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Does iconicity shape Dutch verb-particle constructions? A multimethod study on the semantics of verb separability

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Abstract: In Dutch, verb-particle constructions are traditionally classified as either separable or inseparable. While the formal distinctions between these two types are straightforward, their semantic differences remain contested. This study investigates whether *iconicity* plays a role in distinguishing between separable and inseparable verbs. Using both a synchronic corpus study and an experimental forced-choice task using nonce verbs, we test two existing hypotheses that link separability to either concreteness (Booij, Geert. 2002. *The morphology of Dutch*. Oxford: Oxford University Press) or resultativity (Blom, Corrien. 2004. On the diachrony of complex predicates in Dutch: Predicative and nonpredicative preverbs. *Journal of Germanic Linguistics* 16. 1–75; Blom, Corrien. 2005. *Complex predicates in Dutch: Synchrony and diachrony*. Utrecht: Netherlands Graduate School of Linguistics dissertation), two notions that can be associated with the principle of *iconicity of independence* (Haiman, John. 1983. Iconic and economic motivation. *Language* 59(4). 781–819). While our corpus-based analysis did not yield any significant patterns, the experimental results do reveal a significant relationship between concreteness and separability for the particles *over-* and *om-*. For the particle *door-*, the findings point to a slight tendency toward resultativity, but this effect did not reach statistical significance. Overall, the findings provide empirical support for the claim that language users associate morphosyntactic separability with iconic meaning distinctions.

Keywords: iconicity; (in)separable compound verbs; experimental linguistics; corpus linguistics; Dutch

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1 Introduction

The *Principle of No Synonymy*, and its later reformulation, the *Principle of No Equivalence*, hold that differences in form are generally associated with differences in semantics, pragmatics, or social factors (Goldberg 1995; Leclercq and Morin 2023). However, pinpointing the exact nature of these differences is not always an easy task. On the semantic level, *iconicity* – the resemblance between a sign's form and its meaning (e.g., Haiman 1980, 1985), such as in onomatopoeic words like *meowing* – has often been proposed as an explanatory mechanism, with a growing body of research exploring its role in both signed and spoken languages (see Dingemanse et al. 2015; Perniss et al. 2010 for overviews). In this article, we focus on one of the types of iconicity, viz. *diagrammatic* – or *relative* – *iconicity* (e.g., Dingemanse et al. 2015; Haiman 1980, 1985). *Diagrammatic iconicity* does not rely on a direct resemblance between a form and its referent. Rather, it is through contrast with a formal variant that a form expresses an iconic meaning (Dingemanse et al. 2015: 606; Haiman 1980: 515, 1985: 9–10). A well-known example of *diagrammatic iconicity* is plural formation, where the plural is iconically expressed with the addition of an extra morpheme (e.g., *boek-en* 'book-s'), thereby illustrating that the plural is literally more than the singular. One subtype of *diagrammatic iconicity*, viz. *iconicity of independence*, links structural autonomy to semantic independence: elements that are semantically more independent tend to be expressed by structurally more separate forms (Croft 2003: 213–214; Haiman 1983: 783; Newmeyer 1992: 762–763).¹ For instance, in noun incorporation, morphologically embedded nouns (e.g., *They went deer-hunting* [from Givón 1985: 207]) tend to have less independent meanings, in the sense that it remains uncertain whether an actual deer is shot. By contrast, non-integrated constructions (e.g., *He shot a deer* [from Givón 1985: 207]) do entail that a deer was shot (Newmeyer 1992: 762–763, based on Haiman 1983; Mithun 1984).

The notion of *diagrammatic iconicity* is particularly relevant as an explanatory mechanism for formal variation. One domain where its influence has been demonstrated is verbal morphology. In English, for instance, variation in preterite forms (*-ed* vs. *-t*) has been linked to aspectual differences: longer forms (*-ed*) tend to correlate with durative meanings, while shorter forms (*-t*) are more often linked to punctual events (e.g., Levin 2009; Quirk 1970). The same patterns have been observed in Dutch (De Smet and Van de Velde 2020), thereby supporting the existence of an iconic relationship between the verb's form and its (aspectual) meaning. Still, since research on iconicity in Dutch verbal morphology focused primarily on base verbs in

¹ Other types of *diagrammatic iconicity* are *iconicity of complexity* (Haiman 1985; Haspelmath 2008), *iconicity of cohesion* (Haspelmath 2008), *iconicity of quantity* (Haspelmath 2008: 2), or *iconicity of sequence* (Givón 1985; Greenberg 1963: 103; Haiman 1980).

the past tense, its role in more complex constructions – such as (in)separable verbs – remains underexplored.

Although Dutch separable and inseparable verbs have already been extensively studied from diachronic (e.g., Blom 2004, 2005; Booij 2002; Van der Horst 2008; Van Loey 1976), morphosyntactic (e.g., Booij 1990, 2002; Neeleman and Weerman 1993), and cross-linguistic perspectives (e.g., Van Goethem 2008 on Dutch and French), the semantic distinctions underlying these two verb types remain contested. Some studies (Blom 2004, 2005; Booij 2002) have proposed an iconic link between separability and meaning, but these claims are based on isolated examples and lack empirical support.

Another limitation in the research on iconicity is the scarcity of experimental evidence, with the existing experimental studies mainly addressing iconicity in domains such as sound symbolism, language learning, and gesture (e.g., Cuskley et al. 2019; Gómez Milán et al. 2013; see also Dingemanse et al. 2020). Although corpus-based studies (e.g., De Smet and Van de Velde 2020; Oomen 2020) have offered valuable insights into iconicity in verbal morphology, experimental work in this domain remains limited (but see e.g., De Smet 2021; De Smet and Rosseel 2021, 2023). Nevertheless, experimental methods, especially nonsense verb experiments, could offer a promising avenue for assessing whether language users rely on iconicity during the cognitive processing of compound verbs.

This paper aims to contribute to the growing body of literature on iconicity by investigating its role in Dutch separable and inseparable verbs. By examining the semantic distinctions between these two verb types, we aim to determine whether iconicity plays a role in this area of (Dutch) verbal morphology. This focus is theoretically relevant because it extends research on iconicity beyond its more commonly studied domains, such as lexical semantics and phonology, into the less-explored area of more general morphosyntactic distinctions, such as morphological separability. In doing so, it enables us to assess whether iconicity operates as a more general cognitive principle that also constrains morphosyntactic structure, or whether its effects are limited to more local form-meaning mappings. To investigate this question, we adopt a multimethodological approach, combining a corpus analysis with an experimental study, since this dual approach allows us to address both actual language use and the cognitive reality of iconicity.

The structure of the paper is as follows: Section 2 provides a background on (the semantics of) verb-particle constructions in Dutch. Section 3 presents the corpus-based study, and Section 4 outlines the experimental study. Finally, Section 5 integrates the findings of both studies and discusses their implications for our understanding of the role of iconicity in Dutch verbal morphology.

2 Iconicity in verb-particle constructions in Dutch

Dutch is one of the languages in which verbs consisting of a base verb and a non-verbal element – commonly referred to as *verb-particle constructions* – can appear in both separable and inseparable forms.² The formal distinction between these two verb types is straightforward: in separable compound verbs (SCVs), the particle detaches from the base verb in verb-initial or verb-second position in main clauses, as well as in past participles with the marker *ge-*, and infinitives with the particle *te*. In contrast, inseparable compound verbs (ICVs) retain the prefix permanently attached to the base verb, preventing any syntactic separation.

A second, syntactic distinction between SCVs and ICVs concerns their transitivity: inseparable forms are significantly more frequent in transitive constructions than the separable ones ($p < 0.001$).³ However, this reflects a general tendency rather than an absolute rule, as transitive SCVs (e.g., *aankijken* ‘look at’, *omkopen* ‘bribe’) and intransitive ICVs (e.g., *overwerken* ‘work overtime’, *overlijden* ‘pass away’) still appear.

While the formal distinctions between SCVs and ICVs are well established, the semantic contrast underlying them remains debated. Two main hypotheses have been proposed in this respect. The first hypothesis, formulated by Booij (1998, 2002), links verb separability to a distinction between concrete and abstract meanings. According to Booij (1998, 2002), ICVs emerged historically from SCVs through a process of grammaticalization,⁴ which involved semantic bleaching (e.g., Hopper and Traugott 2003). As the formal cohesion of the non-verbal element and the verb increased during the transition from a SCV to an ICV, these two elements also became semantically more integrated. As a result, SCVs retained the concrete (and often spatial) meaning of their particles, while ICVs developed more abstract and aspectual meanings (Booij 1998: 11, 14; 2002: 211). For example, the separable form of *doorlopen* indicates literal motion through a location (e.g., *het bos doorlopen* ‘lit. through-walk

2 Separable verb constructions also appear in other Germanic languages, like German (e.g., Stiebels and Wunderlich 1994) and English (the so-called *phrasal verbs*) (Van Kemenade and Los 2003), as well as in non-Germanic languages, such as Hungarian (Ackerman 1987; Kalivoda 2021).

3 To calculate this, we linked all verbs with *door-*, *om-*, and *over-* to the Reference File Dutch (van der Vliet 2007), which provides information on both separability and transitivity. In total, we identified 345 verbs with these spatial preverbs, of which 235 were separable (95 intransitive [40.43 %] and 140 transitive [59.57 %]) and 110 inseparable (11 intransitive [10 %] and 99 transitive [90 %]). A chi-square test of independence revealed a significant association between separability and transitivity ($\chi^2(1) = 31.02$, $p < 0.001$, Cramér’s $V = 0.31$), indicating that inseparable verbs are significantly more likely to be transitive than separable verbs.

4 We define *grammaticalization* as the linguistic changes in which a lexical element or a lexical construction acquires grammatical features in certain usages, or, in which a grammatical element acquires further grammatical features (in line with Hopper and Traugott 2003: 2).

the forest'), whereas its inseparable counterpart expresses completion, no longer involving spatial motion (e.g., *de cursus doorlopen* 'complete the course').

Blom (2004, 2005), however, challenges this concreteness-abstractness dichotomy. While she agrees that SCVs and ICVs differ both formally and semantically, she demonstrates with several counterexamples, such as separable *opzoeken* 'look up, find' and inseparable *doorzoeken* 'search through', that SCVs are not necessarily spatial or concrete, nor are ICVs always abstract, thereby undermining Booij's (2002) claim. Blom (2004: 8) then concludes that the loss of the preverb's spatial meaning is neither a necessary nor a sufficient condition for the formal shift from separable to inseparable. Instead, Blom (2004) proposes *resultativity* as the key semantic distinction. She defines *resultativity* as the fact that the preverbal element (*op* 'up' in [1a], and *onder* 'under' in [1b–c]) expresses a result that influences the direct object in transitive constructions (e.g., *de voetbal* 'the football' in [1a]) or the subject in intransitive constructions (e.g., *de zon* 'the sun' in [1b]) (see also Haeseryn et al. 1997). On the contrary, a non-resultative meaning applies when the preverbal element does not express a change or result, such as in (1c), where the direct object *zijn pijn* ('his pain') is not *onder* ('under') as a result of the action *gaan* ('go').

- (1) a. *Hij gooit de voetbal op.* ('He **throws up** the football.)
 b. *De zon gaat onder.* ('The sun **goes down**.)'
 c. *Hij ondergaat zijn pijn.* ('He **undergoes** his pain.)'

According to Blom (2004: 45), SCVs can express both resultative and non-resultative meanings, whereas ICVs, which she argues to have evolved from non-resultative SCVs, consistently convey non-resultative interpretations. She further emphasizes that separable particles often have greater independent and more compositional meanings, whereas inseparable prefixes express a holistic interpretation, reflecting semantic integration because of the prefix's formal fusion with the base verb (Blom and Booij 2003: 67, 89). However, this hypothesis also faces challenges, and counterexamples involving resultative ICVs, such as *onderwerpen* 'subject', suggest that the link between resultativity and separability may be more complex than initially proposed. For a more detailed account of these counterexamples, see Vrielynck et al. (2025).

Interestingly, while Booij (2002) and Blom (2004, 2005) offer competing hypotheses, they share the assumption – albeit implicitly – that iconicity plays a role in verb separability. Indeed, both posit that an increased formal integration of the non-verbal element and the verb correlates with a greater semantic integration, which aligns with the principle of *iconicity of independence*. As mentioned in Section 1, this subtype of diagrammatic iconicity links structural autonomy to semantic independence (Croft 2003: 213–214; Haiman 1983: 783; Newmeyer 1992: 762–763). In this light, SCVs are expected to express more independent and compositional meanings – either concrete and spatial (cf. Booij 2002) or resultative (cf. Blom 2004, 2005). In contrast,

ICVs – characterized by formal cohesion – are expected to have more abstract and aspectual (cf. Booij 2002) or holistic and non-resultative (cf. Blom 2004, 2005) meanings. Thus, while neither of them explicitly evokes the idea of iconicity, their hypotheses clearly reflect this idea.

Nonetheless, because Booij (2002) and Blom (2004, 2005) rely on isolated examples rather than on a systematic large-scale investigation, the existence of counter-examples for both hypotheses undercuts the larger applicability of the semantic distinctions they propose. As a result, it remains unclear whether iconicity really underlies the distinction between SCVs and ICVs.

This study aims to address this lacuna by systematically testing the role of concreteness and resultativity as potential factors in the semantic distinction between SCVs and ICVs. By adopting a quantitative, multi-method approach, we aim to offer a more empirically grounded investigation of the potential semantic factors underlying verb separability. The goal of this study is then not to find an exceptionless rule, but rather to assess whether concreteness and/or resultativity exerts a statistically significant influence on separability, and to determine which, if any, of the two hypotheses offers the most predictive power.

The distinction between SCVs and ICVs may be situated along a broader formal cline, ranging from free prepositional constructions (e.g., *lopen door* ‘run through’), through SCVs and ICVs with still recognisable spatial morphology (e.g., *doorlopen* ‘lit. through-run’), to fully lexicalised verbs with opaque prefixes (e.g., *belopen* ‘lit. be-walk’, *verdenken* ‘suspect’). While descriptively appealing, such a cline is difficult to reconcile with historical evidence. Historical data instead point to multiple source constructions (cf. Van de Velde et al. 2013) and distinct developmental pathways, rather than a single, unified grammaticalization process (Vrielynck et al. 2025; Vrielynck et al. accepted). Moreover, verbs with prefixes such as *be-* and *ver-* constitute a fundamentally different morphological type. These are derived verbs with inherited prefixes that can be traced back to earlier stages of the Germanic languages (Blom 2005: 295) and thus differ both historically and structurally from compound verbs with spatial preverbs. This limits the comparability of the extremes of the proposed cline. For this reason, the present study restricts its scope to spatial preverbs that can synchronically be realised as either separable or inseparable verbs. A broader diachronic or semantic account is left for future research and falls beyond the scope of the present study.

3 Corpus study

To test Booij’s (2002) hypothesis that the distinction between Dutch SCVs and ICVs is influenced by differences in concreteness, we first conducted a corpus-based

analysis, consisting of two components: a quantitative analysis (Section 3.1) followed by a qualitative analysis (Section 3.2).

3.1 Quantitative analysis

3.1.1 Data collection and annotation

We began by compiling a list of all verbs containing the non-verbal elements *door-* ('through'), *om-* ('around'), and *over-* ('over'), based on the dictionary *Van Dale* (2022) and the Reference File Dutch (van der Vliet 2007). These three non-verbal elements were selected because of their productive use in both separable and inseparable verb forms (Blom 2005: 13). The initial selection yielded a total of 648 verbs, of which 381 (58.80 %) were separable and 267 (41.20 %) were inseparable.

To annotate these verbs for concreteness, we used the concreteness ratings provided by Brysbaert et al. (2014a), which contain scores for 30,000 Dutch words on a scale from 1 (*very abstract*) to 5 (*very concrete*). Brysbaert et al. (2014a: 83) define a concept as *concrete* when it refers to existing entities that can be perceived through one's senses or by executing an action. Conversely, *abstract* concepts are defined as those that cannot be directly experienced, and as language-dependent, meaning that the easiest way to explain them is by using other words that capture parts of its meaning.

However, when directly linking the verbs to this dataset, we encountered a key limitation: a majority of verbs in our list (70.06 %) were not present.⁵ Moreover, verbs that exist in both separable and inseparable forms (e.g., *doorlopen*) were listed only once, complicating our analysis – especially since we expect the effect of concreteness to be most prominent in such minimal pairs.

To address this issue, we turned to the *patiens* of the verbs as a proxy for their meaning.⁶ By *patiens*, we refer to the direct object in active constructions and the subject in passive ones. Prior research (e.g., Frassinelli and Schulte im Walde 2019;

5 More specifically, only 64 verbs with *door-*, 52 verbs with *om-* and 78 verbs with *over-* are present in Brysbaert et al.'s (2014a) dataset.

6 An anonymous reviewer, whom we thank for this insightful suggestion, proposed estimating concreteness scores using generative AI rather than relying on the concreteness scores of Brysbaert et al. (2014a). Recent work (e.g., Conde et al. 2026) indeed reports a strong correlation between AI-generated ratings (using GPT-4o-mini) and human judgments, suggesting that such models could in principle be used to assign concreteness scores to compound verbs. However, we did not adopt this approach due to the opacity of the model's training data: they may include metalinguistic discussions claiming that ICVs tend to have more abstract meanings. If so, this raises a potential risk of circularity, as the model's outputs may reflect prior generalizations rather than independent semantic judgments.

see also Pijpops et al. 2021) has demonstrated that a *patiens* reliably reflects a verb's meaning. For instance, Frassinelli and Schulte im Walde (2019) show in their study on English – also drawing on the concreteness ratings from Brysbaert et al. (2014b) – that nouns subcategorised by concrete verbs tend to have significantly higher concreteness scores than those selected by abstract verbs, with all *p*-values below 0.001 (Frassinelli and Schulte im Walde 2019: 41).

This approach seems to be equally applicable to compound verbs. Verbs with concrete meanings, such as *het bos doorlopen* ('lit. through-walk the forest') or *de boom omhakken* ('chop down the tree'), seem to co-occur with concrete nouns (i.e., *bos* 'forest', *boom* 'tree'), whereas abstract meanings like *de stilte doorbreken* ('break the silence') or *de angst doorstaan* ('endure the fear') seem to take abstract objects (i.e., *stilte* 'silence', *angst* 'fear'). This suggests that the concreteness of a verb's *patiens* can also serve as a proxy for the verb's meaning in the case of compound verbs.

To systematically analyse the *patiens* of these compound verbs, we collected corpus data from two corpora: the NITenTen20 corpus (6,836,979,371 tokens; via SketchEngine), and the SoNaR corpus that consists of 540,188,237 tokens (Institute of the Dutch Language 2015). We focused on the past participles of all identified target verbs, as these offer a clear formal distinction between a separable and an inseparable form, with respectively the presence (e.g., *doorgeboord* 'drilled through') or absence (e.g., *doorboord* 'drilled through, pierced') of the prefix *ge-* between the preverbal element and the verb. Although the formal separation of the particle and the verb also occurs in other constructions – such as in verb-initial or verb-second position in main clauses, or in infinitival constructions with *te* (see Section 2) – extracting such forms is considerably more complex and would require manual disambiguation between adpositional constructions and verbal particles, which would drastically reduce the feasibility of a large-scale corpus study.

After extracting all attestations, we automatically identified the verb's *patiens* of all the verb's instances using the Alpino parser for the SoNaR corpus (van Noord 2006) and SpaCy's *nl_core_news_sm* library (Honnibal et al. 2020) for the NITenTen20 corpus. Pronouns were excluded, as they offer limited insight into the concreteness of a verb's meaning. Additionally, we retained only those verbs that appeared at least 10 times in the corpus to ensure that one-off instances would not bias the results. Finally, we matched the identified *patiens* to the dataset of Brysbaert et al. (2014a). While still not all *patiens* could be matched, this approach yielded a dataset large enough to allow for statistical modelling of the effect of concreteness. The final dataset consists of 99,987 attestations covering 253 verbs, as summarized in Table 1.

Table 1: Number of verbs and attestations (corpus study).

		SCV	ICV	Total
Door- ('through')	N of verbs	53 (67.95 %)	25 (32.05 %)	78 (100 %)
	N of attestations	17,428 (56.79 %)	13,259 (43.21 %)	30,687 (100 %)
Om- ('around')	N of verbs	47 (63.51 %)	27 (36.49 %)	74 (100 %)
	N of attestations	13,600 (63.39 %)	7,853 (36.61 %)	21,453 (100 %)
Over- ('over')	N of verbs	45 (44.55 %)	56 (55.45 %)	101 (100 %)
	N of attestations	25,518 (53.33 %)	22,329 (46.67 %)	47,847 (100 %)
Total	N of verbs	145 (57.31 %)	108 (42.69 %)	253 (100 %)
	N of attestations	56,546 (56.55 %)	43,441 (43.45 %)	99,987 (100 %)

3.1.2 Analysis and results

For each verb, we calculated the average concreteness. Subsequently, we analysed the data using binomial logistic regression models for each particle separately.⁷ The dependent variable was SEPARABILITY, classified as either *separable* or *inseparable*, with *separable* as the success level; the fixed effect in the model was AVERAGE CONCRETENESS, measured on a scale from 1 (*abstract*) to 5 (*concrete*). Figure 1 visualizes the effect of concreteness on separability for each particle; Table 2 presents the model outputs.⁸

The model’s output does not confirm Booij’s (2002) hypothesis: a higher degree of concreteness does not significantly correlate with an increased likelihood of a separable verb form. As shown in Table 2, the effects of concreteness vary across particles. For *om-* and *over-*, there is a slight positive effect of concreteness on separability, with estimates of 0.60 and 0.73, respectively. However, both effects are non-significant and accompanied by wide confidence intervals, indicating uncertainty in the estimates. Moreover, the models’ predictive performance is weak, with the *om-*model’s *C*-value even below 0.5 and the *over-*model’s *C*-value barely reaching 0.6, suggesting no discriminative ability for the *om-*model and only limited discriminative ability for the *over-*model. In contrast, the particle *door-* shows a negative estimate (−0.36), suggesting that greater concreteness is, in fact, associated with a decreased likelihood of separable forms, but again this effect is not very reliable given the wide confidence interval and poor model performance, with its

7 For the analysis, we used the R package *glm* (R Core Team [2023]). For the regression model, we used the formula: `model ← glm(separability ~ average_concreteness, data = data, family = binomial)`. Other packages we used are: `dplyr` (Wickham et al. 2025a), `stringr` (Wickham 2023), `pROC` (Robin et al. 2011), `ggplot2` (Wickham 2016), `Showtext` (Qiu Y 2026) and `readr` (Wickham et al. 2024).

8 We also conducted simulation-based power analyses on the three models. These indicate low-to-moderate power (for *om-* = 0.35, *door-* = 0.15, *over-* = 0.46).

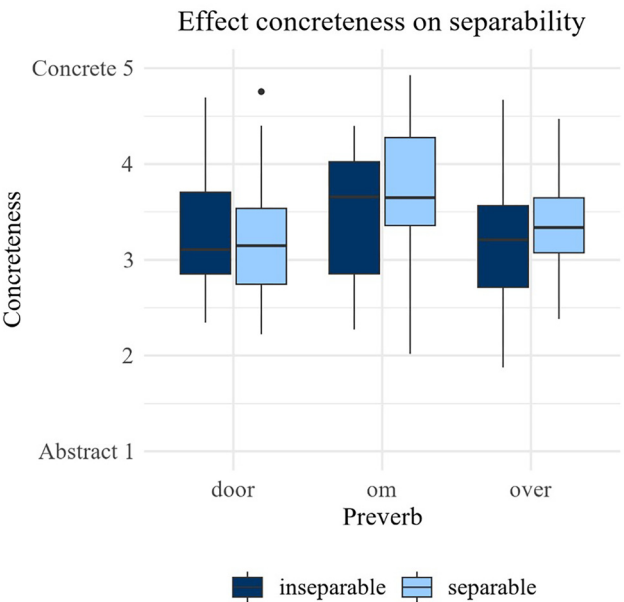


Figure 1: Effect of concreteness on separability (corpus study).

Table 2: Output of binomial logistic regression models (corpus study).

Om- ('around')					
ICV: 27 verbs			C-value: 0.415		
SCV (success level): 47 verbs			OR of AVERAGE CONCRETENESS: 1.83		
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value	
Intercept	−1.63	1.41	−1.15	0.249	
AVERAGE CONCRETENESS	0.60 [−0.14, 1.39]	0.39	1.56	0.119	
Door- ('through')					
ICV: 25 verbs			C-value: 0.451		
SCV (success level): 53 verbs			OR of AVERAGE CONCRETENESS: 0.70		
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value	
Intercept	1.93	1.27	1.52	0.130	
AVERAGE CONCRETENESS	−0.36 [−1.13, 0.39]	0.38	−0.95	0.342	
Over- ('over')					
ICV: 56 verbs			C-value: 0.596		
SCV (success level): 45 verbs			OR of AVERAGE CONCRETENESS: 2.07		
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value	
Intercept	−2.60	1.29	−2.01	0.045	
AVERAGE CONCRETENESS	0.73 [−0.02, 1.53]	0.39	1.87	0.062	

C-value again below 0.5. Overall, none of the models provide robust evidence for a consistent effect of concreteness on separability.

3.1.3 Discussion

The corpus-based results do not confirm Booij’s (2002) hypothesis that the contrast between SCVs and ICVs is driven by concreteness. Although there is a slight tendency for *over*- and *om*-, a higher level of concreteness of the patiens does not significantly increase the likelihood of a separable verb form.

It should be noted, however, that our corpus study relied on the assumption that the patiens functions as a proxy for the verb’s meaning. While this method has been proven valid in previous studies (see Section 3.1.1), it remains important to critically evaluate this methodological assumption. Therefore, we conducted a brief qualitative analysis of our data. Specifically, for each non-verbal element, we selected the five most concrete and the five most abstract patiens – and by extension, verb meanings. Tables 3–4 present the results for the most concrete and most abstract verbs, respectively. For each verb, we also report the most frequent patiens with its concreteness score to allow for an evaluation of the validity of our approach. In cases where multiple patiens occurred with equal frequency, all are listed.

The majority of verbs categorized as *concrete* are separable (80 %). A closer inspection of the verb-object pairs in the corpus shows that they generally express concrete meanings, thereby supporting Booij’s (2002) hypothesis that separability correlates with concreteness. The main exceptions occur with the particle *door*-. These errors are all due to metaphorical meanings, which our method was unable to capture. For example, *de das omdoen* (‘lit. put on a tie’), *het water doorzwemmen* (‘lit. swim through the water’), and *de knoop doorhakken* (‘lit. chop through the knot’) are used

Table 3: Most concrete verbs and patiens (*door*-, *om*- and *over*-).

<i>om</i> - (‘around’)	<i>over</i> - (‘over’)	<i>door</i> - (‘through’)
SCV omdoen – <i>das</i> (4.93) ‘put_around – tie’	ICV overspelen – <i>hand</i> (4.67) ‘over-play – hand’	SCV doorhakken – <i>knoop</i> (4.76) ‘chop_through – knot’
SCV omkappen – <i>boom</i> (4.68) ‘chop_down – tree’	SCV overzwemmen – <i>rivier</i> (4.47) ‘swim_over – river’	ICV doorzwemmen – <i>water</i> (4.70) ‘through-swim – water’
SCV omplooien – <i>bord, draad, portier</i> (4.66) ‘fold_around – sign, wire, car door’	SCV overplooien – <i>portier</i> (4.44) ‘fold_over – car door’	SCV doorbijten – <i>draad, navelstreng</i> (4.40) ‘bite_through – wire, umbilical cord’
SCV omzagen – <i>boom</i> (4.56) ‘saw_down – tree’	SCV oversnijden – <i>keel</i> (4.26) ‘cut_over – throat’	ICV doorboren – <i>hart, long</i> (4.35) ‘through-drill – heart, lung’
SCV omhakken – <i>boom</i> (4.54) ‘chop_down – tree’	SCV overrijden – <i>trein</i> (4.25) ‘drive_over – train’	SCV doorsnijden – <i>keel</i> (4.33) ‘cut_through – throat’

Table 4: Most abstract verbs and patiëns (*door-*, *om-* and *over-*).

<i>om-</i> ('around') ^a	<i>over-</i> ('over')	<i>door-</i> ('through')
SCV <i>omwringen</i> – <i>kans</i> (2.02) 'wring_around – chance'	ICV <i>overtreden</i> – <i>wet</i> (1.88) 'overstep – law'	SCV <i>doormaken</i> – <i>ontwikkeling</i> (2.22) 'make_through – development'
ICV <i>omkleden</i> – <i>beslissing</i> (2.38) 'around-clothe – decision'	ICV <i>overschatten</i> – <i>belang</i> (2.23) 'overestimate – importance'	SCV <i>doordrijven</i> – <i>zin</i> (2.24) 'drive_through – desire'
ICV <i>omarmen</i> – <i>idee</i> (2.49) 'embrace – idea'	ICV <i>overtreffen</i> – <i>verwachting</i> (2.26) 'over-affect – expectation'	SCV <i>doorschieten</i> – <i>overheid</i> (2.26) 'shoot_through – government'
ICV <i>omzeilen</i> – <i>klip</i> (2.56) 'around-sail – difficulty'	ICV <i>overroepen</i> – <i>probleem</i> (2.26) 'over-shout – problem'	SCV <i>doorvoeren</i> – <i>hervorming</i> (2.30) 'carry_through – reform'
SCV <i>ombuigen</i> – <i>achterstand</i> (2.61) 'bend_around – backlog'	ICV <i>overtijgen</i> – <i>verwachting</i> (2.30) 'over-rise – expectation'	ICV <i>doorgronden</i> – <i>geheim</i> (2.35) 'through-ground – secret'

^aAmong the five most abstract verbs with *om-*, one was *omzet*. However, this item was incorrectly classified as a verb, while it referred to the noun *omzet* ('revenue'). As a result, we excluded this from the table and instead included the sixth most abstract verb, namely *omarmen* ('embrace').

metaphorically to express respectively 'kill someone', 'endure hardship', and 'make a decision'. Similarly, *overspelen* ('over-play') appears in the fixed expression meaning 'to overplay one's hand'. Although these cases actually support Booij's (2002) prediction, our method misclassified them due to the concreteness of the object.

For the most abstract verbs, our method performs very well. For *om-*, two of the five abstract verbs are separable, which contradicts Booij's hypothesis, but they are correctly identified as abstract by our approach. For *over-*, all five verbs are inseparable and express abstract meanings, fully consistent with both our classification and Booij's prediction. For *door-*, four verbs are separable – contrary to Booij's hypothesis, yet again correctly identified as abstract by our method.

To conclude, these qualitative findings suggest that our patiëns-based method is overall effective in identifying the concreteness of a compound verb's meaning. Only for *door-*, the number of correctly annotated patiëns-verb pairs is somewhat lower, due to its frequent use in metaphorical and idiomatic expressions. However, metaphorical uses of otherwise concrete patiëns do appear in both separable (e.g., *doorhakken*) and inseparable (e.g., *doorzwemmen*) forms.

Furthermore, it may be that the distinction in concreteness only or most clearly manifests among verb pairs where the same combination of base verb and preverb occurs both as a SCV and ICV, such as *doorlopen* 'walk through; go over' or *overstromen* 'overflow; flood' (cf. Blom 2005: 252, footnote 3). However, a binomial logistic regression model limited to these alternating verb pairs ($n = 30$) also failed to yield a significant effect, although the effect is in the right direction and the model's *C*-value is higher than those in Table 2 (cf. Table 5 for the model's output).

Table 5: Output of binomial logistic regression with verb pairs only.^a

Minimal pairs					
(success level = SCV)			C-value: 0.628		
			OR of AVERAGE CONCRETENESS: 2.26		
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value	
Intercept	−2.83	1.71	−1.66	0.097	
AVERAGE CONCRETENESS	0.82 [−0.11, 1.82]	0.49	1.68	0.093	

^aThe result of the simulation-based power analysis for this model also indicates only moderate power (0.39).

3.2 Qualitative analysis

It should be noted that a purely quantitative, corpus-based account of the observed distributional patterns can only partially determine whether semantic factors such as concreteness play a decisive role. To address this limitation, additional evidence was sought through a cognitively oriented analysis of the preverbs and verbs with which they combine. Adopting the multidimensional, usage-based perspective on lexical meaning proposed by Geeraerts (2023) and building on earlier cognitive-semantic analyses of Dutch prepositions (e.g., Cuyckens 1991), we analysed the preverbs and verbs of the corpus study qualitatively as semantic spaces organised along different dimensions.

Within this view, *om-* reveals a clear semantic differentiation between SCVs and ICVs. SCVs predominantly encode dynamic reorientation processes, such as folding (e.g., *omvouw*en ‘fold over’, *omplooi*en ‘fold back’), toppling (e.g., *omz*agen ‘saw down’, *omst*oten ‘knock over’, *omkiep*eren ‘topple down’) or transformation (e.g., *oms*meden ‘melt to’, *omt*overen ‘transform’, *omd*open ‘rename’), in which the preverb retains a relatively transparent and compositionally accessible direction contribution. By contrast, ICVs cluster around meanings of encirclement (e.g., *omarm*en ‘embrace’, *omcirk*elen ‘encircle’) and covering (e.g., *omz*omen ‘surround’ or *omh*ullen ‘envelop’), in which a spatial meaning can still be discerned, but is construed as a holistic, bounded whole. This contrast broadly aligns with the shift from more concrete and spatially decomposable events to more integrated and conceptually unified ones.

A comparable contrast emerges for *over-*. SCVs typically express dynamic, directional crossing (e.g., *overz*wemmen ‘swim across’, *overrij*den ‘ran over’), transfer (*overb*rengen ‘transfer’, *overd*ragen ‘transfer’, *overhe*velen ‘transfer’) or repetition (e.g., *overd*oen ‘repeat’, *overpl*akken ‘plaster again’, *overschild*eren ‘repaint’), whereas ICVs are associated with more global interpretations such as covering (e.g., *overg*ieten ‘cover’, *overdek*ken ‘cover’, *overspo*elen ‘flood’), excess (e.g., *overtre*ffen

‘exceed’, *overladen* ‘overload’) or domination (e.g., *overwinnen* ‘conquer’, *overmeesteren* ‘overpower’, *overmannen* ‘overwhelm’), in which the affected entity is construed as fully encompassed or exceeded. In ICVs, the spatial meaning is often no longer concrete, but extended metaphorically, resulting in more abstract and holistic construals.

For *door-*, the distinction is less straightforward. SCVs tend to encode dynamic motion along a spatially interpretable path, often with a resultative effect (e.g., *doorsnijden* ‘cut through’, *doorzagen* ‘saw through’, *doorprikken* ‘puncture’) or transfer (e.g., *doorsluizen* ‘funnel’, *doorzenden* ‘transfer’). However, both SCVs and ICVs may express path or duration. This overlap in meaning may help explain why the quantitative results for *door-* were less clear-cut, and why resultativity emerged as a stronger predictor than concreteness. The crucial distinction between the two verb types – like for the other particles – appears to lie in the degree of conceptual integration: ICVs typically express a more holistic, internalised – and often metaphorical – traversal (e.g., *doorstaan* ‘endure’, *doorleven* ‘live through’, *doorzien* ‘understand’, *doorlopen* ‘complete’), whereas SCVs retain a more segmentable, spatially transparent interpretation (*doorspoelen* ‘flush’, *doorschuiven* ‘slide through’).

Overall, this qualitative analysis suggests that the variation between SCVs and ICVs in the corpus study is not arbitrary but is shaped by cognitively motivated semantic distinctions. SCVs are typically associated with dynamic, decomposable events in which the preverb contributes a relatively transparent spatial or directional meaning, while ICVs tend to encode more holistic and integrated construals, often extending into more metaphorical domains. These findings can be related to the notion of iconicity of independence: as the preverb becomes more tightly integrated into the verb, compositional transparency decreases, which favours inseparability.

3.3 Conclusions

Taken together, the findings of the corpus study support the view that the distinction between SCVs and ICVs is grounded in cognitively motivated semantic differences, in line with the notion of iconicity of independence. At the same time, the quantitative results of the corpus study cast doubt on the explanatory power of concreteness as a determining factor in verb separability. This is also reflected in the relatively low *C*-values of the regression models, which do not exceed 0.628, indicating that there is still a large amount of variability unexplained. These findings suggest that other semantic factors – such as resultativity – may play a more decisive role in distinguishing between SCVs and ICVs, as also stated by Blom (2004, 2005). Therefore, this factor is investigated in a second, experimental study.

4 Experiment

In addition to our corpus study, we conducted an experiment to further investigate the semantic factors influencing Dutch compound verbs. This approach allows for the precise and controlled manipulation of specific factors – most notably, not just the factor of concreteness but also that of resultativity.

While our corpus findings reveal no significant influence of concreteness on separability, absence of evidence does not constitute evidence of absence. Hence, we still hypothesize, following Booij (2002), that language users associate separable forms with concrete meanings, and inseparable ones with abstract meanings. Meanwhile, we also aim to test Blom's (2004, 2005) hypothesis that resultativity plays a significant role in determining the choice between separable and inseparable forms. To do so, we designed a forced-choice task in which participants completed sentences by choosing either the separable or inseparable form of a non-existing compound verb. The following sections describe the experimental design (Section 4.1), the target and filler items (Section 4.2), the (potential) lexical confound (Section 4.3), and the experimental procedure (Section 4.4). We then provide details on the participants (Section 4.5), present the analysis and results (Section 4.6), and conclude with a brief interim discussion (Section 4.7).

4.1 Experimental design

The experiment consisted of a binary forced-choice setup with nonsense verbs (cf. De Smet and Rosseel 2023). Participants were presented with a sentence missing a verb, as in Figure 2. Below the sentence, participants had to select one of two options, i.e., a separable and an inseparable one in the case of a target item.

We used a factorial design including three parameters: particle (*om-* vs. *over-* vs. *door-*), resultativity (resultative vs. non-resultative) and concreteness (concrete vs.

Het volk ... de paradox, met het gevolg dat deze niet meer verwarrend is. (doordriezen)

☐ Het volk doordriest de paradox, met het gevolg dat deze niet meer verwarrend is.

☐ Het volk driest de paradox door, met het gevolg dat deze niet meer verwarrend is.

Figure 2: Example of target item (experiment).

abstract). Participants were presented with an equal number of target items for each particle, and we ensured that there was a balanced distribution across resultative and non-resultative contexts, as well as across concrete and abstract contexts. Concreteness was tested within-subject, while resultativity was tested between-subject. This was because resultative and non-resultative sentences were highly similar, making a within-subject design less appropriate, whereas concrete and abstract sentences were sufficiently distinct to allow for within-subject testing (see Section 4.2.2).

As a fourth factor, we controlled for potential lexical confounding arising from participants' possible reliance on existing verbs. Since the nonsense verbs were not explicitly pretested, participants may have mapped the novel forms onto the most plausible existing verbs within a given context and projected properties of these verbs (such as separability) onto the new forms. To address this, we computed a lexical confound score capturing whether existing SCVs or ICVs with *door-*, *om-* and *over-* were differentially associated with concrete/abstract and resultative/non-resultative conditions (for details, see Section 4.3).

To control for syntactic variation, we further included four construction types: past participles, infinitives with *te*, verb-second constructions in the present tense, and verb-second constructions in the past tense. These constructions were selected because they require either a separable or an inseparable form of the verb and exhibit a clear formal difference between SCVs and ICVs (see Section 2). The four construction types were also evenly distributed across the different levels of the other factors.

The design included 36 target verbs. Since each verb ideally needed to appear in four conditions – i.e., resultative – concrete, resultative – abstract, non-resultative – concrete, and non-resultative – abstract – we created two versions of the experiment to minimize priming effects. These versions were mirror images of each other: sentences presented in a resultative context in version A appeared in a non-resultative context in version B, and vice versa. The versions were equally distributed over the participants, and each participant was randomly assigned to one of the two versions. As a result, each verb was presented only twice to each participant – once in a concrete context and once in an abstract context, with either a resultative or a non-resultative meaning. Nevertheless, in this way, priming effects can still occur; therefore, we accounted for these effects in our statistical model (see Section 4.6 for the details).

The experiment consisted of 216 trials: 72 target items and 144 fillers. The trials were pseudo-randomised and organized into four blocks, the order of which was randomized for each participant. Additionally, the order of the possible answers was randomized. Participants were required to complete all trials sequentially, without the option to skip or return to previous questions. Although no explicit time limit was

imposed, response times were recorded by tracking the participant's click behaviour (i.e., the timing of the first and last click). This allowed us to filter out excessively delayed or fast responses on the level of the item, as these responses are indicative of overthinking or lack of focus.

4.2 Target and filler items

To create the target and filler items of the experiment, we used nonsense verbs (Section 4.2.1) and fill-in-the-blank sentences (Section 4.2.2).

4.2.1 Nonsense verbs

The 36 target verbs used in this study are non-existing verbs. These verbs are primarily derived from a list of nonsense verbs developed by De Smet (2021) and De Smet and Rosseel (2023: 9) to which we added the non-verbal elements *over-*, *om-*, and *door-*. This list of base verbs had been pretested to ensure that the verbs were not associated with existing ones, and were judged to be plausible.⁹ Additionally, five new verbs with fictive meanings were generated using ChatGPT (2024). Although these verbs were not explicitly pretested, we ensured that they conformed to the phonotactic constraints of Dutch and appeared plausible. Table 6 presents the final list of non-sense verbs used in the experiment.¹⁰

4.2.2 Fill-in-the-blank sentences

Each item consisted of a fill-in-the-blank sentence, followed by the infinitive of a nonsense verb between brackets, or – in the case of a filler item – a non-existing noun or base verb. The infinitive was chosen as it does not differ between the separable and inseparable form.

The fill-in-the-blank sentences were designed to provide a clear context. For the target items, we used ChatGPT (2024) to generate the sentences, which we adapted where necessary. Specifically, for the items requiring a concrete context, we ensured that all nouns were classified as *concrete* in the dataset of Brysbaert et al. (2014a). Conversely, for abstract contexts, we used nouns rated as *abstract* in the same

⁹ As De Smet and Rosseel (2023: 9) note, a pretest cannot entirely prevent participants from associating non-existing verbs with existing ones. However, they observed considerable variation among participants in the verbs they linked to the non-existing ones during the pretest. Based on this, they argue that such associations are unlikely to significantly skew the results.

¹⁰ The superscripted numbers in Table 6 refer to: ¹ = taken from De Smet (2021); ² = taken from De Smet and Rosseel (2023); ³ = taken from ChatGPT (2024).

Table 6: Non-sense verbs (experiment).

<i>Door-</i> ('through')	<i>Om-</i> ('around')	<i>Over-</i> ('over')
<i>doordelden</i> ²	<i>omflotten</i> ²	<i>overdergen</i> ¹
<i>doordriezen</i> ¹	<i>omgloten</i> ³	<i>overgrelen</i> ²
<i>doorginken</i> ¹	<i>omgrudden</i> ²	<i>overkesten</i> ³
<i>doorgratten</i> ²	<i>omhoten</i> ²	<i>overkrinden</i> ³
<i>doormakken</i> ²	<i>omklutten</i> ²	<i>overkuigen</i> ¹
<i>doormoven</i> ³	<i>omloeven</i> ²	<i>overpoemen</i> ²
<i>doorschedden</i> ²	<i>ommieven</i> ¹	<i>overprempen</i> ¹
<i>doorsmalen</i> ³	<i>omnoven</i> ²	<i>overschuiden</i> ¹
<i>doorsmatten</i> ²	<i>ompijden</i> ¹	<i>oversnaden</i> ²
<i>doorspreten</i> ²	<i>omsmeven</i> ²	<i>overspijven</i> ¹
<i>doorvosten</i> ²	<i>omtrellen</i> ²	<i>overvritten</i> ²
<i>doorvrieden</i> ¹	<i>omtriegen</i> ¹	<i>overwrinken</i> ¹

dataset. Resultative and non-resultative contexts were distinguished with the use of conjunctions: resultative contexts featured connectives such as *daardoor* ('therefore'), *zodat* ('so that'), and *met als gevolg dat* ('as a result'), while non-resultative contexts were consistently marked with *en* ('and'). Although *en* ('and') can optionally still imply a resultative meaning, it does not do so by default, in contrast to explicitly resultative sentences. Consequently, while a resultative interpretation may remain possible in the non-resultative contexts, we expect a stronger preference for SCVs in contexts where the resultative meaning is explicitly marked.

Since our primary goal was to investigate the semantic effects of verb separability, we ensured that all nonsense verbs were used transitively in the experiment to make the two verb forms fully interchangeable. Although ICVs tend to occur more frequently in transitive constructions than SCVs (see Section 2), considerable variation still exists. As a result, although participants will probably show an overall preference for ICVs due to the transitive construction, we still expect a relative preference for SCVs in concrete and/or resultative sentences.

To further divert attention away from the main goal of the study, we added 144 filler items. These followed the same binary-choice format as the target items. Two types of morphosyntactic alternations were tested in these fillers: plural formation (*-en* vs. *-s* suffix, $n = 72$) and past tense formation (strong vs. weak forms, $n = 72$), following the approach of De Smet (2021) and De Smet and Rosseel (2023). For past tense variation, we based our fillers on the target items of De Smet (2021) and adhered to her methodology regarding possible vowel alternations in strong verb forms.¹¹

¹¹ See De Smet (2021: 207–209) for details on the selection of the target items.

One filler item, namely *sievelen* (also taken from De Smet [2021: 209]), served as an attention check. Its strong form, *savel*, violates Dutch vowel alternation patterns, making it a highly implausible form to be chosen by the participants. Selecting the strong form would therefore suggest that participants did not take the experiment seriously and were not focused enough. For the fillers, part of the sentences was adopted from De Smet (2021), De Smet et al. (2022), and De Smet and Rosseel (2023); the remaining sentences were generated by ChatGPT (2024) and adapted where needed.

4.3 Lexical confound

As noted in Section 4.1, participants may have relied on existing associations when interpreting the nonce verbs. To control for this possibility, we computed a *lexical confound* score. To do this, we first compiled a list of all existing SCVs and ICVs sharing the relevant preverbs (*door-*, *om-* and *over-*) based on the *Reference File Dutch* (Van der Vliet 2007). For each verb in each experimental context, we estimated autoregressive language-modelling perplexity scores using the language model *fietje-2* (Vanroy 2024).¹² Perplexity, defined as the exponentiated average negative log-likelihood per token, reflects how surprising a word is in a given context, with lower values indicating a better contextual fit. Due to technical constraints of the model, all experimental contexts were converted into infinitival constructions with *kunnen* ('be able to'), followed by an infinitive slot to be filled in (e.g., *De leraar heeft het papier kunnen [...] waardoor het besmeurd is gemaakt*. 'The teacher managed to [...] the paper, causing it to get smudged').¹³ Based on these perplexity scores, we derived lexical confound scores by calculating, for each context, the difference between the mean perplexity score of the existing SCVs and that of the ICVs. A generalized linear model with lexical confound as the dependent variable and resultativity and concreteness as independent variables revealed that concreteness significantly predicted a preference for existing SCVs ($p < 0.001$), thereby confirming the potential presence of lexical confounding in concrete contexts.¹⁴

¹² <https://huggingface.co/BramVanroy/fietje-2>.

¹³ Converting the contexts into infinitival constructions introduced a formal ambiguity for compound verbs that exist both as SCVs and as ICVs (e.g., *doorlopen* 'walk through; go over'), since the verb *kunnen* does not cause separation of the preverbal element and the verb. To account for this, all verbs listed in the Reference File Dutch (van der Vliet 2007) that occurred both as SCVs and ICVs were annotated as *ambiguous* and excluded from the analysis.

¹⁴ For the analysis, we used the R package *glm* (R Core Team [2023]). For the regression model, we used the formula: `model ← glm(lexical_bias ~ resultativity + concreteness, data = data)`.

4.4 Procedure

The experimental study was approved by the University of Liège and was conducted using the online survey software Qualtrics.¹⁵ As it concerned a convenience sample, the experiment was distributed among second-year undergraduate students of language and literature programs from the University of Antwerp. Participants received course credit upon completing the experiment.

The students were informed that the study aimed to examine how language users process non-existing words. They first received detailed instructions and completed two practice trials before proceeding to the main experiment. One of the two practice trials was also a control question with only one variant grammatically possible: *nakje*, a nonsense noun with a diminutive ending, can only appear with the neuter article *het* and not with the non-neuter option *de* (taken over from De Smet and Rosseel 2023).

To mitigate fatigue effects, the experiment incorporated three scheduled breaks. After completing the task, participants answered four demographic questions regarding their native language, age group, gender, and educational background. At the end, they were asked what they thought the study was truly about and whether they had any additional comments. However, none of the participants correctly identified the purpose of the study.

4.5 Participants

A total of 116 participants completed the experiment. We excluded 6 non-native speakers and 4 participants who failed the control question(s), as well as 1 participant who self-reported difficulties processing non-existent words due to autism. This resulted in a final sample of 105 participants for the analysis. Of these 105 participants, the vast majority ($n = 101$; 96.20 %) were between 18 and 25 years old. Two participants (1.90 %) were aged between 26 and 35, one participant (0.95 %) between 36 and 45, and one (0.95 %) between 46 and 55. We were not able to balance the gender distribution: 77 participants identified as female (73.33 %), 21 as male (20 %), and 7 selected *other* (6.67 %).

Regarding the participant's mother tongue, 97 selected Belgian Dutch as their regional variant (92.40 %), and 6 chose Netherlandic Dutch (5.70 %). One participant (0.95 %) reported a mixed background (i.e., Belgian mother, Dutch father).

¹⁵ <https://www.qualtrics.com> (accessed 19 March 2025).

Additionally, one participant (0.95 %) was bilingual in Dutch and French, but was included in the analysis because of the participant’s full fluency in Dutch.

4.6 Analysis and results

A total of 22,469 attestations were collected. After excluding the filler items, 7,560 target responses remained. Additionally, 180 items were identified as outliers (2.38 %) in response times and were subsequently removed, resulting in a final dataset of 7,380 target responses. We identified as outliers those instances where the standard deviation of the response time was more than three times above or below the mean.

In the resultative context, there were 3,683 observations, of which 1,434 (38.94 %) were completed with a separable form, and 2,249 (61.06 %) with an inseparable form. The non-resultative context contained 3,697 observations, with the separable form selected in 1,397 cases (37.79 %), and the inseparable form in 2,300 cases (62.21 %). The concrete context consisted of 3,690 responses, with 1,535 SCV forms (41.60 %) and 2,155 ICV forms (58.40 %). The abstract context included 3,690 observations, with 1,296 (35.12 %) responses with a separable form and 2,394 (64.88 %) with an inseparable form. Figures 3–4 summarize the recorded answers according to the different meanings of the context.

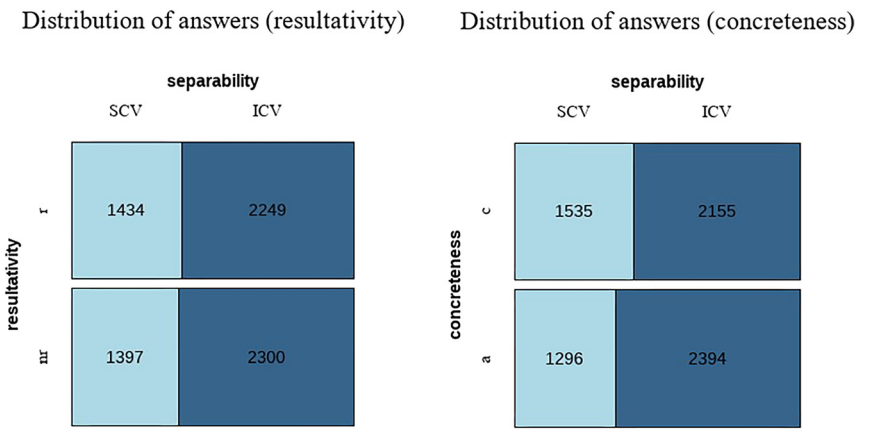


Figure 3–4: Distribution of answers per context.

To analyse the data, we built mixed effects logistic regression models using the *lme4* package (Bates et al. 2015).¹⁶ Separate models were composed for each of the three particles (*door* ‘through’, *om* ‘around’, and *over* ‘over’), with *SEPARABILITY* (separable vs. inseparable) as the dependent variable. Each final model included our independent variables of primary interest, namely *CONCRETENESS* (concrete vs. abstract) and *RESULTATIVITY* (resultative vs. non-resultative). We could not model the interaction between *RESULTATIVITY* and *CONCRETENESS* as this yielded convergence problems.

Since the presence of lexical confounding was confirmed (see Section 4.3), we included *LEXICAL CONFOUND* (scaled and centred) as a third fixed effect in the model. Importantly, this measure was computed separately for each preverb: the final model for *door*- included only scores based on existing verbs with *door*-, the model for *om*- only those based on verbs with *om*-, and the model for *over*- only those based on existing verbs with *over*-.

Additionally, we incorporated several control factors. First, because the experiment included multiple construction types (i.e., past participle, infinitive, verb-second present, and verb-second past), we included *CONSTRUCTION* as a factor.

Second, to account for *PRIMING* effects (priming of SCV, priming of ICV, no priming), we recorded whether the previous answer was a separable (i.e., priming of SCV) or an inseparable form (i.e., priming of ICV). If the previous response was a filler, or the first question of the experiment, this factor was coded as *no priming*.

Third, as each verb still appeared twice (viz. in a concrete and abstract context, see Section 4.1), we controlled for *VERB-SPECIFIC PRIMING* effects (priming of SCV, priming of ICV, no priming). We tracked whether it was the first or second time a participant encountered the same verb. In cases of second exposure, we recorded the participant’s response from the first exposure to measure within-item priming effects. Fourth, we included a predictor for *DISPLAY ORDER* (separable first vs. inseparable first) to control for the randomized order of the multiple-choice options. We also added a scaled and centred numerical variable for *TRIAL NUMBER* to account for potential fatigue effects over time.

Finally, the model included random intercepts for *VERB* and *PARTICIPANT*. We tried to add random slopes, but this led to convergence problems. The resulting model was

¹⁶ Other packages we used are: effects version 4.2.2. (Fox and Weisberg 2019), car version 3.1.3. (Fox and Weisberg 2019), MuMIn version 1.48.4 (Bartoń 2024), pROC (Robin et al. 2011), broom.mixed (Bolker and Robinson 2024), simr (Green and MacLeod 2016), readr (Wickham et al. 2024), dplyr (Wickham et al. 2025a), tidyr (Wickham et al. 2025b), readxl (Wickham and Bryan 2023), Showtext (Qiu Y 2026), vcd (Zeileis et al. 2007), ggplot2 (Wickham 2016), ggeffects (Lüdtke 2018) and stringr (Wickham 2023).

then checked for multicollinearity, but all VIF's were below 5 (Levshina 2015: 160).¹⁷ The numerical outputs are presented in Tables 7–9, and the effects of concreteness and resultativity are illustrated in the effect plots in Figure 5.¹⁸

Table 7: Model's output for *door-* (experiment) (C -value = 0.762; marginal R^2 = 0.025; conditional R^2 = 0.204).

DOOR- ('through')					
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value	
Intercept	0.79 [0.46, 1.12]	0.17	4.66	3.11e-06***	
RESULTATIVITY (reference level: resultative)					
Non-resultative	0.16 [−0.02, 0.34]	0.09	1.75	0.080.	
CONCRETENESS (reference level: concrete)					
Abstract	−0.06 [−0.28, 0.16]	0.11	−0.49	0.622	
LEXICAL BIAS	0.13 [0.004, 0.26]	0.07	2.02	0.044*	
CONSTRUCTION (reference level: v2 present)					
v2 past	0.16 [−0.13, 0.44]	0.14	1.09	0.277	
Past participle	−0.35 [−0.61, −0.09]	0.13	−2.66	0.008**	
te + inf.	0.02 [−0.24, 0.29]	0.13	0.18	0.855	
PRIMING (reference level: no priming)					
Priming SCV	−0.27 [−0.68, 0.14]	0.21	−1.27	0.203	
Priming ICV	−0.04 [−0.57, 0.48]	0.27	−0.16	0.873	
VERB PRIMING (reference level: no priming)					
Priming SCV	−0.31 [−0.62, −0.003]	0.16	−1.98	0.048*	
Priming ICV	0.35 [0.06, 0.63]	0.15	2.39	0.017*	
TRIAL NUMBER	0.02 [−0.11, 0.15]	0.07	0.27	0.790	
DISPLAY ORDER (reference level: ICV first)					
SCV first	−0.11 [−0.30, 0.07]	0.09	−1.18	0.237	
Random effects	Variance	Standard deviation			
PARTICIPANT	0.736	0.858			

17 We used the formula: `fit <- glmer(separability ~ resultativity + concreteness + clexical_bias + construction + priming + verb_priming + ctrialnumber + display_order + (1|participant) + (1|verb), family = binomial, data = d)`. For *door-*, we used the same model, but we excluded the random effect for *verb* because its inclusion resulted in singularity issues.

18 We also conducted the regression models without control variables, which yielded broadly similar patterns. For *door-*, the effects of resultativity and concreteness were respectively significant ($p = 0.040^*$) and non-significant ($p = 0.406$). For *om-*, resultativity ($p = 0.607$) was non-significant, but concreteness ($p = 6.23^e08^{***}$) was. For *over-*, resultativity was non-significant ($p = 0.436$), whereas concreteness showed a highly significant effect ($p = 4.09^e06^{***}$).

Table 8: Model’s output for *om-* (experiment) (C-value = 0.782; marginal R^2 = 0.091; conditional R^2 = 0.259).

OM- ('around')				
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value
Intercept	0.57 [0.08, 1.06]	0.25	2.30	0.022*
RESULTATIVITY (reference level: resultative)				
Non-resultative	−0.09 [−0.28, 0.09]	0.10	−0.99	0.33
CONCRETENESS (reference level: concrete)				
Abstract	0.32 [0.11, 0.52]	0.10	3.03	0.003**
LEXICAL BIAS	0.35 [0.18, 0.52]	0.09	4.04	5.33 ^e 05***
CONSTRUCTION (reference level: v2 present)				
v2 past	−0.44 [−1.07, 0.19]	0.32	−1.38	0.168
Past participle	−0.61 [−1.23, 0.01]	0.32	−1.93	0.054.
te + inf.	−0.67 [−1.29, −0.05]	0.32	−2.12	0.034*
PRIMING (reference level: no priming)				
Priming SCV	−0.14 [−0.59, 0.31]	0.23	−0.63	0.530
Priming ICV	−0.06 [−0.42, 0.30]	0.18	−0.33	0.743
VERB PRIMING (reference level: no priming)				
Priming SCV	−0.16 [−0.42, 0.10]	0.13	−1.23	0.219
Priming ICV	0.51 [0.25, 0.78]	0.14	3.76	0.0002***
TRIAL NUMBER	0.01 [−0.10, 0.12]	0.06	0.15	0.878
DISPLAY ORDER (reference level: ICV first)				
SCV first	−0.34 [−0.52, −0.16]	0.09	−3.72	0.0002***
Random effects	Variance	Standard deviation		
PARTICIPANT	0.629	0.793		
VERB	0.117	0.342		

4.7 Discussion

In contrast to the findings from the corpus study, the experimental study does reveal a significant influence of concreteness on separability for the particles *om-* and *over-*: verbs associated with abstract meanings are significantly more likely to be linked to inseparable forms. For the particle *door-*, the results suggest a slight tendency for resultativity, with non-resultative contexts more frequently associated with inseparable forms. However, this effect did not reach statistical significance and should therefore be interpreted with caution.¹⁹

19 To determine whether this null result reflects a power limitation or suggests a genuine and reliable lack of effect, we conducted a simulation-based power analysis using the fitted mixed-effects

Table 9: Model’s output for *over-* (experiment) (C-value = 0.769; marginal R^2 = 0.063; conditional R^2 = 0.214).

OVER- ('over')				
Fixed effects	Estimate [95 % CI]	Standard error	z-value	p-value
Intercept	1.12 [0.69, 1.54]	0.22	5.10	3.34 ^e 07***
RESULTATIVITY (reference level: resultative)				
Non-resultative	−0.12 [−0.31, 0.07]	0.10	−1.19	0.23
CONCRETENESS (reference level: concrete)				
Abstract	0.51 [0.29, 0.72]	0.11	4.54	5.73 ^e 06***
LEXICAL BIAS	0.10 [−0.001, 0.20]	0.05	1.94	0.053.
CONSTRUCTION (reference level: v2 present)				
v2 past	−0.41 [−0.91, 0.08]	0.25	−1.64	0.101
Past participle	0.05 [−0.45, 0.56]	0.26	0.20	0.839
te + inf.	0.06 [−0.44, 0.55]	0.25	0.22	0.830
PRIMING (reference level: no priming)				
Priming SCV	−0.32 [−0.83, 0.18]	0.26	−1.25	0.211
Priming ICV	−0.26 [−0.70, 0.18]	0.23	−1.17	0.244
VERB PRIMING (reference level: no priming)				
Priming SCV	−0.50 [−0.79, −0.20]	0.15	−3.33	0.0001***
Priming ICV	0.25 [0.001, −0.51]	0.13	1.97	0.049*
TRIAL NUMBER	−0.03 [−0.15, 0.08]	0.06	−0.57	0.566
DISPLAY ORDER (reference level: ICV first)				
SCV first	−0.59 [−0.77, −0.40]	0.10	−6.07	1.32 ^e 09***
Random effects	Variance	Standard deviation		
PARTICIPANT	0.564	0.751		
VERB	0.069	0.262		

Overall, the findings of this study offer clear support for the hypothesis of Booij (2002), while offering only limited support for Blom’s (2004, 2005) hypothesis. The results of this experiment also highlight that the influence of concreteness or resultativity is particle-dependent, with varying effects observed for the three particles.

model of *door-*. The estimated effect of resultativity was small (β = 0.16; OR = 1.18), with a corresponding power of approximately 0.43 (95 % CI [0.39, 0.53]), indicating limited sensitivity to detect effects of this size. Accordingly, the null effect for *door-* should be interpreted with caution: it seems to reflect limited power rather than a genuine absence of an effect.

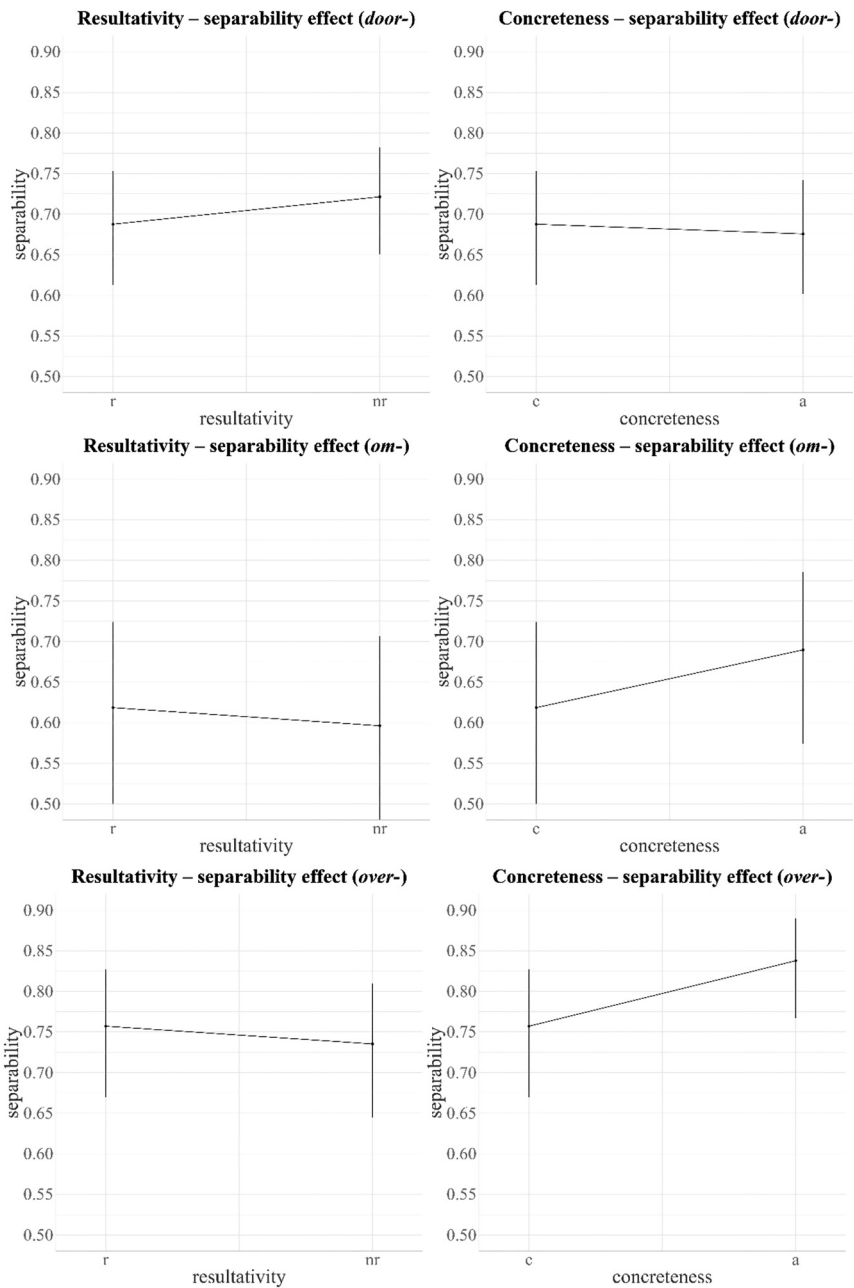


Figure 5: Effect resultativity and concreteness on separability (experiment).

5 General discussion and conclusions

This study has contributed to understanding the role of iconicity in verbal morphology, a domain that up until now has received far less attention compared to other ones. While earlier research on (Dutch) verbal morphology has mainly focused on past tense formation (e.g., De Smet and Rosseel 2023), investigations into the semantics underlying SCVs and ICVs remained scarce and contested. Specifically, we explored whether *iconicity of independence* – operationalized through the semantic contrasts concrete versus abstract and resultative versus non-resultative – plays a role in differentiating separable from inseparable verb forms. Furthermore, by combining a corpus study with an experimental forced-choice task, this research not only addressed the debate regarding the semantics in (in)separable verbs but also responded to the broader lack of experimental work in the domain of morphological iconicity.

Interestingly, the two studies yielded varying results. While the quantitative results of the corpus study did not uncover any significant relationship between separability and concreteness, the experimental study showed a clearer effect: concreteness influenced separability for the particles *om-* and *over-*, while the particle *door-* showed a slight, non-significant tendency toward resultativity. Together with the qualitative findings from the corpus study, the experimental data support the idea that iconicity of independence indeed influences the separability of compound verbs; however, its impact differs across the particles examined. This expands the scope of iconicity to a new morphological domain and aligns with Booij's (2002) hypothesis, while offering only limited support for Blom's (2004, 2005) account.

How then do we explain the discrepancies between the quantitative corpus results and the experimental ones? There are three reasons why the corpus-based study may not have been able to yield significant results.

First, the corpus study relied on the assumption that the *patiens* serves as a proxy for the verb's meaning. Although this method has been validated in previous studies and appears applicable to the current data (see Section 3.1.3), it may not fully capture all nuances of verb meaning. However, by complementing the quantitative analysis with a qualitative analysis, we were able to demonstrate that the distinction between SCV and ICV does indeed appear to be linked to iconicity of independence (see Section 3.2).

A second potential explanation of the different results between the corpus study and the experiment lies in the exclusive focus on past participles in the corpus study. Since past participles are often lexicalized over time, this may influence their behaviour with respect to separability. However, since the results for past participles in the experimental study did not yield significantly different results from those of

the other verb forms – except in the case of *door-* – we believe that this methodological choice can only partially account for the differences between the two studies. Nevertheless, including other verb forms in a follow-up corpus study would be interesting in this respect, to see whether the effect of iconicity observed in the experiment can also be found in actual language use.

A third and, in our view, the most plausible limitation accounting for the differing results, is data scarcity. The limited size of the dataset may have reduced the ability to detect significant patterns in the corpus analysis. Although we examined 253 verbs, some categories contained only around 20 data points (e.g., only 25 ICVs with *door-*, and 27 ICVs with *om-*), which constrained statistical power, as also reflected in the relatively wide confidence intervals and low-to-moderate discriminative performance of the models. Nevertheless, certain patterns do emerge (see Section 3.1.2), viz. a positive effect of concreteness on separability for both *om-* and *over-*, but not for *door-*, just like in the experimental study. Importantly, none of the confidence intervals provide precise estimates. Therefore, it is possible that with a larger dataset, these effects would be estimated more precisely, with narrower confidence intervals and more stable effect size estimates. Importantly, the absence of strong effects in our corpus study should not be taken as evidence that iconicity has no cognitive relevance, but rather as a consequence of limited statistical power and estimation uncertainty. This interpretation is further supported by the qualitative semantic analysis of the verbs examined in the corpus study (Section 3.2), which suggests that the variation between SCVs and ICVs indeed reflects cognitively motivated semantic distinctions that can be linked to iconicity of independence.

In conclusion, these studies offer evidence that iconicity of independence is at play in differentiating between Dutch SCVs and ICVs, although the specific semantics through which iconicity operates may vary for each particle.

The findings may also generalise to other languages with comparable preverb-verb constructions, such as German and English, although the morphosyntactic realisation of (in)separability may differ across languages. Preliminary evidence suggests comparable semantic patterns, with separable forms more often linked to concrete or resultative meanings (e.g., *umfallen* ‘fall over’, *turn around*) and inseparable forms to more abstract meanings (e.g., *umgeben* ‘surround’, *overestimate*). This would suggest that the relationship between semantics and (in)separability may reflect more general cognitive constraints rather than language-specific properties. However, these cross-linguistic similarities remain tentative and therefore require systematic testing in future corpus-based and/or experiment-based research.

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Data availability: The datasets and R code generated during the current study are openly available at the following link: <https://osf.io/e5n63/overview>.

References

- Ackerman, Farrell. 1987. *Miscreant morphemes: Phrasal predicates in Uglic*. Berkeley: University of California dissertation.
- Bartoń, Kamil. 2024. *MuMIn: Multi-model inference*. R package version 1.48.4. Available at: <https://cran.r-project.org/web/packages/MuMIn/index.html>.
- Bates, Douglas, Martin Mächler, Ben Bolker & Steve Walker. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software* 67(1). 1–48.
- Blom, Corrien. 2004. On the diachrony of complex predicates in Dutch: Predicative and nonpredicative preverbs. *Journal of Germanic Linguistics* 16. 1–75.
- Blom, Corrien. 2005. *Complex predicates in Dutch: Synchrony and diachrony*. Utrecht: Netherlands Graduate School of Linguistics dissertation.
- Blom, Corrien & Geert Booij. 2003. The diachrony of complex predicates in Dutch: A case study in grammaticalization. *Acta Linguistica Hungarica* 50. 61–91.
- Bolker, Ben & David Robinson. 2024. *Broom.mixed: Tidying methods for mixed models*. R package version 0.2.9.6. Available at: <https://CRAN.R-project.org/package=broom.mixed>.
- Booij, Geert. 1990. The boundary between morphology and syntax: Separable complex verbs in Dutch. In Geert Booij & Jaap van Marle (eds.), *Yearbook of morphology*, Vol. 3, 45–63. Berlin & Boston: Mouton De Gruyter.
- Booij, Geert. 1998. Samenkoppelingen en grammaticalisatie [*Couplings and grammaticalisation*]. In Eric Hoekstra & Caroline Smits (eds.), *Morfologiedagen 1996*, 6–20. Amsterdam: P.J. Meertens-Instituut.
- Booij, Geert. 2002. *The morphology of Dutch*. Oxford: Oxford University Press.
- Brysaert, Marc, Michaël Stevens, Simon De Deyne, Wouter Voorspoels & Gert Storms. 2014a. Norms of age of acquisition and concreteness for 30,000 Dutch words. *Acta Psychologica* 150. 80–84.
- Brysaert, Marc, Amy Beth Warriner & Victor Kuperman. 2014b. Concreteness ratings for 40 thousand generally known English word lemmas. *Behavior Research Methods* 46. 904–911.
- Conde, Javier, Gonzalo Martínez, María Grandury, Carlos Arriaga, Juan Haro, Sascha Schroeder, Florian Hintz, Pedro Reviriego & Marc Brysaert. 2026. Updating the German psycholinguistic word toolbox with AI-generated estimates of concreteness, valence, arousal, age of acquisition, and familiarity. *Journal of Cognition* 9(1). 9.
- Croft, William. 2003. *Typology and universals*, 2nd edn. Cambridge: Cambridge University Press.
- Cuskley, Christine, Mark Dingemanse, Simon Kirby & Tessa van Leeuwen. 2019. Cross-modal associations and synesthesia: Categorical perception and structure in vowel-color mappings in a large online sample. *Behavior Research Methods* 51. 1651–1675.

- Cuyckens, Hubert. 1991. *The semantics of spatial prepositions in Dutch: A cognitive-linguistic exercise*. Antwerp: University of Antwerp dissertation.
- De Smet, Isabeau. 2021. *De sterke werkwoorden in het Nederlands. Een diachroon, kwantitatief onderzoek [The strong verbs in Dutch. A diachronic, quantitative study]*. Leuven: KU Leuven dissertation.
- De Smet, Isabeau & Laura Rosseel. 2021. An experimental approach to iconicity in Dutch strong and weak verb morphology. *Language Sciences* 85. 1–16.
- De Smet, Isabeau & Laura Rosseel. 2023. Who's afraid of homophones? A multimethodological approach to homophony avoidance. *Language and Cognition*. 1–24. <https://doi.org/10.1017/langcog.2023.50>.
- De Smet, Isabeau, Laura Rosseel & Freek Van de Velde. 2022. Are non-native speakers the drivers of morphological simplification? A Wug experiment on the Dutch past tense system. *Journal of Language Evolution* 7(2). 224–245.
- De Smet, Isabeau & Freek Van de Velde. 2020. Semantic differences between strong and weak verb forms in Dutch. *Cognitive Linguistics* 31(3). 393–416.
- Dingemanse, Mark, Damián E. Blasi, Gary Lupyan, Morten H. Christiansen & Padraic Monaghan. 2015. Arbitrariness, iconicity, and systematicity in language. *Trends in Cognitive Sciences* 19(10). 603–615.
- Dingemanse, Mark, Marcus Perlman & Pamela Perniss. 2020. Construals of iconicity: Experimental approaches to form-meaning resemblances in language. *Language and Cognition* 12. 1–14.
- Fox, John & Sanford Weisberg. 2019. *An R companion to applied regression*, 3rd edn. Newbury Park: Sage Publications.
- Frassinelli, Diego & Sabine Schulte im Walde. 2019. Distributional interaction of concreteness and abstractness in verb-noun subcategorisation. In *Proceedings of the 13th international conference on computational semantics – Short papers*, 38–43.
- Geeraerts, Dirk. 2023. The structured nature of prepositional meaning. In Hendrik De Smet, Peter Petr   & Benedikt Szmrecsanyi (eds.), *Context, intent and variation in grammaticalization*, 135–157. Berlin: De Gruyter Mouton.
- Giv  n, Thomas. 1985. Iconicity, isomorphism and non-arbitrary coding in syntax. In John Haiman (ed.), *Iconicity in syntax*, 187–219. Amsterdam & Philadelphia: Benjamins.
- Goldberg, Adele. 1995. *Constructions: A construction grammar approach to argument structure*. Chicago: Chicago University Press.
- G  mez Mil  n, Emilio, Oscar Iborra, Mar  a Jos   de Cordoba, Ver  nica Ju  rez-Ramos, Mar  a Angeles Artacho Rodr  guez & Jos   Luis Rubio Garc  a. 2013. The Kiki-Bouba effect: A case of personification and Ideasthesia. *Journal of Consciousness Studies* 20(1–2). 84–102.
- Green, Peter & Catriona J. MacLeod. 2016. SIMR: An R package for power analysis of generalised linear mixed models by simulation. *Methods in Ecology and Evolution* 7(4). 493–498.
- Greenberg, Joseph H. 1963. Some universals of grammar with particular reference to the order of meaningful elements. In Joseph H. Greenberg (ed.), *Universals of language*, 73–113. Cambridge: MIT Press.
- Haeseryn, Walter, Kirsten Romijn, Guido Geerts, Jaap de Rooij & Maarten van den Toorn (eds.). 1997. 30.3.2.3 Resultatieve complementen [Resultative complements]. *Algemene Nederlandse Spraakkunst*. <https://e-ans.ivdnt.org/topics/pid/ans30030203lingtopic> (accessed 2 March 2025).
- Haiman, John. 1980. The iconicity of grammar: Isomorphism and motivation. *Language* 56(3). 515–540.
- Haiman, John. 1983. Iconic and economic motivation. *Language* 59(4). 781–819.
- Haiman, John. 1985. *Natural syntax: Iconicity and erosion*. Cambridge: Cambridge University Press.
- Haspelmath, Martin. 2008. Frequency vs. iconicity in explaining grammatical asymmetries. *Cognitive Linguistics* 19(1). 1–33.
- Honnibal, Matthew, Ines Montani, Sofie Van Landeghem & Adriane Boyd. 2020. spaCy: industrial-strength natural language processing in Python. <https://doi.org/10.5281/zenodo.1212303>.

- Hopper, Paul J. & Elizabeth C. Traugott. 2003. *Grammaticalization*, 2nd revised edn. Cambridge: Cambridge University Press.
- Kalivoda, Ágnes. 2021. *Preverb constructions in Hungarian*. Budapest: Pázmány Péter Catholic University dissertation.
- Leclercq, Benoît & Cameron Morin. 2023. No equivalence: A new principle of no synonymy. *Constructions* 15. 1–16.
- Levin, Magnus. 2009. The formation of the preterite and the past participle. In Günter Rohdenburg & Julia Schlüter (eds.), *One language, two grammars? Differences between British and American English*, 60–85. Cambridge: Cambridge University Press.
- Levshina, Natalia. 2015. *How to do linguistics with R: Data exploration and statistical analysis*. Amsterdam & Philadelphia: Benjamins.
- Lüdtke, Daniel. 2018. Ggeffects: Tidy data frames of marginal effects from regression models. *Journal of Open Source Software* 3(26). 772.
- Mithun, Marianne. 1984. The evolution of noun incorporation. *Language* 60(4). 847–893.
- Neeleman, Ad & Fred Weerman. 1993. The balance between syntax and morphology: Dutch particles and resultatives. *Natural Language & Linguistic Theory* 11. 433–475.
- Newmeyer, Frederick J. 1992. Iconicity and generative grammar. *Language* 68(4). 756–796.
- [nlTenTen20] Corpus of the Dutch Web. 2020. *Sketch Engine*. <https://www.sketchengine.eu/nlnten-dutch-corpus/> (accessed 31 May 2024).
- Oomen, Marloes. 2020. *Iconicity as a mediator between verb semantics and morphosyntactic structure – A corpus-based study on verbs in German Sign language*. Utrecht: Netherlands Graduate School of Linguistics dissertation.
- OpenAI. 2024. *ChatGPT* [Large language model]. chat.openai.com/chat. (Version of February 2025).
- Perniss, Pamela, Robin L. Thompson & Gabriella Vigliocco. 2010. Iconicity as a general property of language: Evidence from spoken and signed languages. *Frontiers in Psychology* 1. 1–15.
- Pijpops, Dirk, Dirk Speelman, Stef Grondelaers & Freek Van de Velde. 2021. Incorporating the multi-level nature of the construction into hypothesis testing. *Cognitive Linguistics* 32(3). 487–528.
- Qiu, Yixuan. 2026. *Showtext: Using fonts more easily in R graphs*. R package version 0.9-8. Available at. <https://CRAN.R-project.org/package=showtext>.
- Quirk, Randolph. 1970. Aspect and variant inflection in English verbs. *Language* 46(2). 300–311.
- R Core Team. 2023. *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Robin, Xavier, Natacha Turck, Alexandre Hainard, Natalia Tiberti, Frédérique Lisacek, Jean-Charles Sanchez & Markus Müller. 2011. pROC: An open-source package for R and S+ to analyze and compare ROC curves. *BMC Bioinformatics* 12. 77.
- SoNaR-corpus (Version 1.2.1). 2015. [Data set]. Available at the Institute of the Dutch Language: <http://hdl.handle.net/10032/tm-a2-h5>.
- Stiebels, Barbara & Dieter Wunderlich. 1994. Morphology feeds syntax: The case of particle verbs. *Linguistics* 32. 913–968.
- Van Dale groot woordenboek van de Nederlandse taal [Van Dale great dictionary of the Dutch language]. 2022. Utrecht: Van Dale Uitgevers.
- Van de Velde, Freek, Hendrik De Smet & Lobke Ghesquière. 2013. On multiple source constructions in language change. *Studies in Language* 37(3). 473–489.
- van der Horst, Joop. 2008. Vaste werkwoordelijke verbindingen in het Nederlands en het Afrikaans [Fixed verbal combinations in Dutch and Afrikaans]. *Atn&a*. 29–43.
- van der Vliet, Hennie. 2007. The referentiebestand Nederlands as a multi-purpose lexical database. *International Journal of Lexicography* 20(3). 239–257.

- Van Goethem, Kristel. 2008. Les constructions préverbaux du français et du néerlandais: typologie et grammaticalisation. *Journal of French Language Studies* 18(2). 227–248.
- Van Kemenade, Ans & Bettelou Los. 2003. Particles and prefixes in Dutch and English. In Geert Booij & Jaap van Marle (eds.), *Yearbook of morphology 2003*, 79–117. Dordrecht: Kluwer.
- van Loey, Adolphe. 1976. *Scheidbare en onscheidbare werkwoorden hoofdzakelijk in het Middelnederlands, analytische studiën* [*Separable and inseparable verbs mainly in Middle Dutch, analytical studies*]. Gent: Secretariaat van de Koninklijke Academie voor Nederlandse Taal- en Letterkunde.
- van Noord, Gertjan. 2006. At last parsing is now operational. In Piet Mertens, Cédric Fairon, Anne Dister & Patrick Watrin (eds.), *TALN 2006. Verbum Ex Machina. Actes de la 13e conférence sur le traitement automatique des langues naturelles*, 20–42. Louvain-la-Neuve: Cental.
- Vanroy, Bram. 2024. Fietje: An open, efficient LLM for Dutch. *Computational Linguistics in the Netherlands Journal* 14. 473–504.
- Vrielynck, Ann-Sophie, Julien Perrez & Dirk Pijpops. 2025. Diachroon corpusonderzoek naar complexe predicaten in het Nederlands: Een pilootstudie [Diachronic corpus study of complex predicates in Dutch: A pilot study]. *Nederlandse Taalkunde* 30(1/2). 196–224.
- Vrielynck, Ann-Sophie, Dirk Pijpops & An Van linden. Pathways to applicatives: The diachrony of preverbs in Dutch. [Accepted].
- Wickham, Hadley. 2016. *ggplot2: Elegant graphics for data analysis*. New York: Springer-Verlag.
- Wickham, Hadley. 2023. *Stringr: Simple, consistent wrappers for common string operations*. R package version 1.5.1. Available at: <https://CRAN.R-project.org/package=stringr>.
- Wickham, Hadley & Jennifer Bryan. 2023. *Readxl: Read excel files*. R package version 1.4.3. Available at: <https://CRAN.R-project.org/package=readxl>.
- Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller & Davis Vaughan. 2025a. *dplyr: A grammar of data manipulation*. R package version 1.1.4. Available at: <https://cran.r-project.org/web/packages/dplyr/index.html>.
- Wickham, Hadley, Jim Hester & Jennifer Bryan. 2024. *Readr: Read rectangular text data*. R package version 2.1.5. Available at: <https://CRAN.R-project.org/package=readr>.
- Wickham, Hadley, Davis Vaughan & Maximilian Gillich. 2025b. *Tidyr: Tidy messy data*. R package version 1.3.2. Available at: <https://cran.r-project.org/web/packages/tidyr/index.html>.
- Zeileis, Achim, David Meyer & Kurt Hornik. 2007. Residual-based shadings for visualizing (conditional) independence. *Journal of Computational and Graphical Statistics* 16(3). 507–525.