Traces of responsibility:
Digital analysis of safety discourses and the language of a million patents

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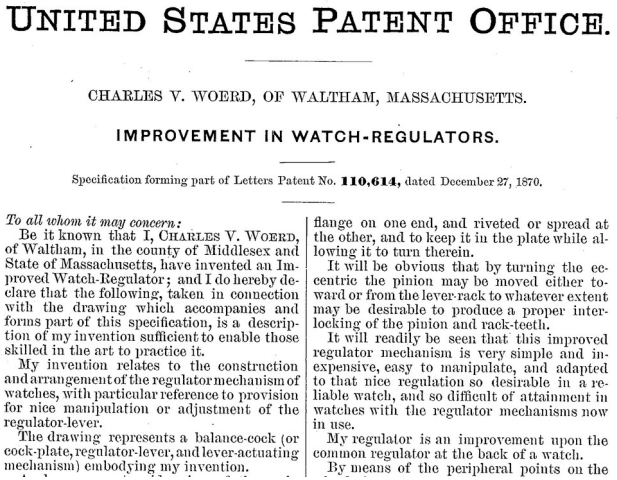
The past of “(ir)responsible” innovation?

- Calls for more “anticipation”, “reflexivity”, “engagement”, “responsiveness”
- Many examples of past widespread use of certain technologies in spite of “known” issues
- How did past innovators display concern or indifference for the consequences of their activity?

Sources and Pre-processing

- US patents 1836 - 1920: 1,361,587 scanned documents
- Pipeline from OCR to analyzable text
  - processed (redressed, standardized margins),
  - turned into text using the Tesseract OCR engine,
  - corrected mistakes using a custom dictionary and a script using a fast spellchecker

Sources and Pre-processing



UNITED STATES PATENT OFFICE.

CHARLES V. WOERD, OF WALTHAM, MASSACHUSETTS.

IMPROVEMENT IN WATCH-REGULATORS.

Specification forming part of Letters Patent No. **110,614**, dated December 27, 1870.

To all whom it may concern:

Be it known that I, CHARLES V. WOERD, of Waltham, in the county of Middlesex and State of Massachusetts, have invented an Improved Watch-Regulator; and I do hereby declare that the following, taken in connection with the drawing which accompanies and forms part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

My invention relates to the construction and arrangement of the regulator mechanism of watches, with particular reference to provision for nice manipulation or adjustment of the regulator-lever.

The drawing represents a balance-cock (or cock-plate, regulator-lever, and lever-actuating mechanism) embodying my invention.

flange on one end, and riveted or spread at the other, and to keep it in the plate while allowing it to turn therein.

It will be obvious that by turning the eccentric the pinion may be moved either toward or from the lever-rack to whatever extent may be desirable to produce a proper interlocking of the pinion and rack-teeth.

It will readily be seen that this improved regulator mechanism is very simple and inexpensive, easy to manipulate, and adapted to that nice regulation so desirable in a reliable watch, and so difficult of attainment in watches with the regulator mechanisms now in use.

My regulator is an improvement upon the common regulator at the back of a watch.

By means of the peripheral points on the

```
To all whom tt may concern:
Be it known that I, CHaRLes V. WoERD,
of Waltham, in the county of Middlesex and
State of Massachusetts, have invented an Jmproved
Watch-Regulator; and I do hereby declare that the
following, taken in connection
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regulator-lever.
The drawing represents a halanee- cock (or
cock-plate, reg tlator- lever, and lever-actuating
mechanism) embodying my invention.
```

Searching for Discourses Related to “Safety”

danger, dangers, dangerous, hazards, hazardous, threaten, safety, poison, poisonous, accident, accidental, accidentally, explosion, explosions, exploding, harm, harmful...

Challenges when searching for “safety”

Most relevant patents?

“Snow-Plow”, “Improvements in auto loading fire-arms”, “Beehive”, “Safety appliance for locomotive-engines or motor-vehicles”, …

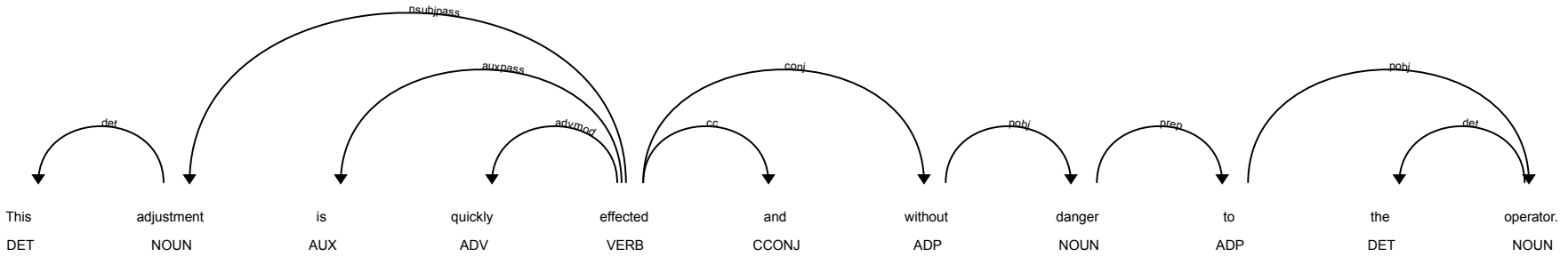
→ ??

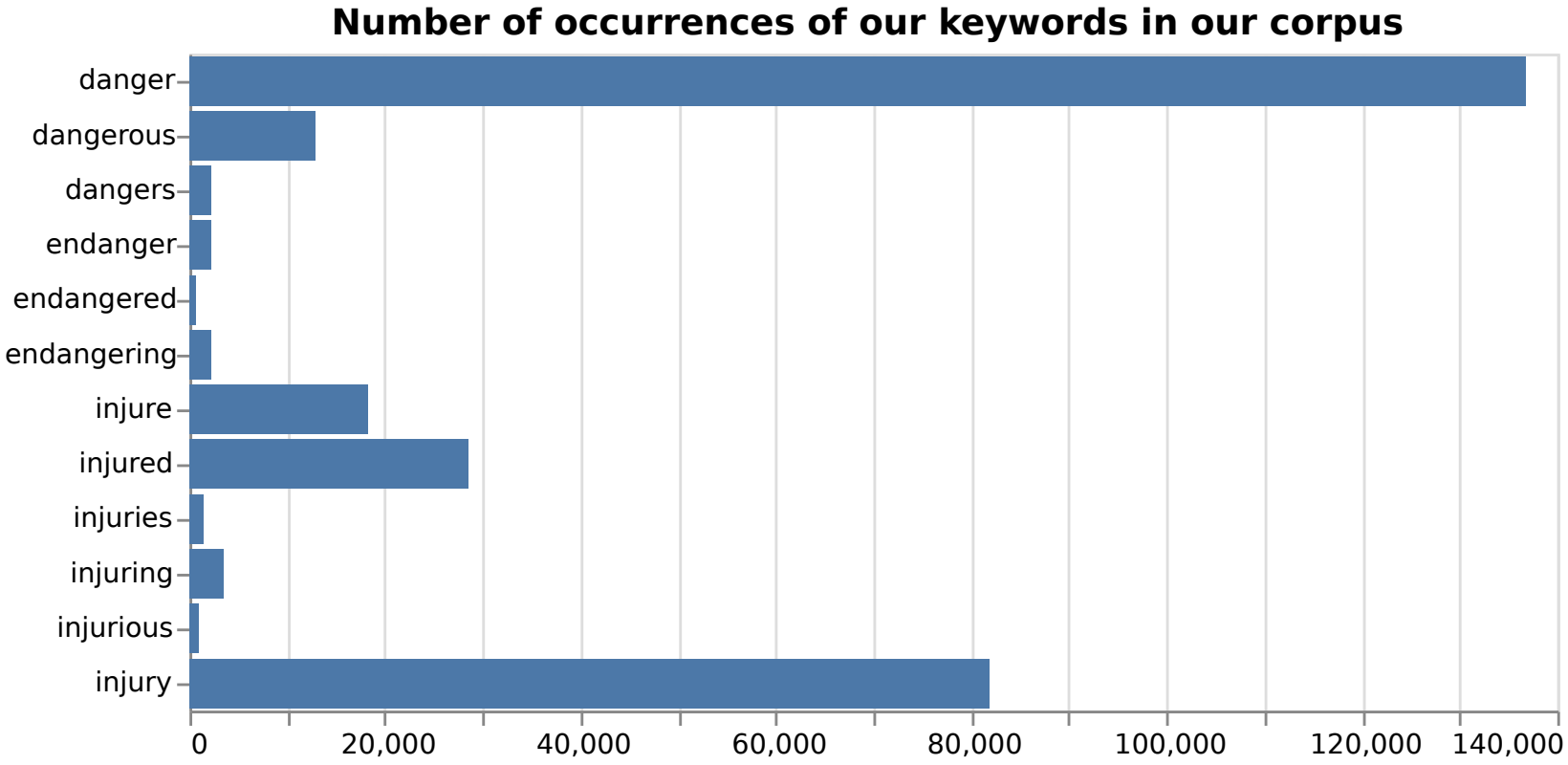
Focusing on sentences

- Open-source Natural Language Processing (NLP) library: spaCy
- Pretrained statistical neural network models
- Trained (mostly) on web data

Parsing sentences

“This adjustment is quickly effected and without **danger** to the **operator**.”




Number of occurrences of our keywords in our corpus
danger
dangerous
dangers
endanger
endangered
endangering
injure
injured
injuries
injuring
injurious
injury
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100,000
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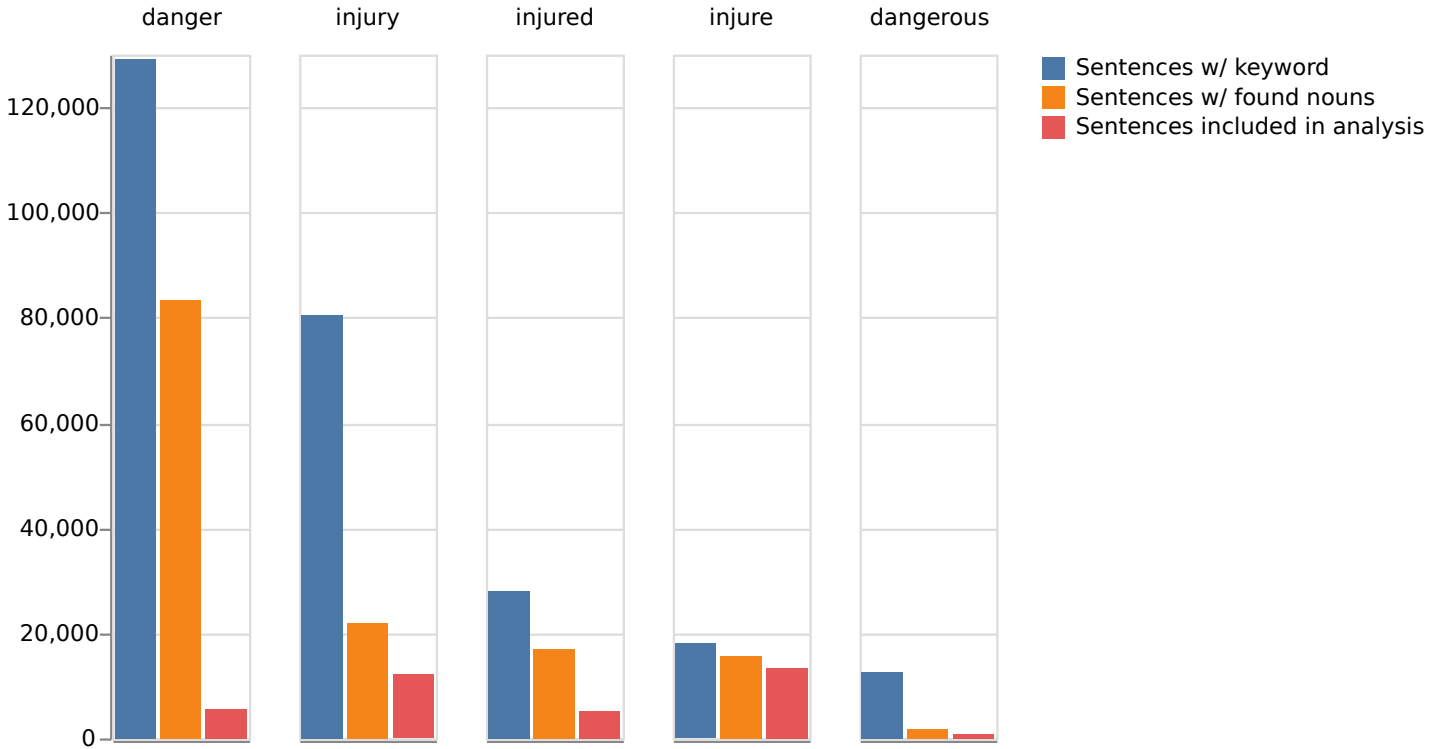
140,000

Filtering sentences and nouns

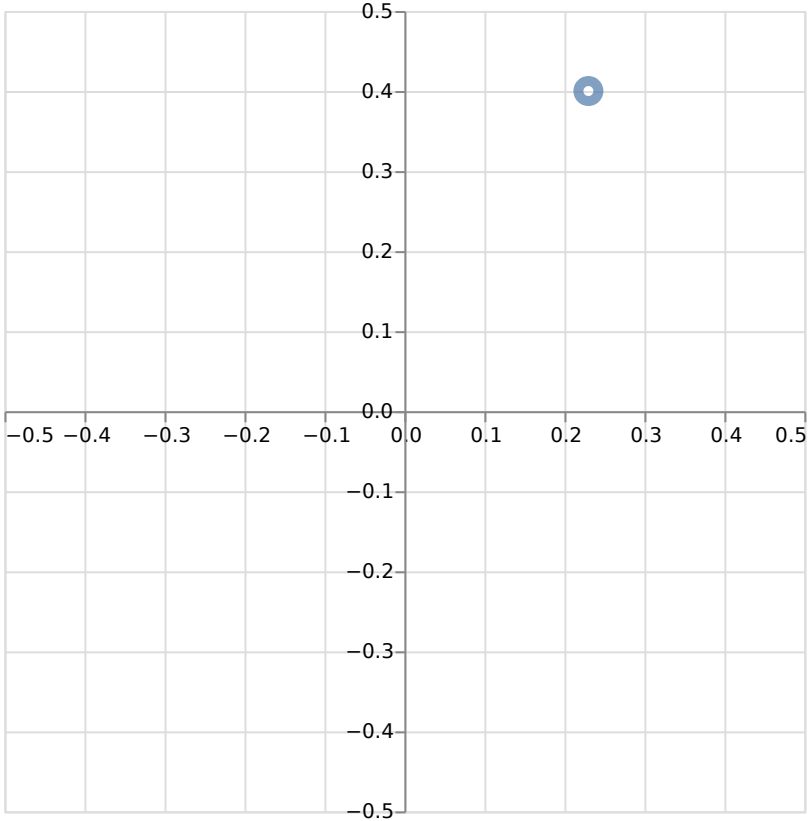


Word embeddings

Representing words as list of numbers (vectors), depending on the context they are used in

“Semantic space”: list of numbers as coordinates, e.g. (0.23, 0.40)

… but with many more dimensions: (0.23, 0.40, -1.64, 0.37,-0.50, -1.04, 0.61, …)



Useful feedback from word embeddings

```
'hazards':
['contestants', 'goals', 'outfield',
'rules_game', 'participants','umpire',
'baseball_game', 'ball_batted',
'game_baseball', ‘goal']
```

Word embeddings

Representing words as list of numbers (vectors), depending on the context they are used in

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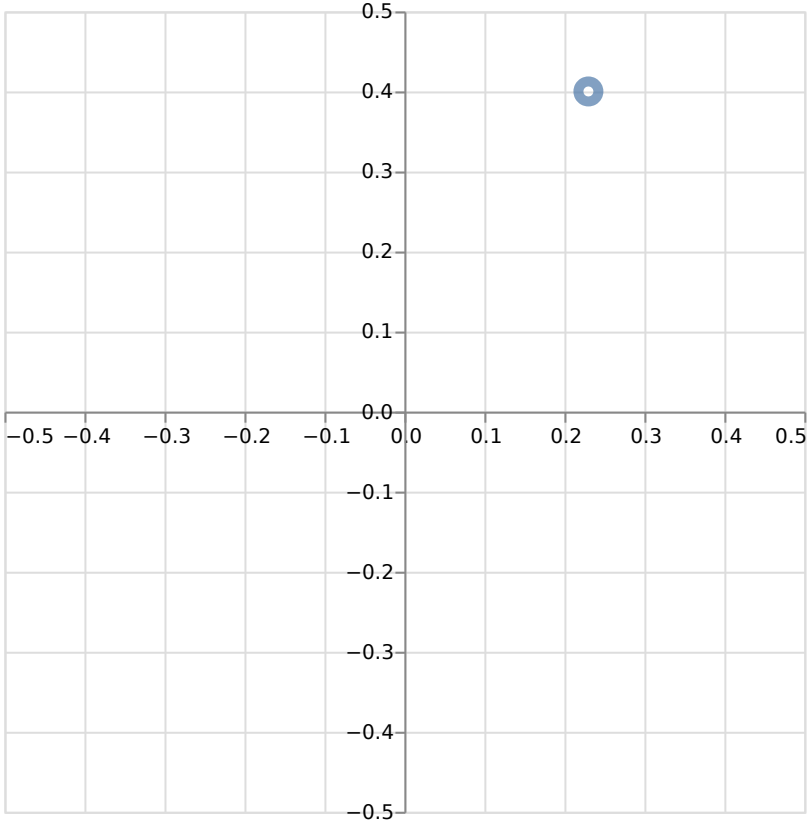
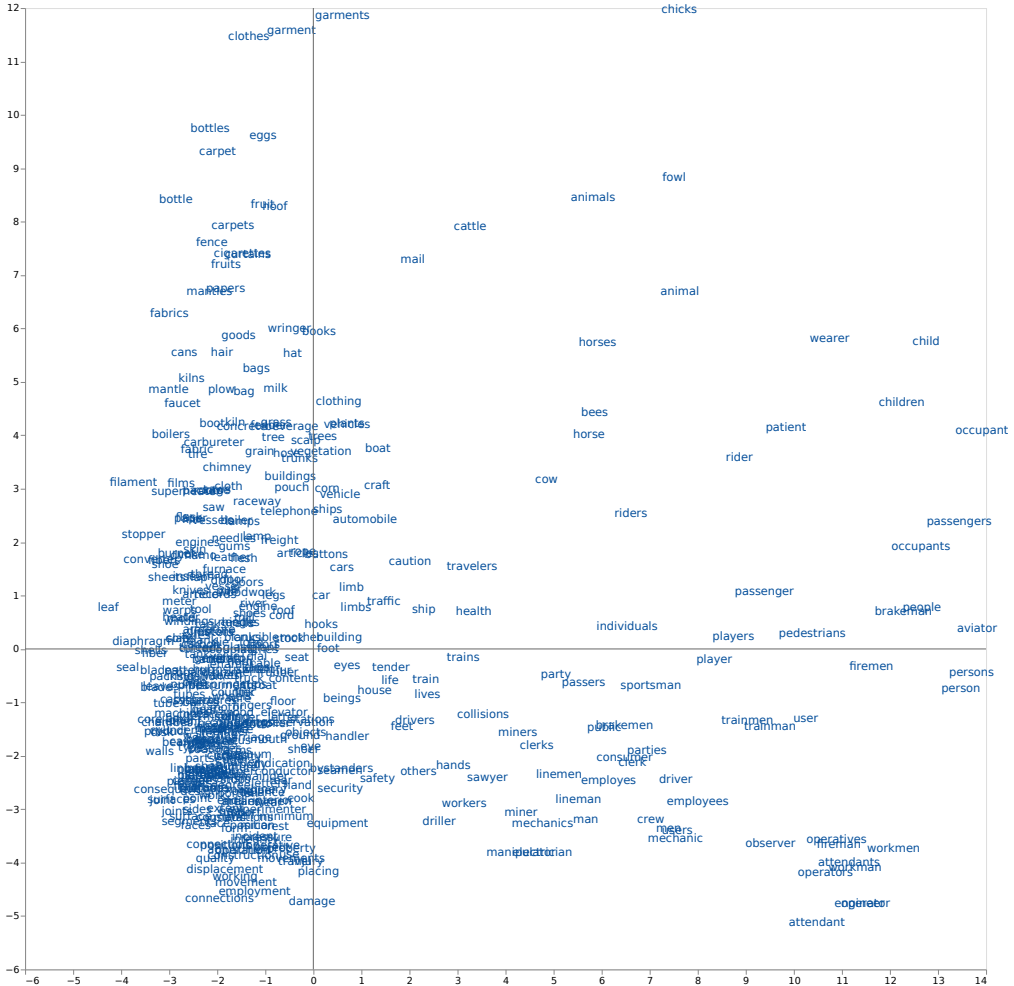
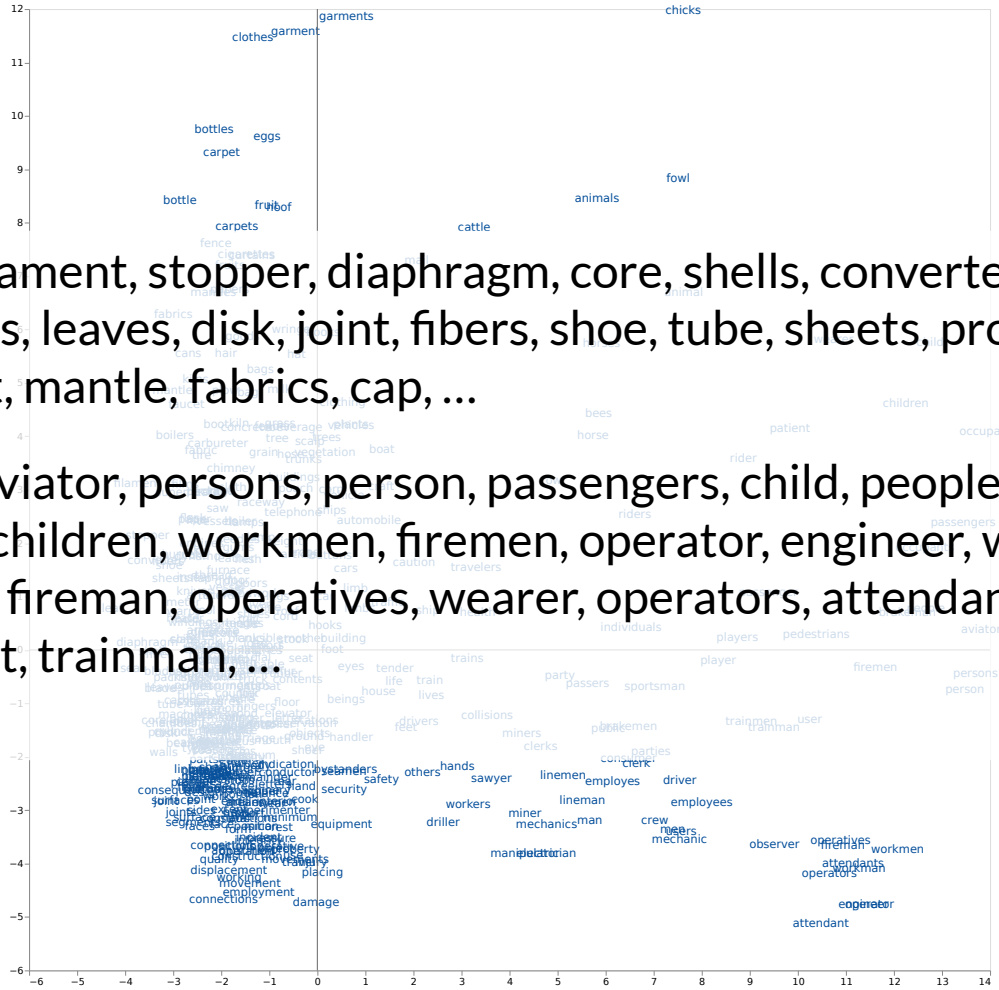
… but with many more dimensions: (0.23, 0.40, -1.64, 0.37,-0.50, -1.04, 0.61, …)



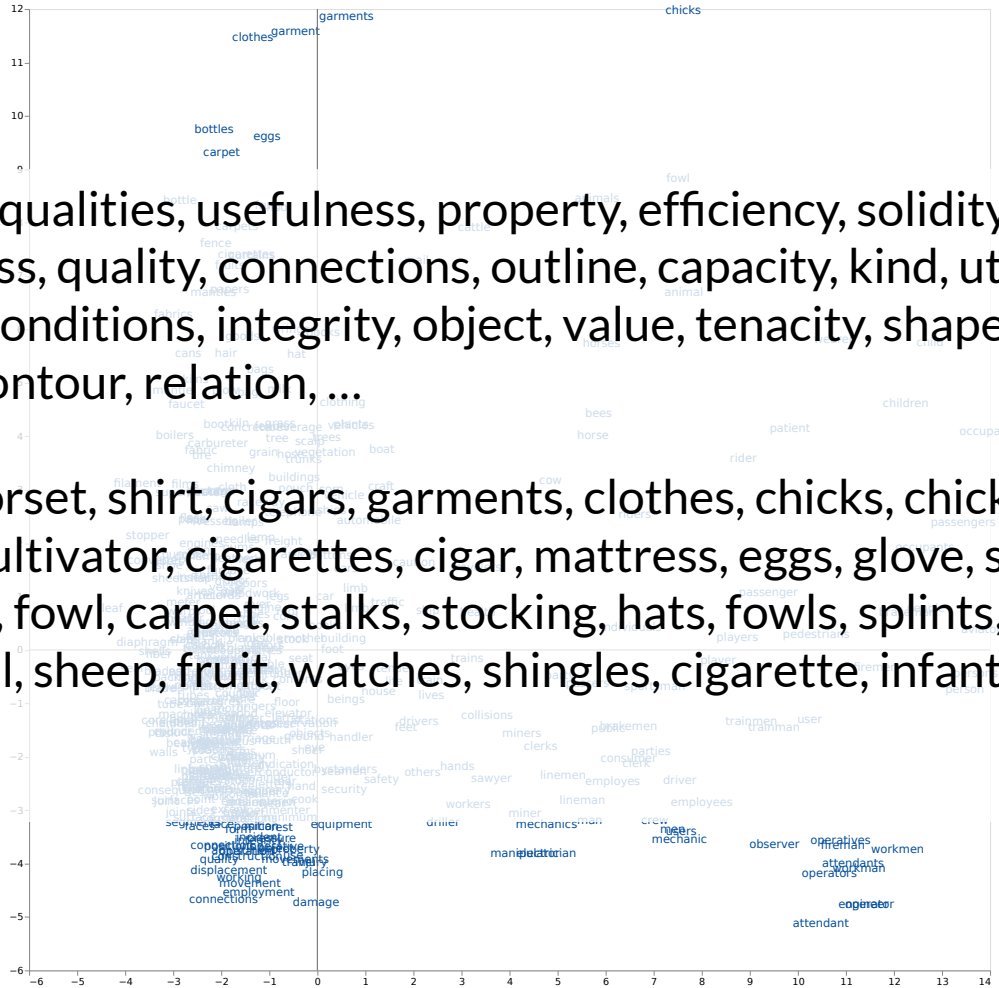


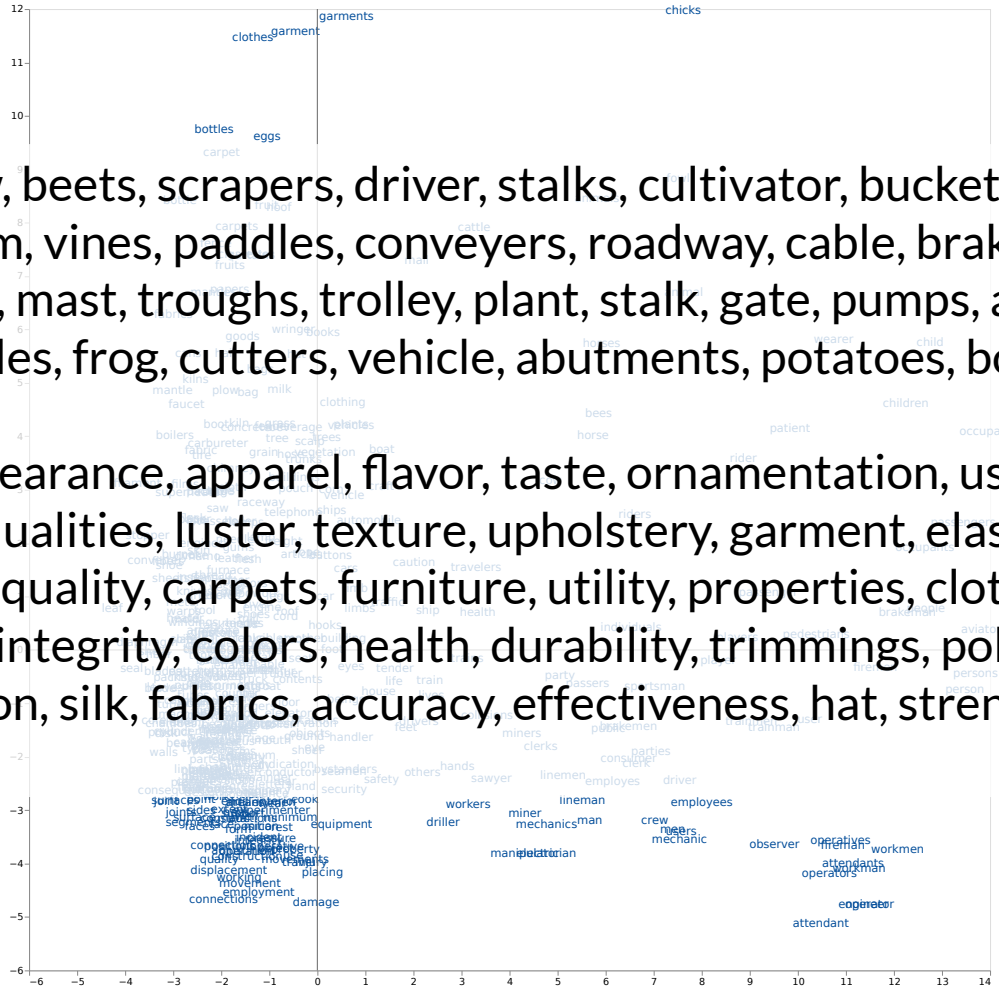
chicks
garments
garment
clothes
bottles
eggs
carpet
fowl
animals
bottle
fruit
hoof
carpets
cattle
fence
mail
fruits
animal
fabrics
goods
wringer
books
horses
wearer
child
cans
hair
hat
bags
kilns
mantle
plow
bag
milk
faucet
clothing
children
bees
patient
occupant
boilers
horse
carbureter
tree
scalp
trees
boat
rider
chimney
trunks
buildings
cow
filament
films
pouch
craft
vehicle
raceway
saw
telephone
ships
riders
automobile
passengers
stopper
occupants
cars
caution
travelers
limb
passenger
car
traffic
leaf
limbs
ship
health
brakeman
people
hooks
individuals
aviator
pedestrians
players
building
foot
trains
player
seat
eyes
tender
firemen
persons
life
train
party
passers
sportsman
person
house
lives
beings
floor
collisions
trainmen
user
trainman
drivers
feet
miners
clerks
parties
consumer
clerk
hands
others
sawyer
linemen
employes
driver
safety
security
workers
lineman
employees
miner
mechanics
man
crew
equipment
driller
mechanic
observer
workmen
attendants
operators
placing
displacement
working
movement
employment
connections
damage
attendant



leaf, seal, filament, stopper, diaphragm, core, shells, converter, fiber, blade, blades, walls, leaves, disk, joint, fibers, shoe, tube, sheets, product, chamber, consequent, mantle, fabrics, cap, …

occupant, aviator, persons, person, passengers, child, people, occupants, brakeman, children, workmen, firemen, operator, engineer, workman, attendants, fireman, operatives, wearer, operators, attendant, pedestrians, user, patient, trainman, …


garments
chicks
clothes
garment
bottles
eggs
carpet
fowl
animal
children
bees
patient
occupant
horse
rider
passengers
passenger
players
equipment
driller
mechanics
mechanic
observer
operatives
fireman
workmen
attendants
workman
operators
engineer
attendant
displacement
placing
damage
connections
employment
movement
employees
employee
driver
lineman
linemen
sawyer
miners
clerks
parties
consumer
chief
trainmen
tranman
user
drivers
collisions
workers
hands
others
safety
security
floor
feet
beings
lives
boat
vegetation
trunks
buildings
chimney
boilers
tree
trees
grain
stopper
faucet
cans
hair
fence
infantries
infantry
cloth
clothing
bottle
beverage
vehicles
carburetor
craft
cow
stalks
foot
wall
walls
shelf
shelves
partition
floor
ceiling
roof
window
door
stairs
steps
chair
table
bed
desk
lamp
light
kitchen
bathroom
toilet
sink
mirror
curtain
carpet
rug
pillow
blanket
sheet
mattress
cushion
sofa
couch
armchair
bookcase
shelf
drawer
cabinet
wardrobe
closet
hanger
coat
jacket
shirt
pants
dress
skirt
shoe
boot
sock
glove
hat
cap
scarf
tie
belt
watch
clock
ring
necklace
bracelet
earring
glasses
sunglasses
umbrella
bag
purse
wallet
key
phone
computer
keyboard
mouse
screen
monitor
printer
camera
television
radio
speaker
microphone
headphone
book
magazine
newspaper
pen
pencil
paper
envelope
stamp
letter
card
picture
painting
frame
mirror
vase
flower
plant
tree
grass
leaf
branch
root
seed
fruit
vegetable
apple
banana
orange
grape
strawberry
cherry
peach
pear
lemon
lime
tomato
potato
carrot
onion
garlic
pepper
salt
sugar
flour
bread
cake
cookie
pie
candy
chocolate
ice cream
milk
cheese
butter
egg
meat
beef
pork
chicken
fish
shrimp
lobster
crab
oyster
clam
soup
salad
sandwich
pizza
hamburger
hot dog
fries
rice
pasta
noodle
sauce
ketchup
mustard
mayonnaise
vinegar
oil
water
juice
soda
beer
wine
liquor
coffee
tea
cup
glass
bottle
can
jar
box
bag
basket
barrel
bucket
pot
pan
knife
fork
spoon
plate
bowl
napkin
tablecloth
stove
oven
refrigerator
freezer
microwave
dishwasher
sink
faucet
drain
garbage
trash
recycle
soap
shampoo
toothpaste
toothbrush
towel
washcloth
bathtub
shower
toilet
paper
tissue
razor
blade
comb
brush
hair
makeup
lipstick
perfume
cologne
deodorant
lotion
sunscreen
bandage
medicine
pill
syringe
thermometer
scale
weight
measure
ruler
tape
scissors
knife
hammer
screwdriver
wrench
pliers
saw
drill
nail
screw
bolt
nut
washer
wire
cable
plug
socket
switch
battery
light bulb
fan
heater
air conditioner
thermostat
window
door
lock
key
alarm
camera
sensor
motion
detector
smoke
fire
extinguisher
ladder
rope
chain
hook
pulley
gear
lever
spring
wheel
axle
engine
motor
transmission
brake
clutch
steering
wheel
tire
rim
valve
piston
cylinder
crankshaft
camshaft
gasoline
diesel
oil
filter
radiator
coolant
battery
alternator
starter
headlight
taillight
turn signal
windshield
wiper
mirror
seat
belt
airbag
dashboard
speedometer
odometer
fuel gauge
temperature gauge
oil pressure gauge
tachometer
gear shift
parking brake
accelerator
brake pedal
clutch pedal
steering wheel
horn
radio
speaker
antenna
trunk
hood
bumper
fender
door
window
roof
rear view mirror
side mirror
headlight
taillight
turn signal
windshield
wiper
license plate
exhaust pipe
muffler
catalytic converter
fuel injector
carburetor
intake manifold
exhaust manifold
timing belt
timing chain
water pump
thermostat
radiator
coolant
oil pan
oil filter
oil pressure sensor
oil level sensor
oil temperature sensor
oil pressure gauge
oil level gauge
oil temperature gauge
oil pressure warning light
oil level warning light
oil temperature warning light
check engine light
service engine soon light
traction control light
anti-lock brake system light
airbag light
seat belt light
door ajar light
trunk ajar light
hood ajar light
low fuel light
high beam indicator
turn signal indicator
hazard light
fog light
daytime running light
headlight
taillight
brake light
reverse light
license plate light
interior light
dome light
map light
glove box light
trunk light
ashtray light
cigarette lighter
power outlet
USB port
auxiliary input
CD player
radio
speaker
antenna
navigation system
GPS
backup camera
parking sensor
blind spot monitor
lane departure warning
forward collision warning
adaptive cruise control
automatic emergency braking
pedestrian detection
traffic sign recognition
driver attention monitor
night vision
head-up display
heated seats
ventilated seats
massaging seats
power seats
memory seats
lumbar support
side bolsters
headrest
armrest
center console
cup holder
storage compartment
glove box
sunroof
moonroof
panoramic roof
convertible top
soft top
hard top
roof rack
ski rack
bike rack
tow hook
trailer hitch
spare tire
jack
lug wrench
tire iron
tire pressure gauge
tire inflator
jumper cables
first aid kit
fire extinguisher
emergency triangle
flashlight
reflective vest
emergency blanket
emergency food
emergency water
emergency radio
emergency whistle
emergency signal
emergency flare
emergency road kit
emergency tool kit
emergency repair kit
emergency tire repair kit
emergency tire inflator
emergency jumper cables
emergency first aid kit
emergency fire extinguisher
emergency triangle
emergency flashlight
emergency



plows, plow, beets, scrapers, driver, stalks, cultivator, buckets, saws, shovel, wagon, team, vines, paddles, conveyers, roadway, cable, brakeman, drill, horses, hoe, mast, troughs, trolley, plant, stalk, gate, pumps, axle, reins, bucket, cables, frog, cutters, vehicle, abutments, potatoes, bolls, bit, bolt

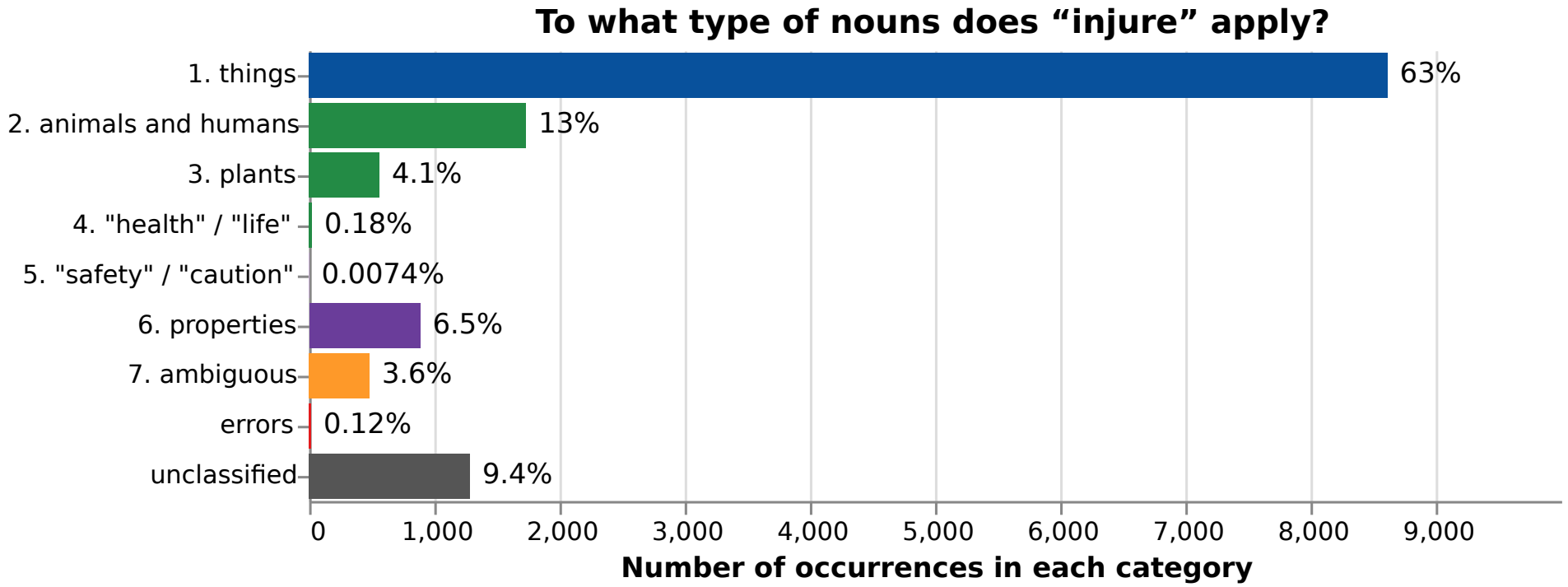
beauty, appearance, apparel, flavor, taste, ornamentation, usefulness, garments, qualities, luster, texture, upholstery, garment, elasticity, flexibility, finish, hats, quality, carpets, furniture, utility, properties, clothing, uniformity, shirt, scarf, integrity, colors, health, durability, trimmings, polish, solidity, configuration, silk, fabrics, accuracy, effectiveness, hat, strength

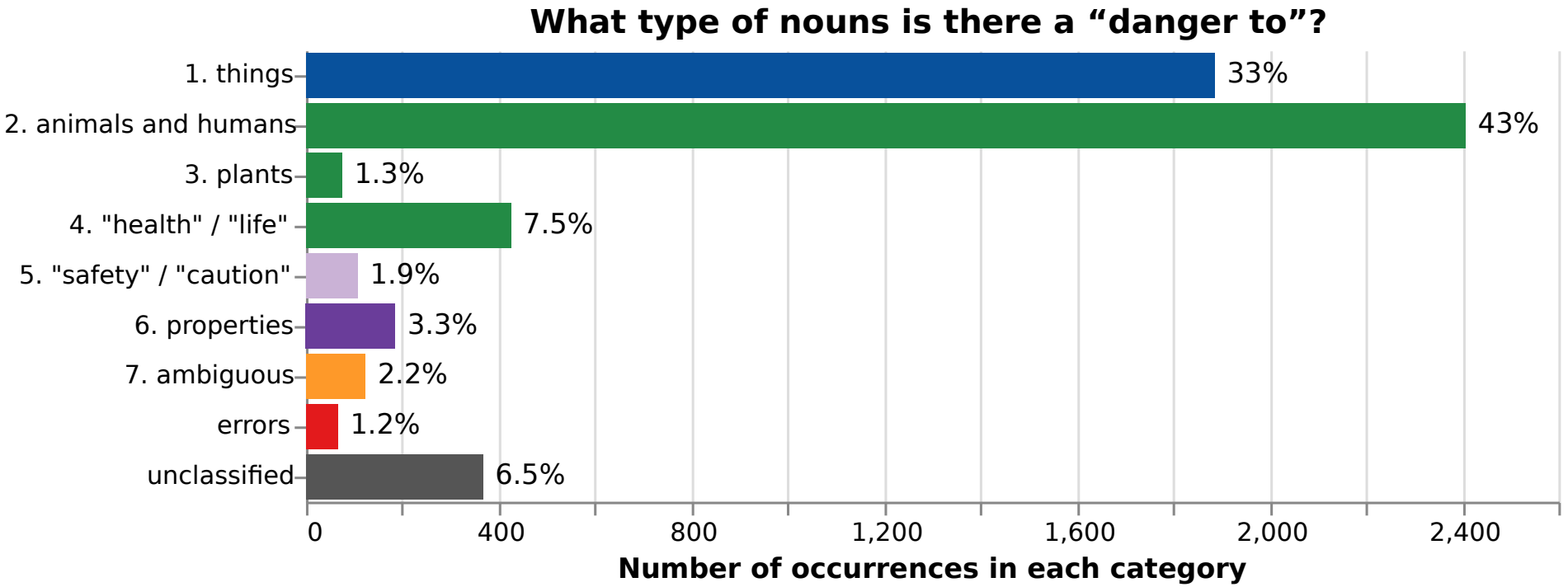
Categorizing

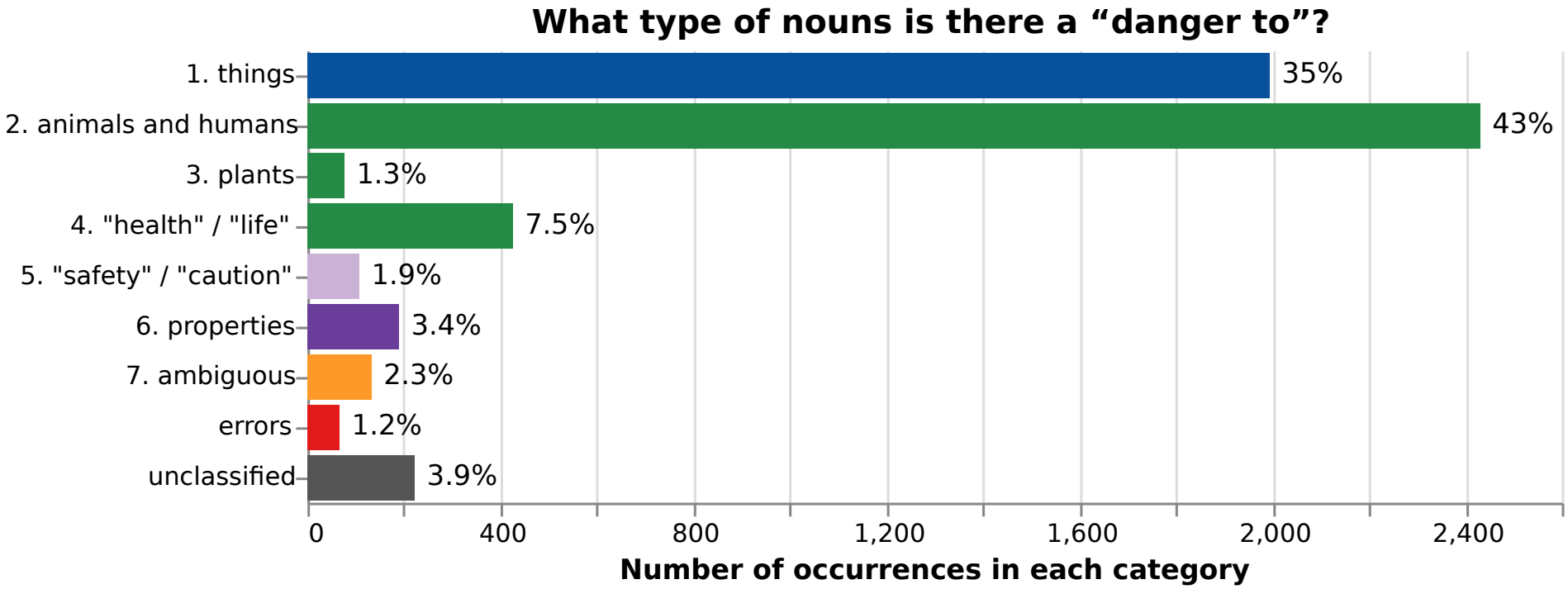
- 1. things
- 2. animals and humans
- 3. plants
- 4. "health" / "life"
- 5. "safety" / "caution"
- 6. properties
- 7. ambiguous
- errors

Parsing problems

“My invention relates to an improvement in devices for conveying or transferring coal, merchandise, or other materials from on ship to another while at sea, whereby the **danger to** life and property **incident** to the methods now and heretofore in use may be avoided.”


To what type of nouns does “injure” apply?
1. things
2. animals and humans
3. plants
4. "health" / "life"
5. "safety" / "caution"
6. properties
7. ambiguous
errors
unclassified
63%
13%
4.1%
0.18%
0.0074%
6.5%
3.6%
0.12%
9.4%
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
Number of occurrences in each category


What type of nouns is there a “danger to”?
1. things
2. animals and humans
3. plants
4. "health" / "life"
5. "safety" / "caution"
6. properties
7. ambiguous
errors
unclassified
33%
43%
1.3%
7.5%
1.9%
3.3%
2.2%
1.2%
6.5%
0
400
800
1,200
1,600
2,000
2,400
Number of occurrences in each category


What type of nouns is there a “danger to”?
1. things
35%
2. animals and humans
43%
3. plants
1.3%
4. "health" / "life"
7.5%
5. "safety" / "caution"
1.9%
6. properties
3.4%
7. ambiguous
2.3%
errors
1.2%
unclassified
3.9%
0
400
800
1,200
1,600
2,000
2,400
Number of occurrences in each category

NBER classification: whole corpus

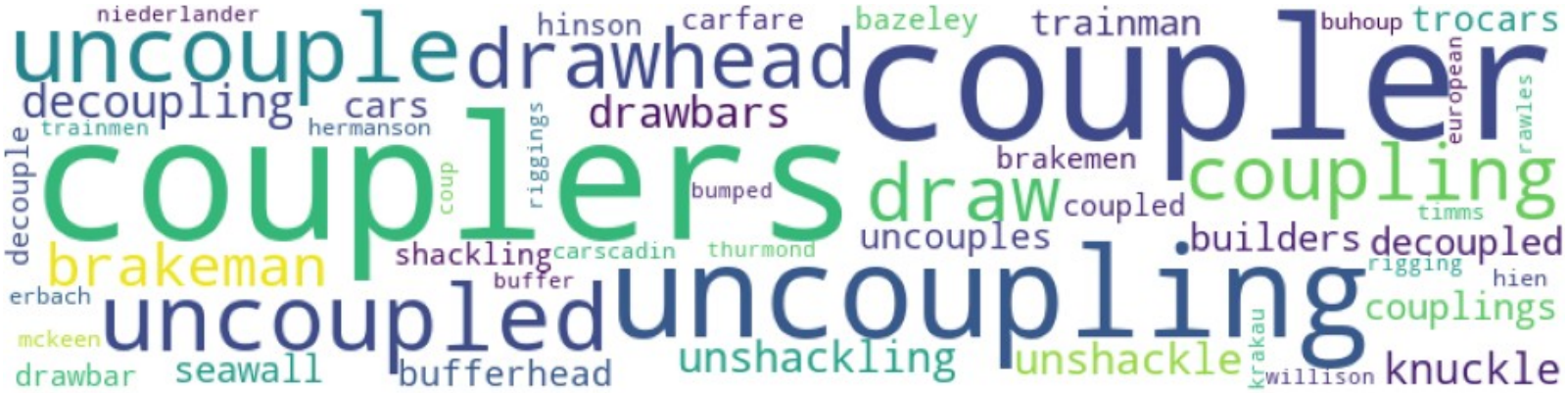
- Chemical
- Computers & Communication
- Drugs & Medical
- Electrical & Electronics
- Mechanical
- Others

NBER classification: whole corpus

• Chemical	8.38%
• Computers & Communication	1.08%
• Drugs & Medical	1.25%
• Electrical & Electronics	4.41%
• Mechanical	36.24%
• Others	48.65%

Topics based on embeddings

Topic 11



Productive interdisciplinary frictions

- Technical challenges
- How to make methods understandable / interpretable?
- Questions left out: “responsibility”? Patents as specific documents?
- How to categorize? How much should we “trust” the computer?
- “Blind” quantification VS “cherry-picking”?