NOTHING NEW UNDER THE SUN: NOVELTY CONSTRUCTS AND MEASURES IN SOCIAL STUDIES

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ABSTRACT

The concept of novelty is central to questions of creativity, innovation, and discovery. Despite the prominence in scientific inquiry and everyday discourse, there is a chronic ambiguity over its meaning and a surprising variety of empirical measures, which muddle the interpretation of prior findings and frustrate the consolidation of knowledge. To help dispel some of the unclarity, this paper presents a survey and synthesis of conceptualizations and operationalizations of novelty scattered across social, cognitive, and organizational studies. From this analysis, I advance the argument that novelty is generally regarded as a function of frequency or proximity, and in these two complementary perspectives, it is commonly bounded its empirical study and theoretical understanding. I further argue that contextual and temporal aspects are integral to the specification of novelty and primary contributors to its multifaceted nature.

Keywords: Novelty; frequency; proximity; creativity; innovation; measurement

INTRODUCTION

Novelty is a deceivingly simple notion. We make use of it in our everyday life, when discussing new songs and movies, or evaluating new products and services, or wondering about new ideas and technologies. Novelty is equally commonplace in scientific discourse, especially across academic traditions on individual creativity

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(e.g., Amabile, 1982), organizational innovation (e.g., Cohen & Levinthal, 1990), entrepreneurial opportunities (e.g., Baron & Ensley, 2006), and scientific discovery (e.g., Merton, 1957), often unaccompanied by exacting discussion over its definition. The apparent clarity and straightforwardness of the concept would dissolve surprisingly quickly, however, if we only submitted it to closer scrutiny.

Consider, for instance, the painting *Impression, soleil levant* by Claude Monet (Fig. 1) and ask yourself: is this an exemplar of novelty? A series of discording answers is likely to follow the question. For once, the impatient reader may simply dismiss it by noticing that the painting is over a century old and certainly not *recent* enough to be regarded as novel. The art neophyte might instead acknowledge that, indeed, she is *unfamiliar* with the specific artwork but does not believe it to be very much *different* from other landscape paintings of the same period. The art historian would remind us that this small canvas is largely recognized to be the *first*, eponymous instance of the impressionist movement. And the nitpicking art lover will not miss the opportunity to point out that some of the most *original* and *distinctive* contributions of the impressionist movement were in fact anticipated by the Macchiaioli, a coeval group of Italian artists.

What this vignette aims to illustrate is that novelty, far from being a monolithic and definite concept, encompasses a constellation of distinct dimensions and connotations, each supporting a potentially discordant interpretation of what constitutes a new entity. Support to this proposition is not limited to fictional examples. When looking backward to organizational and social studies on the subject, we can observe a chronic tendency to revise and reinvent the conceptualization of

Fig. 1. *Impression, Soleil Levant*, Claude Monet (1872).
Oil on canvas, 48 × 63 cm. Paris: Musée Marmottan Monet.
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novelty, advancing alternative dichotomies and typologies, each based on complementary dimensions (Garcia & Calantone, 2002; Rosenkopf & McGrath, 2011). And when looking across research traditions, we cannot help but notice that novelty has recurrently surfaced as the subject of intellectual examination, but under different guises or different acceptations (Foster, Rzhetsky, & Evans, 2015). Under these miscellanea of terminologies and constructs, it is possible to detect recurring patterns and clusters of meaning that deserve a separate and more explicit analysis.

This discussion is more than an abstract sophism. It is not superfluous to recall that the notion of novelty is central to the definitions of innovation and creativity (Amabile, 1982; Anderson, Potocnik, & Zhou, 2014; Rogers, 1954). Both the application of inconsistent terminologies to a unitary phenomenon and the assimilation of different phenomena under a loose, umbrella construct threaten the comparability and validity of scientific findings. Either practice, when unrestrained and unaddressed, foreshadows the forthcoming fall or sustained ambiguity of the construct, potentially undermining the significance of both past and future research efforts (Hirsch & Levin, 1999).

The purpose of the present paper is to bring some clarity around the meaning and measurement of novelty. It does so by sifting through theoretical perspectives and methodological approaches to novelty and related constructs in organizational, social, and cognitive studies and contrasting, comparing, and clustering them based on their underlying assumptions and employed measures, following the premise that looking at the exact operationalization may help to dispel some of the ambiguity surrounding their conceptualization. In this survey and synthesis of prior work, special emphasis is given to empirical studies that do not rely on subjective assessment of novelty but are rather anchored on the analysis of substantive properties and features. The rationale for this choice is simple. Much attention has already been devoted to novelty measures based on perceptions, judgments, decisions, and behavioral responses by experts, gatekeepers, and other relevant individuals (Garcia & Calantone, 2002). Studies that do discuss measures of novelty that are independent of coders' ratings and respondents' evaluations tend to be focused on a specific class of innovations or stream of literature and are thus less applicable across social sciences and not necessarily representative of the broader set of relevant approaches (Dahlin & Behrens, 2005; Rosenkopf & McGrath, 2011). Perhaps more importantly, with the decision of mapping academic understanding of "substantive" novelty across disciplines, this paper can contribute to future research interested in explaining why new ideas and cultural products are overlooked or misconstrued by domain experts, field gatekeepers, and the broader public (Bavato, 2020), a feat otherwise impossible if the same experts, gatekeepers, and collective forms of evaluation are the sole arbiters of what constitutes true novelty.

In so doing, I advance the argument that in present-day organizational inquiries and social studies, novelty is in fact proximity and frequency in disguise, and answers to fundamental questions on the emergence and recognition of novelty are often rooted in these implicit perspectives. I also identify alternative approaches that offer complementary and under certain conditions more satisfactory accounts of what novelty means.

NOVELTY AND PROXIMITY

Conceptualization

When we think of novelty, we probably imagine something that is different, unique, or unlike anything else. This notion finds empirical support in lay theories and cognitive models of novelty and creativity (Baron & Ensley, 2006; Loewenstein & Mueller, 2016), and in prior scientific literature, where novelty is closely associated with kin constructs of differentiation, distinctiveness, distance, diversity, deviance, discontinuity, and uniqueness, or it is construed as the antonym of similarity and typicality. For instance, cultural products have been regarded to be new when they possessed different or distinctive features from the products already present in the same cultural space (Askin & Mauskapf, 2017; de Vaan, Vedres, & Stark, 2015; Slavich & Castellucci, 2016); technological inventions and scientific writings have been considered new when dissimilar from prior art (Dahlin & Behrens, 2005; Trapido, 2015); and organizational and entrepreneurial endeavors have been characterized as new when they constituted a departure from existing knowledge and business practices (Dewar & Dutton, 1986; Navis & Glynn, 2011; Rosenkopf & McGrath, 2011).

The key intuition shared by all these accounts is that the novelty of a particular element, be it an idea, artifact, event, or piece of information, is a function of its *proximity* to the elements populating the same context or sociocultural space (Table 1). Or in simpler terms, being novel means being dissimilar, different, or distant.[1] The relation between novelty and proximity is mostly implicit, suggestive, or non-formalized in prior literature. In some cases, the existence of a conceptual link can be extrapolated from the association or interchangeable use of novelty with other proximity constructs. In other cases, the fact that novelty is a function of proximity is made clear by methodological choices and the employment of similarity or distance indexes to measure novelty. A few authors however attempted to offer a more explicit distinction, characterizing novelty in terms of proximity to *prior* instances; differentiation, diversity, or uniqueness in terms of proximity to *present* instances; and impact or adoption as proximity to *future* instances (Balietti, Goldstone, & Helbing, 2016; Dahlin & Behrens, 2005; Hofstra et al., 2020). Such temporal caveat is not without challenges. In the first place, it is not clear whether novelty can and should be reduced to a special case of proximity, or whether the proposed definition serves only as a proxy. In the latter case, the definition leaves unanswered questions regarding the exact relation between proximity and novelty and its boundary conditions (i.e., is novelty a monotonic or linear function of proximity? Is proximity to prior instances necessary or sufficient to classify something as novel or non-novel?). Importantly, the proposed definition introduces the issue of meaningfully and operationally separating the present from the recent past and immediate future and it replaces the problem of distinguishing between proximity and novelty with the issue of disentangling novelty from change (Berlyne, 1960). Notwithstanding these open issues, the basic insight that novelty is better represented as a departure from the recent past is echoed in the design and reasoning of many studies (e.g., Askin & Mauskapf, 2017; de Vaan et al., 2015), and it has the merit of recognizing the centrality of temporal considerations in the conceptualization of novelty.

Table 1. Examples of Novelty-related Constructs and Measures in Social Studies

Construct	Measure	Example study
Proximity-based		
Typicality	Average pairwise cosine similarity	Similarity of songs' sonic features (e.g., danceability, tempo) relative to *Billboard Hot 100* songs in the preceding week or 52 weeks (Askin & Mauskapf, 2017)
Distinctiveness	Average pairwise cosine distance	Distance of videogames' stylistic features (e.g. genre, point of view) relative to videogames in *MobyGames* in the preceding 1, 3, 5 or 7 years (de Vaan et al., 2015)
Novelty	Average cosine distance	Distance between topic keywords in incoming e-mail messages relative to inbox e-mails of employees in US recruiting firm over a 10-month period (Aral & Van Alstyne, 2011)
Intellectual distance	Cosine distance	Distance of MeSH keywords in grant proposals relative to keywords in evaluators' prior publications in *PubMed* (Boudreau et al., 2016)
Innovation	Average pairwise Euclidean distance	Distance between Chernoff faces' facial features (e.g., shape and size of eyes, ears, mouth) and faces submitted in the preceding round of online *Art exhibition game* (Balietti et al., 2016)
Novelty	Reverse-coded average pairwise Jaccard similarity[a]	Unusualness of citations in information theorists' publications relative to publications in the same knowledge domain and all preceding years (Trapido, 2015)
Uniqueness	Minimum average pairwise Jaccard similarity[b]	Dissimilarity of tennis racket patents' citations relative to patents granted in the same product class and year (Dahlin & Behrens, 2005)
Frequency-based		
Atypicality	10th percentile normalized frequency	Rarity of a papers' journal references co-occurrences in the Web of Science database in the preceding years, normalized it based on the frequency of the co-occurrence to be expected on chance alone (Uzzi et al., 2013)
Familiarity	Recency-weighted frequency	Frequency of patents' subclasses and their co-occurrences in U.S. patents in *MicroPatent* in all preceding years, multiplied by an exponential decay factor to account for recency of prior subclass occurrences and co-occurrences (Fleming, 2001).
Novelty	Recency-weighted infrequency	Infrequency of framings in biotech and pharma research reports relative to reports in *InvestextPlus* in preceding 60, 90 or 120 days, with linearly decreasing weights to account for recency (Giorgi & Weber, 2015)
Novelty	Percentage of non-repeated co-occurrences (frequency = 1)	Unprecedentedness of grant proposals' keywords co-occurrence relative to keywords in *PubMed* publications in all preceding years or in the preceding decade (Boudreau et al., 2016)
Jump, new bridge, new consolidation	Presence of non-repeated occurrences or co-occurrences (frequency = 1)	Unprecedentedness of chemicals and their co-occurrences in chemistry publications relative to publications in *MEDLINE* in the preceding year or all preceding years (Foster et al., 2015)

Table 1. (*Continued*)

Construct	Measure	Example study
Originality	Sum of weighted relative infrequency	Infrequency of responses to originality test batteries (e.g., verbal or visual associations; ideas) relative to other study participants (Wilson et al., 1953)
Originality	Sum of additive inverse of relative frequency	Infrequency of two-note combinations in musical themes relative to all themes in *Barlow & Morgenstern* dictionaries across all years (repertoire originality) and its difference to the originality to be expected on the same year (*zeitgeist* originality; Simonton, 1980).

[a] In the study by Trapido (2015), the average pairwise Jaccard similarity score is reversed by subtracting it from the maximum similarity score observed in the year of the focal publication.
[b]Dahlin and Behrens (2005) refer to the measure as "overlap score," formulated as "the number of patents cited by both patent *i* and patent *j* divided by the number of patents cited by *i* and *j*" (p. 727). It is an equivalent specification of the Jaccard index, which generally indicates the ratio between intersection and union of two finite sets of values. A patent is then considered unique if it has the "lowest overlap score for their grant year" (2005: 728).

Measurement

It is interesting to note a certain degree of consistency in methodological approaches of studies implicitly or explicitly conceptualizing novelty as a function of proximity. Proximity (and thus in turn novelty) is typically inferred from relevant features or properties that characterize the elements of a sociocultural space – for songs, it could be their tempo, danceability, or other sonic features (Askin & Mauskapf, 2017); for e-mail communications, their keywords and associated topics (Aral & Van Alstyne, 2011); and for patented inventions or scientific writings, their references to prior art (Dahlin & Behrens, 2005; Trapido, 2015). The basic assumption is that these features can serve as coordinates to model the elements' positions and relative distances in a determined sociocultural space (Goldberg, Hannan, & Kovács, 2016; Kovács & Hannan, 2015). The novelty of each particular element is then derivable from the average of its pairwise distances to other (pre-occurring) elements populating the same space, distances which can be computed calculating the cosines of the vectors representing each element's feature profile. While variants of this operationalization can be found in these and other studies (e.g., employing alternative proximity measures, such as Jaccard coefficient, Euclidean distance), they tend to share common assumptions, including direct proportionality between novelty and distance, and equal contribution of any pairwise relation and any feature to the novelty of an element.

When reflecting on these assumptions and their plausibility, it is informative to juxtapose them to subjective models of novelty recognition. Early experimental evidence testimonies that perceptions of novelty of a focal element indeed vary inversely to the number of attributes distinguishing it from prior occurrences (Berlyne, 1960; Berlyne & Parham, 1968). And yet to my knowledge conclusive evidence has not been presented with regard to the exact relation between novelty and proximity. Empirical tests document only modest agreement between

subjective evaluation of novelty and feature-based measurement of proximity (cf. Trapido, 2015, p. 1493; Hofstra et al., 2020, p. 9289). Additional studies also offered compelling arguments on the fact that judgments of dissimilarity violate basic axioms on which a metric distance model rests (i.e., symmetry, minimality and triangle inequality, Tversky, 1977), raising the possibility that perceptions and evaluations of novelty may analogously fail to concord with distance-based measurements. We should also expect empirical violations of the second assumption. Individuals are particularly likely to weigh more the proximity to elements affiliated to the same category or to the nearest exemplar (Murphy, 2004), and certain features are likely to be more diagnostic in perceptions and evaluations of novelty (cf. Guetzkow, Lamont, & Mallard, 2004). It is also reasonable to expect idiosyncrasies in the mental representations people hold for a particular domain, market, industry, or other sociocultural space. Under this circumstance, novelty may be more precisely modeled as the proximity of an element's features to the elements previously known or available to the audience of reference (e.g., intellectual distance between the topic of a research proposal and the topics of its reviewer's publications, cf. Boudreau, Guinan, Lakhani, & Riedl, 2016). *In summa*, despite the versatility of feature-based measures of proximity, and evidence on convergent validity with subjective ratings of novelty, it is important to note that the exact operationalization must be adjusted to the research question and empirical context of interest, and further validation is required when the intention is to plausibly mirror an audience perception and evaluation of novelty.

Theoretical Implications

The way we think of novelty inevitably primes the way we theorize its emergence and legitimation. Under a conceptualization of novelty as a special case of proximity, it is unsurprising that forces and factors favoring the emergence of dissimilarities and differences, such as *blind variation* (Campbell, 1960), *divergent thinking* (Guilford, 1957), *distant search* (March, 1991), and *prior related knowledge* and *diversity of background* (Cohen & Levinthal, 1990), have been traditionally invoked as explanations for creativity and innovation. The essential insight is that differences breed differences and similarity begets similarity. Thus, it is argued that exposure to heterogeneous information, interests, and input increases possibilities to form remote or distant associations (Aral & Van Alstyne, 2011; de Vaan et al., 2015; Harvey, 2013; Hoever, van Knippenberg, van Ginkel, & Barkema, 2012); access to nonredundant contacts and distinct domains introduces opportunities for transferring, translating, and integrating what is typical to one context and yet alien to another (Burt, 2004; Hargadon & Sutton, 1997). Scholars resort to proximity-related arguments also to explain the failures and difficulties surrounding the emergence of innovation. It has been shown that it is easier to attend to and assimilate and thus refine and extend what is similar to what is already known (Cohen & Levinthal, 1990; Piezunka & Dahlander, 2015). Diversity is found to raise issues of coordination and to negatively affect the exchange, processing, and elaboration of information (Aral & Van Alstyne, 2011; Harvey, 2014; Hoever et al., 2012). As a consequence, conditions that alleviate or

resolve the conflicting needs for distance and closeness (e.g., structural folding, de Vaan et al., 2015), diversity and homogeneity (e.g., perspective taking, Hoever et al., 2012), similarities and differences (cf. processes of creative synthesis, Harvey, 2014) proved to be fertile avenues of inquiry.

A similar pattern is observable also across studies on the recognition and legitimation of novelty. For example, literature on optimal distinctiveness acknowledges the competing demands for similarity and differentiation necessary to obtain legitimacy and recognition (e.g., Zuckerman, 2016). The trade-offs are resolved with moderation (e.g., moderate proximity promotes popularity and critical acclaim, Askin & Mauskapf, 2017; Slavich & Castellucci, 2016), disguise (e.g., similarity in product form compensates for dissimilarity of technological features, Rindova & Petkova, 2007), duplicity (e.g., simultaneously affirming contextual similarity and dissimilarity, distinctiveness and resonance, Martens, Jennings, & Jennings, 2007; Navis & Glynn, 2011),[2] or by means of social proximity (e.g., the role of homophilic tendencies and homologous receptive spaces, Cattani, Ferriani, & Allison, 2014; Koppman, 2016). These examples, while inadequate in offering a comprehensive and satisfactory account of these strands of literature, prove useful in illustrating the broader pattern in which proximity-based mechanisms serve to model the emergence and legitimation of novelty. The observation is important, because it raises the question of whether alternative conceptualizations of novelty could lead to complementary theories and even contradictory findings, a possibility that I will especially examine in the following sections.

NOVELTY AND FREQUENCY

Conceptualization

The notion of novelty can also inspire images of things unprecedented, unusual, the first of their kind. Once again, this is evidenced in studies on implicit theories of novelty (Loewenstein & Mueller, 2016), and by scholarly practice, where the concept of novelty appears side by side or is used interchangeably with kin constructs of atypicality, originality, rarity, uniqueness, unusualness and as the opposite of familiarity, commonness, and conventionality. Work illustrative of this perspective includes studies on research and project proposals that feature previously unseen combinations of topics (Boudreau et al., 2016; Criscuolo, Dahlander, Grohsjean, & Salter, 2017; Hofstra et al., 2020), bibliometric analysis assessing the rarity or atypicality of citation patterns in scientific articles and inventions (Chai & Menon, 2019; Fleming, 2001; Uzzi, Mukherjee, Stringer, & Jones, 2013), and investigations on the generation of unique or infrequent ideas (Simonton, 1980; Wilson, Guilford, & Christensen, 1953).

In these accounts, novelty is essentially conceived as a function of the *frequency* of occurrences of a focal element or its constituting components relative to the other elements populating the same context or sociocultural space (Table 1). In the strictest interpretation, novelty is a binary construct, which refers only

to *first-time occurrences* and *co-occurrences* (Boudreau et al., 2016; Criscuolo et al., 2017). Being "new" means being something that "did not exist before" or "has never previously been thought" (Wilson et al., 1953, p. 362), a "first appearance" (Fleming, Mingo, & Chen, 2007, p. 453), combining what was "otherwise disconnected" (Goldberg et al., 2016, p. 9). While this interpretation has the merit of simplicity, face validity, and specificity, in practice it poses nontrivial issues. In the first place, there is a clear difficulty in establishing what counts as the chronologically first instance, well known in the sociology of science as the issue of priority (Merton, 1957). Novel insights often mature independently and even simultaneously (Bikard, 2020; Merton, 1957; Simonton, 1979). Twin ideas and multiple discoveries are in fact reputed to be so prevalent to argue that "all scientific discoveries are in principle multiples, including those that on the surface appear to be singletons" (Merton, 1961, p. 477) and that the emergence of novelty is inevitable, the deterministic result of the *zeitgeist*, "the sociocultural system as a whole, embodied as the spirit of the times" (Simonton, 1979, p. 1603). The co-appearance of novelty inevitably undermines the tractability and meaningfulness of restricting its definition only to first-time instances, due to uncertainty in the attribution of priority but also because it fails to recognize any degree of novelty in rediscoveries and independent inventions. This issue is further exacerbated by the fact that novelty often emerges progressively and cumulatively, rather than being the result of an instantaneous moment of creation or discovery. It thus becomes arbitrary and potentially contentious to select a specific event that should be regarded as the birthday or genesis of an innovation (e.g., the first observation of an anomaly vs. the publication of its explaining theory; the first conception of an idea vs. the commercialization of the resulting product). Privileging an understanding of novelty as first-time occurrence also ends up entangling novelty with aspects of execution (e.g., the first to be produced, patented, published, publicized, is more likely to be recorded than the first to be observed, created, or conceived) and attribution (cf. Matilda effect and gender biases in the recognition of novelty and creativity, Rossiter, 1993; Zhou, Wang, Bavato, Tasselli, & Wu, 2019; attributional vs. point model of discovery, Pinch, 2001). In chess, for instance, a theoretical novelty indicates "a move in the opening which is thought not to have been played before" (Hooper & Whyld, 1992, p. 418) and yet it is generally understood only in reference to opening variations which are already present in chess theory and literature. The fact that new openings performed by chess grandmasters or in select tournaments are more likely to enter "the theory" inextricably attaches connotations of merit and status to this conceptualization of novelty and any ensuing theory.

Several scholars expanded on the first-of-its-kind interpretation building on the premises that novelty is relative to a specific sociocultural space, and that any element can simultaneously belong to an array of stacked or overlapping contexts. Much like a Matryoshka doll, a product may be nested in a particular product line, which in turn is nested within a broader firm portfolio, market category, and industry at large. Each of these contexts serves as relevant comparison set or frame of reference to ascertain novelty (e.g., *new to the world/industry/*

market/firm/customer, Garcia & Calantone, 2002). Other scholars analogously reflected on the relativity of novelty with respect to its modality. Novelty may stem from either a first-time discovery or the first-time combination of old material (Berlyne, 1960; Foster et al., 2015; Strumsky & Lobo, 2015). Both approaches lend themselves to the configuration of hierarchical taxonomies, which enable an ordinal understanding of novelty (e.g., the broader the context, or the less frequent the modality, and the more novel the achievement). For instance, the first-time appearance of the "HIV-1" concept in the scientific corpora could be argued to be more novel than the first-time conceptual bridge between "HIV-1" and "genetic algorithms", which in turn could be considered to be more novel than the first-time linkage between concepts that are already semantically related (e.g., "HIV-1" and "vaccine"; cf. Foster et al., 2015; Hofstra et al., 2020). These extensions certainly address some of the reservations discussed above, particularly by encouraging a nonbinary understanding of novelty and explicitly accounting for structural and relational aspects of the context of reference. Still, they remain vulnerable to critiques, especially on questions of priority. A compelling example is the history of the HIV discovery, which saw an acrimonious dispute between France's Pasteur Institute and the US National Cancer Institute (NCI) over recognition for being the first to identify the virus behind the global AIDS pandemic. The dispute escalated into lawsuits over patent royalties, followed then by legal settlements, joint statements of co-participation in the discovery, and rekindled animosity when the Nobel prize was bestowed to the French researchers, but not to the US team, for their scientific achievement (Pinch, 2001).

In its broader interpretations, novelty may also refer to nonroutine or rare occurrences and thus vary on a continuum ranging from the unique to the most frequent. In this sense, being new means being "uncommon" or "statistically infrequent for the population of which the individual is a member" (Wilson et al., 1953, p. 363); introducing "unusual combinations" compared to what could be expected by historical standards or chance alone (Simonton, 1980, p. 973; Uzzi et al., 2013, p. 469). Such frequentist perspective of novelty abandons the criterion of priority (i.e., not only the first but also the second, third, and n^{th} instance may be considered novel if unusual with respect to their sociocultural space), and it may be more or less sensitive to chronological considerations (Table 2). The latter aspect is especially evident when contrasting different strands of scholarship. In creativity studies, novelty is often linked with *originality* and characterized as the uniqueness and rarity of a response, independently of priority or existence of precedents outside of the experimental setting (Reiter-Palmon, Forthmann, & Barbot, 2019; Wilson et al., 1953). In other strands of innovation literature, uniqueness and rarity are informative of novelty and *familiarity* only with respect to past occurrences (Fleming, 2001; Zunino, Suarez, & Grodal, 2019). The distinction between ahistorical and historical interpretations is not trivial. Take the case of Beethoven's compositions: an analysis of the relative frequency of the notes and notes permutations in his melodies would characterize his artistic production as unoriginal compared to the entire repertoire of classical music, and yet original relative to the melodic themes of his time (Simonton, 1980).

Table 2. A Comparison of Frequency-based Characterizations of Novelty.

		Window of Comparison	
		Historical	Ahistorical[i]
Frequency	Unrepeated (frequency = 1)	First-of-its-kind also: unprecedented	Unique
	Infrequent (frequency ≥ 1)	Unfamiliar also: unusual, uncommon, atypical	Original also: rare

[i]I borrow this expression from Simonton (1980, p. 974) to refer to characterizations of novelty insensitive to the historical context, in the sense that chronological considerations are uninfluential or secondary to the definition of the comparison set.

Measurement

A varied assortment of frequentist methodological approaches has been employed in the past (Table 1). Although at the heart of all operationalizations is a measure of frequency, each one comes with its bells and whistles, reflecting the alternative conceptualizations discussed above and the different solutions scholars employed to address their specific limitations and difficulties.

In studies following a first-of-its-kind interpretation, novelty is usually measured as a binary variable representing the presence or absence of prior instances of the same element. It has been argued before that establishing whether an element is truly the first is a highly impractical, if not virtually impossible task (Wilson et al., 1953). While it can be established that something is *not* novel with some degree of certainty (i.e., evidence of a preceding, identical instance), the converse can hardly be proved with equal assuredness (as the saying goes, absence of evidence is not evidence of absence). Unambiguously establishing chronological ordering is also challenging, especially since data are often available only at larger units of time (e.g., year, month). These issues are usually sidestepped, simply limiting the unit of analysis to recorded instances, and acknowledging or addressing threats of survival and selection biases that are typical of archival data (Dahlin & Behrens, 2005; Fleming et al., 2007; for an alternative method for the identification of twin ideas and co-discoveries, see Bikard, 2020). Some solutions have been instead proposed with regard to the binary nature of the first-of-its-kind definition, which does not allow to discriminate between different levels of novelty (Wilson et al., 1953). An example of workaround is to consider the novelty of an element a continuous variable directly proportional to its share of novel subcomponents or features (e.g., novelty being measured as the percentage of first-recorded keyword pairings in a research proposal, Boudreau et al., 2016; Criscuolo et al., 2017). Another path is to derive an ordinal scale based on hierarchical taxonomies of first-time occurrences based on the modality or the sociocultural context of reference, as discussed above (e.g., Foster et al., 2015).

Studies considering novelty as kin to originality and uniqueness are typically based on measures of observed frequencies (absolute or relative), with uniqueness indicating singularity (e.g., absolute frequency equal to one) and

originality denoting rarity (e.g., the additive inverse of relative frequency, e.g., Kornish & Ulrich, 2011; Runco & Smith, 1992; Simonton, 1980; Wilson et al., 1953).[3] Both methodological approaches, not unlike procedures aimed at establishing priority, are complicated by the question of "how much overlap should be taken to constitute 'identity'" (Merton, 1968, pp. 9–10). This issue is especially salient to creativity and innovation scholars comparing responses of individuals in brainstorming sessions or divergent thinking tasks, responses that are often uniquely worded, but "essentially identical" (Kornish & Ulrich, 2011). In these cases, it is upon the researcher the task of setting a (potentially arbitrary) threshold of similarity to discriminate between identical and non-identical instances, relying on either subjective ratings or feature-based indexes (Reiter-Palmon et al., 2019).

Also in the family of operationalizations that pertains to familiarity, frequency serves as primary instrument to identify novelty. In cognitive and neuroscientific experimental studies, for example, novelty is induced by manipulating the number of times a subject is exposed to a determined stimulus (Berlyne, 1960; Poppenk, Köhler, & Moscovitch, 2010; Ranganath & Rainer, 2003). Frequency alone is, however, an insufficient proxy, especially outside of the lab. While it can be argued that novelty wears off with repetition (Berlyne, 1960; Simonton, 1980), also knowledge and memory of prior occurrences decay over time (Fleming, 2001; Sorah & Godart, 2018). This is relevant because "[n]ovel patterns can contrast with others only if those which have occurred before effect permanent changes, of a sort that can be called *learning*" (Berlyne, 1960, p. 19). Recency is therefore a determining factor to assess familiarity and in turn novelty, because of its influence on salience, availability, and ease of recollection of past stimuli (Berlyne, 1960; Kahneman & Miller, 1986; Yonelinas, 2002). A common remedy to account for recency in measures of novelty and familiarity is to limit the window of comparison to the recent past, such as the preceding quarter or year (Table 1). Alternatively, measures of familiarity have been proposed where the extent to which a prior instance contributes to the familiarity score of a focal element is weighted for the time interval between their occurrences (cf. Fleming, 2001, and his assumptions on constant loss of knowledge over time).

Theoretical Implications

To be sure, there are many parallelisms and overlaps between the proximity and frequency-based perspectives, including in their implications for theories of novelty emergence and legitimization. Understanding novelty as something unfamiliar, unique, or unprecedented calls to mind similar sources of innovation (e.g., exploration and distant search, Fleming, 2001), analogous trade-offs (e.g., comprehension vs. obviousness, curiosity vs. dissonance, Zunino et al., 2019), and comparable strategies to overcome them (e.g., narrating resonance and coherence, Navis & Glynn, 2011). Further reflections, however, reveal important complementarities and at times discrepancies between the two perspectives and their specific conceptualizations. Understanding novelty as unfamiliarity, and

thus emphasizing the notion that the novelty of an idea, discovery, or artifact depends on the collective memory and attention of an audience, suggests the importance not only of spatial but also of temporal exploration for the emergence of innovation (e.g., Nerkar, 2003) and gives ground to cyclical models of recognition and legitimation (Simonton, 1998). Thinking of novelties as first-of-their-kind instances brings to mind the factors affecting the timeliness of attention (Maula, Keil, & Zahra, 2013), adoption (Rogers, 1983), and appropriation of an opportunity (Shepherd, 1999), from structural advantages of organizations and individuals in information diffusion processes (e.g., Burt, 2004; Maula et al., 2013; Rogers, 1983), to the (pre)maturity of an idea with respect to its sociocultural context (Stent, 1972).

It is also interesting to note that potentially contradictory predictions and results may emerge from juxtaposing proximity and frequency-based perspectives. For example, the so-called novelty effect, according to which novel information is better detected and encoded (Ranganath & Rainer, 2003), has been argued to arise from the effect of distinctiveness, rather than unfamiliarity (Poppenk et al., 2010). And while an element may in principle retain its distinctiveness intact over time, thus suggesting that novelty is a persistent property, we know that unfamiliarity is affected by repetition and habituation processes, supporting a contrasting view of novelty as temporary in nature and transitory in its arousing potential and hedonic value (Berlyne, 1960, 1970).

DISCUSSION

The Hallmarks of Novelty

Three main observations emerge from the above synthesis of prior research, each prompting critical reflections on the current state of the literature but also highlighting unique opportunities to advance our understanding of novelty. The first general pattern is that both scholars and laypeople customarily resort to notions of proximity and frequency to define and identify what is novel in our world. In itself, this is an old observation. It has long been proposed that novelty denotes remoteness and uncommonness (Wilson et al., 1953), similarity and repetition (Berlyne, 1960), distance and frequency (Litchfield, Gilson, & Gilson, 2015). And yet the connection between these constructs is scarcely appreciated and remains an important source of ambiguity. Proximity and frequency-based perspectives are often adopted implicitly and independently, and the decision to compartmentalize their analysis in this paper is a mere reflection of this fact. Within these two broader perspectives, a plethora of overlapping but distinct constructs can be found (e.g., atypicality, dissimilarity, distance, distinctiveness, diversity, originality, unfamiliarity, uniqueness), whose interdependencies and relations with novelty have rarely been formalized and systematically validated (cf. Zhou et al., 2019). To further blur conceptual boundaries, identical or equivalent measurements are often employed to operationalize these distinct constructs, or measures with quite distinct properties and meanings are applied to capture what should be a unitary concept (Table 1).

At first glance, the most obvious way to start addressing these concerns would be to better integrate proximity and frequency perspectives. The underlying premise for such an approach is that independently, each perspective is insufficient to satisfactorily capture novelty. Arguably, a distinctive artifact can still be a replica, and an unprecedented or unique idea can still be called derivative. This is well exemplified in patent law: inventions that are absent from prior art are not considered novel if they lack distinctive characteristics or fail to be "sufficiently far removed" from publicly disclosed exemplars (EPO, 2021). The theoretical foundations for a more integrated approach are already partly in place. We have seen in this paper how the understanding of frequency requires considerations of proximity. To acknowledge something as unique or unprecedented, we must first determine, consciously or unconsciously, how much dissimilarity constitutes identity, or how many similarities can be tolerated before considering two elements equivalent (cf. Merton, 1957). In turn, we also saw how frequency can be informative of proximity. It has been argued that elements that tend to simultaneously occur in the same location or unit of observation "lie close in the sociocultural space, […] while those that rarely co-occur are distant" (Kovács & Hannan, 2015, p. 254), or in other words, frequency of "co-occurrence maps to similarity" (Kovács & Hannan, 2015, p. 261).

In practical terms, scholars could start conceptualizing and measuring novelty at the intersection of proximity and frequency. Recent examples in this direction are the notion of *distal novelty* (Hofstra et al., 2020; see also Wang, Veugelers, & Stephan, 2017), and the distinction between *new bridge* and *new consolidation* (Foster et al., 2015), both attempts to simultaneously consider unprecedentedness (e.g., first-time linkage between two concepts) and distance (e.g., whether concepts are located in separate semantic clusters or knowledge domains). Scholars following this approach should, however, be mindful of the strong connotation of interdisciplinarity that is unavoidably attached to such a conception of novelty (Fontana, Iori, Montobbio, & Sinatra, 2020), and the consequent risk that the appellation of novelty would be restricted to elements that span different domains or branches of knowledge. This is potentially problematic because first-time occurrences can also be associated with proximal or local knowledge combinations. In a study conducted by Kaplan and Vakili (2015), it was shown that local knowledge recombinations were a better predictor of first-time emergence of a topic in a technological corpus than distant or unfamiliar knowledge combinations. The above warning and finding should thus caution us against simple resolutions. Assimilating both frequency and proximity into a unitary definition of novelty, while appearing *prima facie* to be a logical step toward conceptual advancement, might ultimately fail to be universally applicable or hold widespread empirical validity.

An alternative and perhaps more sensible avenue of scientific progress is to instead acknowledge the existence of a plurality of meanings and measures of novelty. Advocates of such an approach should, however, call for more precise and explicit connections between the specific conceptualization adopted in a study and its theoretical premises and empirical idiosyncrasies. For instance, social scientists should consider whether their understanding of novelty is consistent with their

theory of novelty emergence. Representing novelty as unprecedentedness is most compatible with a punctuated model of innovation and technological change, where invention and discovery are approximated to sudden, temporally bounded events and thus less susceptible to ambiguity and disputes in the assignment of priority (cf. Pinch, 2001), whereas a gradualist or cumulative view of innovation is better aligned with an understanding of novelty as distance or dissimilarity from the past. Another point of reflection is whether in the empirical context of choice, it is appropriate to assume novelty to be bounded or unbounded, continuous or discrete. As Litchfield and co-authors (2015) aptly noted:

> measures of newness [being the first-of-its-kind] and frequency are bounded or have a limit; for example, an idea is perfectly new if it has never been mentioned in the specific context and perfectly infrequent if it occurs only once in a set of ideas. […]. Distance is a clearer conceptualization in that the scaling of novelty does not imply any particular upper limit. (p. 242)[4]

Taking a step further the idea that novelty is a loose term that encompasses a set of related properties and phenomena, it may also be worth reflecting whether proximity and frequency are sufficient to exhaustively capture its most important connotations and shades of meaning. In all likelihood, they do not. Novelty is also associated with unexpectedness and surprise (Berlyne, 1960; Godart, Seong, & Phillips, 2020; Loewenstein & Mueller, 2016). Cognitive psychologists have even referred to novelty as a "mismatch between stimulation and a neuronal model of expectations" (Kahneman, 1973, p. 53), the "response to information that is not expected or predicted in a given context on the basis of prior experience" (van Kesteren, Ruiter, Fernández, & Henson, 2012). Interpretations of novelty as violations of expectations are similarly prominent in sociological accounts of scientific discovery (Barber & Fox, 1958; Kuhn, 1970). It has been argued that "[n]ovelty ordinarily emerges only for the man who, knowing with precision what he should expect, is able to recognize that something has gone wrong" (Kuhn, 1970, p. 65). Unconventionality is another common hallmark of novelty. Prior literature has often underlined how novelty is a form of counter-normative behavior (Haslam, Adarves-Yorno, Postmes, & Jans, 2013; Sgourev, 2013) and a challenge to established canons and standards (Cattani et al., 2014; Mainemelis, 2010). Unconventional, noncanonical, and unorthodox are all cues that identify original and novel work (Elsbach & Kramer, 2003; Guetzkow, Lamont, & Mallard, 2004).

The conspicuous absence of these dimensions from the previous survey of the literature is not due to their irrelevance, but rather due to the scarce availability of organizational and social studies that incorporate them in both their theoretical models and quantitative estimates of novelty. Remedy to this lacuna can nevertheless be found in adjacent fields. In neuroscience, experimental designs have been proposed to disentangle the effects of distinctiveness, familiarity, and surprise on neural and cognitive responses (Schomaker & Meeter, 2015). In information sciences, Bayesian probabilistic framework and outlier-based methods have been applied to define and detect novelty and surprise (Itti & Baldi, 2009; Markou & Singh, 2003) and could be readily exploited in organizational and social studies. Successful scholarly attempts to move beyond prevalent conceptualizations of proximity and frequency will in all likelihood depend on theoretical

advancements but also on the introduction and validation of alternative ways to empirically capture what we mean when we talk about novelty.

Novelty in Context and Time

A second insight, which directly follows from the first observation, is the contextual nature of novelty. Both proximity and frequency are meaningfully definable only within a specific comparison set or against a determined reference point and thus support an essentially comparative understanding of novelty. Corollary to this notion is that the definition of the boundaries and inclusion criteria of the sociocultural context are integral components of the definition of novelty and primary contributors to its multifaceted nature. Once again, this proposition is not alien to prior literature. The distinction between *absolute* and *relative novelty* (e.g., Anderson, de Dreu, & Nijstad, 2004), the taxa of *new to the world* and *new to the firm* (e.g., Garcia & Calantone, 2002), and the dichotomy of *global* versus *local novelty* (e.g., Eapen & Grewal, 2019) are all examples of taxonomies in which the context acts as the main classificatory feature of novelty. This contextual relativism, despite being already acknowledged, is seldomly translated into methodological and conceptual considerations. Empirical studies evaluating the "substantive" novelty of a particularly entity typically do so in reference to a single context and at a single point in time (e.g., the novelty of a grant proposal, manuscript, or invention is determined based on the state of art of a specific domain at the specific moment of submission or dissemination). Such approach makes it impossible to account for any potential heterogeneity or fluctuation in the level of novelty due to differences or changes across relevant social and cultural environments.

Future studies could address this limitation by investigating novelty across multiple contexts, especially at lower levels of analysis. Instead of considering only relations between elements populating the same corpus of scientific knowledge (Trapido, 2015), cultural market (de Vaan et al., 2015), public repertoire (Giorgi & Weber, 2015), or private repository (Aral & Van Alstyne, 2011), scholars could define novelty against micro, individual-level contexts, such as the past portfolio of an individual creator (Balietti et al., 2016; Sgourev & Althuizen, 2014) or the personal frame of reference and domain knowledge of an individual evaluator (cf. intellectual distance, Boudreau et al., 2016). In such types of approaches lies the opportunity for studying the microfoundations of novelty, and informing dynamics of fragmentation and social aggregation, dissensus and consensus, not only based on evaluative and perceptual responses (Zhou et al., 2019) but grounded in substantive heterogeneity or homogeneity of novelty across audiences and contexts. Social scientists could also address more extensively and explicitly structural and relational factors (including the connectivity among individual elements, cf. Deichmann et al., 2020) influencing the definition of novelty. It is illustrative of this point the reflection that context-level proximity and frequency may deeply influence element-level novelty: in a context where all ideas tend to be equally idiosyncratic (and thus from an operational and evaluative standpoint, equidistant), no one can truly stand out as new, and yet in a

context where no idea is perfectly duplicated, all could be regarded to be new to a certain extent.

A related but equally important observation is the temporal sensitivity of novelty. In this paper, we have repeatedly seen how novelty is subject to chronological considerations, albeit in different degrees and different fashions. In some cases, *priority*, or the condition of being the first of a kind, has been treated as the hallmark of novelty; in other cases, the timing and order of appearance have been absolutely irrelevant to its definition and measurement. Scholars showed dissimilar approaches also with regard to the direction and span of the historical comparison. On the one extreme, studies examined the proximity and frequency of an element only in relation to its most recent, preceding instances; at the other end of the spectrum, academic investigations have looked across time periods and compared each element to the complete repertoire of instances, both past and future (Table 1). These differences are illustrative of the richness of perspectives that characterizes this field of research and may offer some inspiration on how to best interpret and model the relation between time and novelty.

Consider, for instance, the common practice of assessing novelty only backward, narrowing the window of comparison to preceding instances. Since audiences typically compare elements not only to their predecessors but also to their successors, and given the prevalence of temporal lags between genesis, realization, and recognition of a new element, it may often be more appropriate to analyze proximity and frequency with respect to instances in the immediate past and future or even in the complete repertoire. In fact, it is nontrivial to reflect on the possibility that altering the temporal window of comparison can lead to different answers on the emergence and legitimation of novelty, a point that is often treated as a robustness issue (e.g., Boudreau et al., 2016; de Vaan et al., 2015), but that holds also theoretical merit and potential (e.g., differential relation of repertoire and zeitgeist originality with fame, Simonton, 1980). More in general, it may be worth examining alternative ways to incorporate temporal considerations in conceptualizations of novelty. Less common and yet relevant notions of modernity and "the spirit of the times" could be captured examining the simultaneous detachment from the past and conformity to the idiosyncrasies of the present age; inquiries on fads, fashions (Abrahamson, 1991), and cyclical trends (Simonton, 1998) could similarly reveal facets of novelty that are compatible, rather than antithetical to familiarity and similarity to the past. And potentially, it could be even possible to find the meaning of novelty looking forward, analyzing proximity to future instances not only as a metric of impact (Dahlin & Behrens, 2005; Hofstra et al., 2020) but also of "wise anticipation" (Campbell, 1960), of futuristic ideas and premature discoveries, ahead of their time (Stent, 1972).

CONCLUSION

In 1968, British-Canadian psychologist Daniel Berlyne wrote of the "snares and dilemmas" we encounter when trying to define novelty, despite its idiomatic

and everyday use, and he warned of the prevailing unclarity and confusion with related constructs (Berlyne & Parham, 1968, p. 415):

> The word "novelty" is commonly bandied about in psychological and neurophysiological literature with scant attention to the need for specifying exactly what it denotes. There are several different senses in which something can be novel (Berlyne, 1955, 1960). The essentially empirical question of how the variables corresponding to these senses may be related has generally been neglected, and novelty is all too often confused with other properties, such as change, surprisingness, and incongruity.

Over half a century later, there is hardly anything new under the sun. The same issues still plague scientific practice, leaving scholars pondering on the meaning and measurement of novelty and fretting about the comparability and generalizability of existing findings (Garcia & Calantone, 2002; Rosenkopf & McGrath, 2011). This paper does not hold the ambition of single-handedly resolving the issue by rallying support and consensus around yet another typology of novelty. Rather, the aim is to present macro patterns of meaning and measurement, by sifting through the host of constructs and measures that proliferated over time and across streams of research, and to reflect on how they contribute to shaping the way we think and answer questions on the emergence and legitimation of novelty. It also represents an attempt to illuminate some of the most important assumptions and limitations that implicitly characterize common approaches to the study of the novelty, a construct that despite its outwardly simplicity and straightforwardness continues to elude theoretical and methodological consensus. The importance of this issue cannot be overstated. Scientific evidence is mounting on the risks and returns of pursuing novelty, evidence often accompanied by explicit policy prescriptions or subtle normative narratives but grounded on diverse premises and indicators (e.g., Balietti et al., 2016; Foster et al., 2015; Hofstra et al., 2020; Uzzi et al., 2013). As interest and attention continue to grow, research efforts will increasingly be subject to validity challenges (Fontana et al., 2020; Hirsch & Levin, 1999). It thus becomes crucial to start identifying the hallmarks of novelty, critically assessing dominant and emerging perspectives, and reflecting on how the science of novelty must progress.

NOTES

1. Similarity, difference, and distance are intended here as different facets of proximity. More elaborate discussions on their mutual relations can be found in the work of Tversky, Shepard, and subsequent extensions of their models (Shepard, 1987; Tenenbaum & Griffiths, 2001; Tversky, 1977). It may still be worth noting that concepts of similarity and difference, while typically treated as complementary, can be asymmetrically judged depending on the framing of the task; and whereas metric distance is assumed to be symmetrical, similarity is not necessarily so (Tversky, 1977). The latter point implies that given a pair of elements a and b, directionality can affect similarity judgments (i.e., assessing similarity of a to b might lead to a different result than assessing similarity of b to a). Overall, these reflections offer potentially interesting insights for the study of framing and novelty perceptions (Cattani, Falchetti, & Ferriani, 2020). Consider, for instance, the "focusing hypothesis" advanced by Amos Tversky (1977): "the direction of asymmetry is determined by the relative salience of the stimuli so that the less salient stimulus is more similar to the salient stimulus than vice versa. In particular, the variant is more similar to the prototype than the

prototype is to the variant, because the prototype is generally more salient than the variant" (p. 333). If novelty is truly a reflection of similarity and dissimilarity, this hypothesis would also suggest asymmetry in judgments of novelty: contrary to what one might expect, prototypical elements could be perceived to be more novel when compared to their variants than their variants are perceived when compared to their prototypes.

2. Or as eloquently stated elsewhere, "[s]tories can bridge the gap, by affirming the former without negating the latter" (Aldrich & Fiol, 1994, p. 652).

3. It may be worth reminding that the present survey is restricted to methodological approaches that do not rely on subjective forms of assessments (e.g., experts' ratings or raters' coding of originality).

4. I concur with the authors, albeit with a clarification. Also indexes of distance and similarity can have upper and lower bounds. Cosine similarity reaches its theoretical maximum when two vectors are overlapping and theoretical minimum when perpendicular. For other proximity indexes (e.g., Euclidean distance), the upper or lower bounds are contingent on a number of factors, including the measurement scales of features along which distance is measured, as well as the number of elements in the comparison set (Harrison & Klein, 2007).

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