

Associative stem priming with semantically opaque prefixed verbs in Dutch

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Morphological stem priming experiments consistently show that Dutch and German prefixed verbs (e.g. *door-lopen* ‘walk along’, *ver-lopen* ‘expire’) prime their stem (*lopen* ‘walk’) in visual, cross-modal, and auditory paradigms, regardless of semantic transparency between the verb and its stem [2, 3, 8–10]. Here, we ask whether the lexical-semantic meaning of the embedded stem in opaque prefixed verbs is retrieved during spoken word recognition, i.e., whether the meaning of *lopen* as ‘walk’ is retrieved when the prefixed verb *verlopen* ‘expire’ is processed.

Background Previous results are mixed. Some suggest that the stem in semantically opaque complex words cannot be primed by a semantic associate (or vice versa) in German (*umbringen* ‘kill’ → *HOLEN* ‘get, pick up’ [11]) and Dutch (*SMULLEN* ‘to feast on’ → *uitvreten* ‘be up to’ [3]). A German cross-modal study reports null effects for both opaque and transparent forms [7], while a Dutch study reports priming for the stems in suffixed opaque words only with a long Stimulus Onset Asynchrony [6]. However, all of these studies used visual targets. Visual semantic and associative priming has been shown to result in much smaller effect sizes compared to auditory priming [4, 5], potentially causing the reported null effects. In addition, most studies used a between-items design in which targets differ across conditions, complicating direct comparisons.

Methods We ran an *auditory* primed continuous lexical decision experiment in Dutch to examine whether a prefixed verb primes a semantic associate to its stem. We used a within-target design in which the same target is presented in multiple prime conditions to different participants. Primes are prefixed verbs in four conditions (see Table 1): (i) morphologically and semantically transparent; (ii) morphologically related but semantically opaque; (iii) the stems of the transparent and opaque verbs, and (iv) unrelated control verbs. Targets ($n=32$) are semantic associates to the stems (e.g. *RENNEN* ‘run’ to the stem *lopen* ‘walk’). The task had a random inter-stimulus interval between 300-400 ms, and a random inter-trial interval between 1100-1200 ms. Fillers and non-words were included, and critical items were distributed over different lists according to a Latin Square design. Participants were 28 natives speakers of Dutch.

Results Log-transformed response times (RTs) to targets were analyzed with LME models, after minimal a-priori data trimming and model criticism [1]. Apart from prime condition, fixed effects for target duration, prime and target frequency, ISI, prime RT, trial number, target Part of Speech (POS), and an interaction between Condition and POS were included, and random intercepts for subjects, primes, and targets. The model indicates significant priming in the stem ($\beta=-0.067$, $p<0.001$), transparent ($\beta=-0.053$, $p<0.001$), and opaque ($\beta=-0.035$, $p=0.026$) conditions (see Figure 1). While targets preceded by semantically opaque primes show a numerically smaller priming effect compared to targets preceded by unprimed stem primes and targets preceded by semantically transparent primes, the model does not reveal significant differences in the RTs to targets in the opaque and transparent conditions ($p=0.219$) and between the RTs in the opaque and stem conditions ($p=0.065$).

Conclusions The results show significant priming effects for the semantic associates to the stems in all conditions, including the semantically opaque prefixed verb primes, i.e., upon hearing *verlopen* ‘expire’, the meaning for *lopen* ‘walk’ is retrieved. This provides additional evidence that an opaque word like *verlopen* ‘expire’ involves the same morpheme as free-standing *lopen* ‘walk’. In addition, and crucially, the results provide support for a model of word recognition in which the meaning of the embedded stem is retrieved during the auditory processing of prefixed verbs, even when the stem’s typical meaning does not play a role in the meaning of the opaque prefixed verb. We further present the results of an additional experiment that examines the retrieval of the meaning of the whole-word versus the meaning of the stem, by using semantic associates of the stem and of the prefixed verb.

Table 1: Conditions and sample critical items.

Stem	Transparent	Opaque	Control	Target
<i>lopen</i> 'walk'	<i>doorlopen</i> 'walk along'	<i>verlopen</i> 'expire'	<i>bewaken</i> 'guard'	<i>rennen</i> 'run'
<i>werpen</i> 'throw'	<i>afwerpen</i> 'throw off'	<i>ontwerpen</i> 'design'	<i>verslapen</i> 'oversleep'	<i>gooien</i> 'throw'
<i>wijzen</i> 'point'	<i>aanwijzen</i> 'point out'	<i>bewijzen</i> 'prove'	<i>beklimmen</i> 'climb'	<i>vinger</i> 'finger'

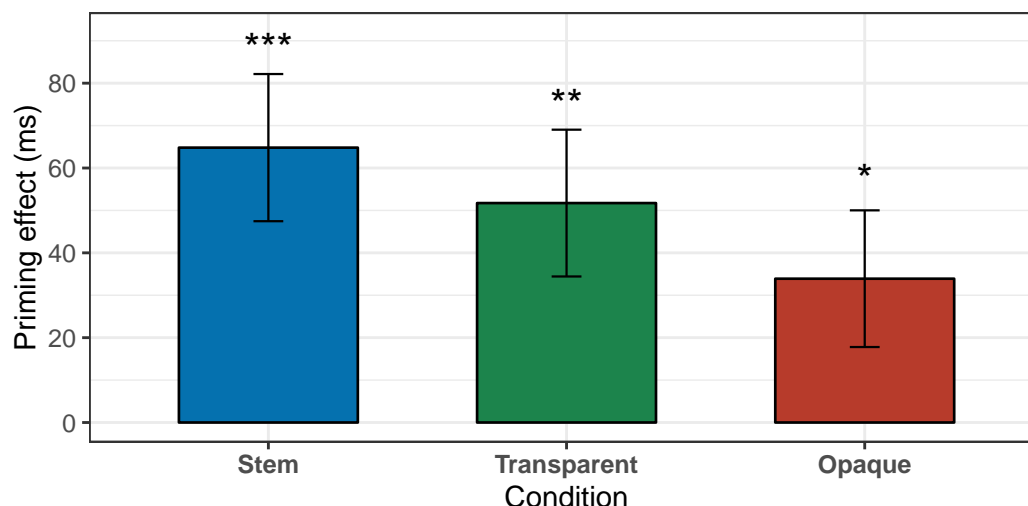


Figure 1: Priming effects (relative to the control condition) in the stem (e.g., *lopen* 'walk' → *RENNEN* 'run'), semantically transparent (e.g., *doorlopen* 'walk along' → *RENNEN* 'run'), and semantically opaque (*verlopen* 'expire' → *RENNEN* 'run') conditions. Error bars represent ± 1 standard error of the sampling distribution of differences.

Selected References: [1] Baayen & Milin (2020), "Analyzing reaction times", *Int. J. Psychol. Res.* • [2] Creemers, Goodwin Davies, Wilder, Tammenga, & Embick (2020), "Opacity, transparency, and morphological priming: A study of prefixed verbs in Dutch", *JML*. • [3] De Grauwe, Lemhöfer, & Schriefers (2019), "Processing derived verbs: The role of motor-relatedness and type of morphological priming", *Lang. Cogn. Neurosci.* • [4] Gomes, Ritter, Tartter, Vaughan, & Rosen (1997), "Lexical processing of visually and auditorily presented nouns and verbs: Evidence from reaction time and N400 priming data", *Cogn. Brain Res.* • [5] Hutchison (2003), "Is semantic priming due to association strength or feature overlap? A microanalytic review", *Psychon Bull Rev.* • [6] Schreuder, Burani, & Baayen (2003), "Parsing and semantic opacity", *Reading Complex Words*. • [7] Smolka (2019), "Aufhören ('stop') activates hören ('hear') but not Musik ('music'): The difference between lexical and semantic processing of German particle verbs", *The Ment. Lex.* • [8] Smolka, Komlosi, & Rösler (2009), "When semantics means less than morphology: The processing of German prefixed verbs", *Lang. Cogn. Proc.* • [9] Smolka, Libben, & Dressler (2019), "When morphological structure overrides meaning: Evidence from German prefix and particle verbs", *Lang. Cogn. Neurosci.* • [10] Smolka, Preller, & Eulitz (2014), "Verstehen ('understand') primes 'stehen' ('stand'): Morphological structure overrides semantic compositionality in the lexical representation of German complex verbs", *JML*. • [11] Zwitserlood, Drews, Bolwiender, & Neuwinger (1996), "Kann man Geschenke umbringen?", *Perspektiven der kognitiven Linguistik*.