

Evaluating morphosemantic demotivation through experimental and distributional methods

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Introduction

- The lexicalization of complex words, i.e. their inclusion in the lexicon, can induce a loss of compositionality (Lipka 1997, Bauer 1983, Corbin 1987, Blank 2001, Brinton & Traugott 2005, Hilpert 2020, a.o.)
- The semantic analyzability of lexicalized complex words is highly variable
 - Motivated
 - *abattoir* 'slaughterhouse' / *abattre* 'slaughter'
 - Demotivated
 - *couloir* 'corridor' / *couler* 'flow'
 - Semi-demotivated
 - *trottoir* 'sidewalk' / *trotter* 'trot'
- Demotivation, i.e. the obliteration of a morphosemantic relation between a base and a derivative, can be seen as a gradual phenomenon (Cruse 1986, Roché 2004)
 - How can degrees of demotivation be reliably identified?

- We investigate the gradual nature of morphosemantic demotivation and explore methods that can be used to measure it accurately
 - Experimental: based on speakers' judgements
 - Computational: based on distributional semantics
- The study is based on the evaluation of semantic transparency between morphologically related verbs and nouns in French
 - Semantic transparency can be quantified (Marelli & Baroni 2015, Gagné *et al.* 2017, Creemers *et al.* 2020, Bonami & Tribout 2021, Varvara *et al.* 2021)
 - To what extent do experimental and distributional measures of transparency converge?

Data

- Definition of 3 conditions
 - C1** - demotivated
 - C2** - semi-demotivated
 - C3** - motivated
- 6 experts selected 78 verb-noun pairs
 - 26 pairs per condition
 - 8 deverbal suffixes
- All pairs satisfy the following properties:
 - Nouns can be formally analyzed as derived from verbs through suffixation
 - The morphosemantic relation is historically attested
- Verb-noun pairs are selected according to the following criteria:
 - C1, C2 and C3 have an equal number of pairs
 - Suffixes are represented in equal proportions across conditions
 - Pairs are comparable in terms of length, frequency and semantic type

Examples

| | C1 | | C2 | | C3 | |
|-------|---------------------------|-----------------------|-------------------------------|-----------------------------|------------------------------|------------------------|
| | Noun | Verb | Noun | Verb | Noun | Verb |
| -ade | boutade 'joke' | bouter 'push out' | taillade 'gash' | tailler 'carve' | brimade 'bullying' | brimer 'bully' |
| -age | partage 'sharing' | partir 'leave' | tapage 'disturbance' | taper 'hit' | passage 'passing' | passer 'pass' |
| -ance | créance 'debt' | croire 'believe' | ordonnance 'prescription' | ordonner 'command' | attirance 'attraction' | attirer 'attract' |
| -et | cachet 'seal' | cacher 'hide' | fumet 'aroma' | fumer 'smoke' | jouet 'toy' | jouer 'play' |
| -ette | éprouvette 'test tube' | éprouver 'feel' | mouillette 'test strip' | mouiller 'wet' | sonnette 'doorbell' | sonner 'bell' |
| -eur | procureur 'prosecutor' | procurer 'provide' | synthétiseur 'synthesizer' | synthétiser 'synthesize' | danseur 'dancer' | danser 'dance' |
| -oir | couloir 'corridor' | couler 'flow' | trottoir 'sidewalk' | trotter 'trot' | abattoir 'slaughterhouse' | abattre 'slaughter' |
| -ure | serrure 'lock' | serrer 'grip' | fourniture 'supplies' | fournir 'supply' | déchirure 'tear' | déchirer 'tear' |

Experimental approach

Principle

- Verb-noun pairs are presented through an online survey to French native speakers, asked to evaluate the semantic proximity between members of each pair

Task

D'après vous, à quel point les sens du nom **conservatoire** et du verbe **conserver** sont-ils proches ?

0 - sans rapport

6 - extrêmement proches

☐ 0

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

☐ 6

☐

Je ne connais pas un de ces mots

Figure 1: Stimulus and instructions example

Participants

- 309 Bachelor students from the University of Toulouse Jean Jaurès (France) participated in the survey (17 to 25 years old, mean 19.4)

Hypothesis

- Demotivated pairs (C1) should elicit judgements of lower semantic proximity than motivated ones (C3), and judgements for semi-demotivated pairs (C2) should fall in between

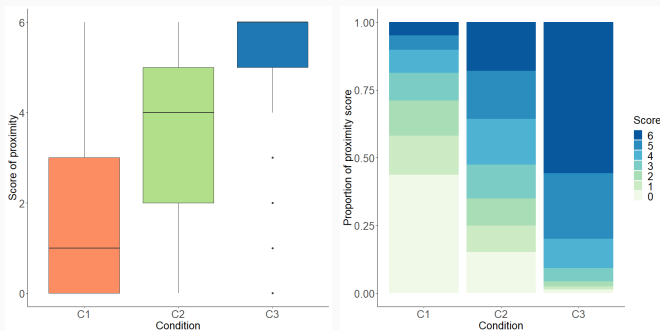


Figure 2: Experimental proximity score per condition

- A mixed ordinal regression shows a significant effect of the condition (C1-C3) on experimental proximity scores ($p < 2.2e-16$)
- Results show consistency between experts' and non-experts' intuitions, highlight the psychological reality of semantic demotivation and its scalarity

Distributional approach

- Distributional semantics builds on the hypothesis that words with similar distributions, i.e. that appear in similar contexts, have similar meanings.
- Meaning of words in a given corpus is represented by vectors computed based on their co-occurrences
- The semantic similarity between two words is assessed by the distributional proximity of their vectors on a scale from 0 to 1.

- We computed the vectors with Word2Vec (Mikolov *et al.* 2013) from the French Wikipedia (900 million words)
 - Concatenation of 5 DSMs with the following parameters: CBOW, Negative Sampling, frequency threshold of 5, window of 5, lemmatized corpus
- For each verb-noun pair, we compute the cosine similarity between the vectors
 - We expect cosine scores to be higher (closer to 1) for C3 pairs than C1 pairs (closer to 0) (given that identical suffixes and semantic types are considered in each condition)
 - We expect C2 pairs to have intermediate cosine scores

- C3 pairs have on average higher cosine scores than C2 and C1 pairs
 - Differences observed across the 3 conditions are significant ($p = 2.21\text{e-}05$)

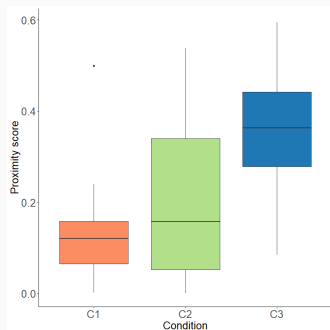


Figure 3: Distributional proximity score per condition

- Differences in morphosemantic motivation are visible through distribution

Comparing approaches

Comparison of both approaches

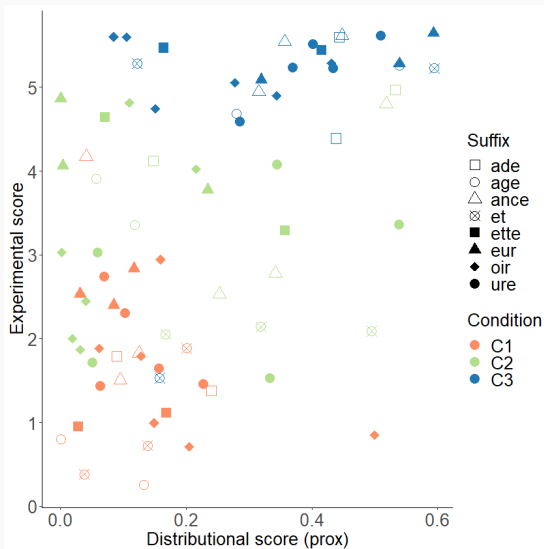
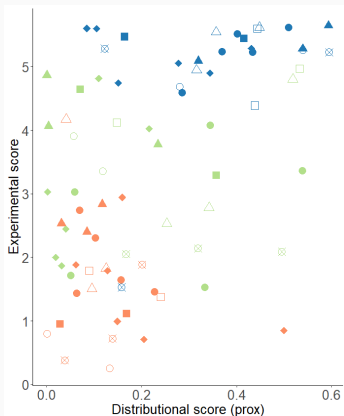
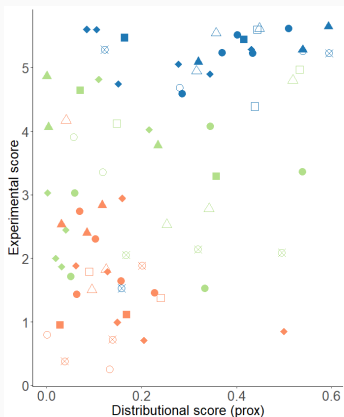


Figure 4: Experimental (0 to 6) and distributional (0 to 1) score per pair



- Overall both methods converge
 - A mixed ordinal regression model shows that distributional scores significantly predict experimental scores ($p = 7.876e-06$)
- The main differences observed point towards particularities of each method
 - Formal similarity encourages semantic similarity in speakers' judgements
 - *traiteur* 'caterer' - *traiter* 'treat'
 - Distributional assessment can be affected by factors unrelated to motivation
 - Polysemy
(*raser* 'shave/destroy/bore' - *rasoir* 'razor')
 - Referential domains
(*peignoir* 'bathrobe' - *peigner* 'comb')
 - Corpus bias

Additional insights



- The confrontation of the two approaches highlights two remarkable clusters
- The convergence of both approaches is a clue for their individual reliability
 - Strong distributional similarity is a solid hint for semantic motivation
 - Low experimental proximity is a solid hint for semantic demotivation

Conclusion

- We confirm the gradual character of demotivation both in a linguistic and a psycholinguistic perspective
 - Semi-demotivated pairs are widely spread across the similarity spectrum
 - Both motivated and demotivated pairs vary wrt (non-)similarity
- Experimental and distributional methods can be seen as complementary
 - Experimentation allows for a more fine-grained assessment of demotivation, but is costly and biased by its artificiality
 - Distribution provides a usage-based assessment, but suffers from the limits of the tool

- The tested dataset needs to be extended (more morphological diversity)
- Other measures of semantic transparency should be explored
 - Priming effects (Longtin *et al.* 2003)
 - Distributional inclusion (Varvara *et al.* 2021), offset vectors (Bonami & Tribout 2021)
- Demotivation can be investigated wrt affixes and productivity
 - Do some affixes present a higher rate of demotivation?
 - Is motivation correlated to affix productivity?

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