation par les pairs.
- Mise à disposition des ressources, bases de données et outils pour réaliser des travaux pratiques.
- Création et gestion du Moodle pour la structuration du cours, apporter des clarifications et promouvoir les échanges.
- Organisation et évaluation des travaux finaux sous modalité « poster » avec la participation du personnel académique du collège des humanités de l'EPFL.

2.3 INVITATIONS À DISPENSER DES COURS

MAI 2021

Université de Fribourg. Cours Bachelor et Master « Les enjeux sociologiques de la numérisation:Ce que le web fait aux liens sociaux »

Intervention « Matching et profilage » sous la direction de T. Jammet.

NOV. 2020, SEPT. 2019

Institut Mines-Télécom Business School, Paris. Cours Master « Data Protection Management »

Intervention « Tinder comme étude de cas pour comprendre la collecte et le traitement algorithmique de données sensibles » avec la collaboration de A. Barde.

NOV. 2020

EPFL et UNIL, Lausanne. Cours SHS Bachelor « Jeu vidéo et société »

Intervention « Entre mimétisme et distinction dans les pratiques de développement des applications mobiles. Quels enjeux pour la protection de données ? » sous la direction de Y. Rochat.

AOÛT 2019

Haute École d'art de Zurich. École d'été Européenne et Asiatique "Hacking Global Pop Icons"

Intervention "Sociological analysis of Tinder's matching system" sous la direction de K. Ng, C. Bucher, T. Gerber, et J. Wong.

2.4 ENCADREMENT DE PROJETS

NOV 2019 – MAI 2020

École Polytechnique de l'Université de Nantes, France.

Co-encadrement d'un projet de recherche-développement (niveau Master 1) autour de l'analyse des traces de sélection des variables des applications de rencontres.

OCT. 2018 – SEPT 2020

EPFL, Lausanne

Recrutement et direction de deux étudiants assistants (Bachelor et Master en sciences de données).

NOV. 2018 – JAN .2019

HEAD Genève

Expertise et supervision d'un projet de Bachelor : catalogue du musée sur l'évolution historique du couple et les moyens de rencontre.

3. ANIMATION ET RESPONSABILITÉS ACADÉMIQUES

3. 1 ACTIVITÉS ADMINISTRATIVES

2018 - 2021

EPFL. Membre du comité d'enseignement de la section des Humanités Digitales (SoDH)

Évaluation et conseil à la mise en application des plans d'études, médiation avec les étudiant·e·s en Master et Doctorat, contribution à l'intégration des cours en humanités d'autres universités suisses.

3. 2 ORGANISATION DES MANIFESTATIONS SCIENTIFIQUES

PRÉVU EN OCTOBRE 2021

Co-organisation de la Unconference 'Critique digitale'

avec dhCenter UNIL-EPFL, Programme Doctoral en Études Numériques (PDEN), Digital Humanities am Walter Benjamin Kolleg der Universität Bern, infoclio.ch, Digital Humanities Lab Universität Basel.

PRÉVU EN NOVEMBRE 2021

Université de Zurich, programme National Research Program "Big Data" (NRP 75), du FNS.

Retraite d'études interdisciplinaire de trois jours pour les femmes « Algorithms in the making ».

MARS 2021

EPFL. Séminaire « Quand l'INED rencontre Meetic »

Invitation de Marie Bergström (INED, France).

FÉV 2020, MARS 2021

EPFL. Atelier "AI & Gender: A Human Rights Toolbox"

avec la collaboration du Bureau de l'égalité EPFL et C. Kraft-Buchman (association Women at the Table, Genève) et A. Hattori (responsable des droits humains à l'ONU).

DÉC. 2019

EPFL. Séminaire « AI for Humans »

Invitation de la prof. Pascale Kuntz (Polytechnique de Nantes, France).

SEPT. 2019

EPFL. Exposition grand public sur l'évolution des moyens de rencontres en Europe lors des « Portes Ouvertes »

En collaboration avec Johanne Joho (HEAD, Genève).

3.3 ANIMATION DE LA COMMUNAUTÉ SCIENTIFIQUE

2019 - 2021

Fondatrice et représentante de l'association « dhelta UNIL-EPFL »

des chercheur·e·s, étudiant·e·s et collaborat·eur·rice·s en Humanités Numériques. Planification et obtention des fonds pour un échange entre universités suisses « Swiss DH Exchange ». Liaison avec les programmes : européen DARIAH-EU et national Digital Humanities Network (DHCH) initié par swissuniversities.

Membre active de Data Champions EPFL

Contribution à la rédaction des politiques de données de l'EPFL sous des principes Open Science, formulation et mise en place d'un plan de gestion de données sensibles pour la recherche en conformité légale avec le RGPD et la Loi fédérale sur la protection des données selon les procédures du comité d'éthique.

Membre du dhcenter UNIL-EPFL

Réseautage interinstitutionnel, organisation des événements et contribution à la planification des cours et séminaires.

Participante au groupe de lecture hebdomadaire EPFL « AI Safety »

DEPUIS 2017

Doctorante affiliée au STS Lab à l'Université de Lausanne

Participation aux ateliers doctoral et de recherche avec le STSLab et le Laboratoire de cultures et humanités digitales (LADHUL).

3.4 VIE ASSOCIATIVE

DEPUIS 2021

Fondatrice du collectif "Dating Privacy"

Investigation sur les conséquences des algorithmes de matching et la conception d'une notion située de privacy.
Création des outils promouvant la data literacy pour les utilisateurs et utilisatrices des applications de rencontres.
Protocole d'utilisation de données personnelles pour la recherche en sciences sociales dans le respect de la vie privée et selon une charte éthique définie.

DEPUIS 2020

Experte chez l'association personaldata.io

Analyse sociologique pour divers projets et contribution à une cartographie wiki des données personnelles collectées par des applications mobiles diverses.

MARS 2020

Organisatrice du hackathon « HackCOVID Léman »

avec personaldata.io, la société civile et des expert.e.s au niveau mondial. 50 participant.e.s.

DEPUIS 2019

Membre de MyData Global et fondatrice de MyData Vaud

Participation aux débats pour la transparence et l'habilitation des droits de la protection des données personnelles.
Constitution du collectif local pour la sensibilisation à la protection de données personnelles.

4. OUTILS NUMÉRIQUES

- Digital Methods : Googlescraper “Lippmannian Device” et Search Engine Scraper (Université d’Amsterdam), Gephi (exploration et visualisation des réseaux, Open Source, MédiaLab)
- Analyse textuelle qualitative et quantitative : NVivo12, Iramuteq (Open Source), Hyphe de Sciences Po Média Lab (analyse des controverses)
- Langages de programmation et analyses statistiques : R, Python (connaissances basiques)
- Data Asset Management : Canto CUMULUS et Adobe Experience Manager
- LaTeX et Microsoft Office (Notions avancées Excel)
- Outils de gestion du travail de développement et support technique : JIRA, iceScrum, Pivotal Tracker, Footprints
- Prototypage des interfaces: Balsamiq (Wireframes pour applications mobiles et sites web), Figma (Outil collaboratif de design)