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Regular Plurals in Dutch Compounds: Linking Graphemes or Morphemes?

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In this paper, we address the functional role of the orthographic realisation of the linking schwa in Dutch nominal compounds. From a diachronic perspective, the linking schwa is a historical relic of the now obsolete morphological system of medieval Dutch. Synchronically, however, it appears in two orthographic forms, *-e* and *-en*, both of which are homographs of high-frequency inflectional affixes. The suffix *-e* primarily functions as an agreement marker without intrinsic meaning. The suffix *-en* primarily realises plural number on nouns and verbs. Are plural semantics activated in the mental lexicon when the linking schwa is written as the plural suffix? This question has become relevant for Dutch in the light of a recent change in the spelling rules which now prescribe the *-en* spelling for compounds with no meaning of plurality. We addressed this question by means of four experiments, which revealed that writing the linking schwa in the orthographic form of the plural suffix does indeed lead to the activation of the plural semantics, even when plural semantics are not intended. We interpret our results within the framework of a parallel dual-route model of morphological processing.

INTRODUCTION

In English, compounds such as *buildings inspector*, with a regular noun plural as the first constituent, are possible but rare (see Booij, 1993; Pinker & Prince, 1994). In Dutch, however, words such as *boekenkast* ("bookScase") and *slangenbeet* ("snakeSbite") are very common. A long-standing issue in Dutch linguistics is whether the left-hand members of these compounds are genuine plurals (Woordenlijst, 1954), or singulars followed by two

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meaningless letters—generally referred to as "linking graphemes"—that happen to be homographic with the plural suffix *-en* (Woordenlijst, 1995). Until late 1996, the Dutch spelling system was based on the conviction that *boeken* ("books") in *boekenkast* ("bookcase") was a genuine noun plural. To differentiate such genuine plurals from nouns for which a plural interpretation is unlikely, a second linking grapheme was available, a single *-e*. In this spelling system, one had to write *slangebeet* and not *slangenbeet*, as a snake bite can only be inflicted by a single snake. In late 1996, a new spelling system was introduced that enforced the spelling *slangenbeet* for *slangebeet*. This change was motivated by the desire to obtain a more uniform spelling system. The choice for the spelling *-en* rather than *-e* was based on the wish to minimise the number of compounds for which the spelling would have to be changed, with the theoretical assumption that both *-e* and *-en* are meaningless linking graphemes. The question with which this paper is concerned is whether this assumption is correct from a processing point of view. In the light of the high productivity of the *-en* plural suffix, it is not at all self-evident that the processing system will be able to ignore its presence in the visual input.

We first introduce, in more detail, the linguistic issues concerning the linking graphemes in Dutch and the presence or absence of the letter *n* in the spelling of words such as *boekenkast* and *slangenbeet* in particular. Following this, we describe the parallel dual-route model of morphological processing that provides the theoretical background for our experiments. Next, we present four experiments that address the issue of how the presence or absence of the *-n* affects comprehension in reading. Experiment 1 focuses on the early stages of visual perception. In this experiment, we investigate how the presence or absence of the letter *n* affects the identification of the orthographic form. Experiments 2 and 3 assess in what way the presence or absence of the letter *n* influences more central lexical processing. More specifically, we investigate whether the meaning of plurality becomes activated when the *-n* is present in the orthography, in which case the orthographic form effectively contains the plural suffix *-en*. Experiment 4 is an off-line rating study that provides further support for the conclusions reached on the basis of the preceding experiments.

LINKING PHONEMES IN DUTCH

Dutch nominal compounds can be classified into five categories, based on the way in which the boundary between the two constituents is realised, as shown in (1):

1. rund-vlees	"ox-meat", "beef"
rund-er-gehakt	"ox-ER-minced-meat", "minced beef"
lam-s-vlees	"lamb-S-meat", "mutton"

boek-en-kast	"book-EN-case", "bookcase"
slang-e-beet	"snake-E-bite", "snake bite"

The linking graphemes *-er*, *-en* and *-e* (the latter two pronounced as the schwa vowel as in English *the*), and *-s* are the last remnants of now obsolete morphological forms (case markers, older plural suffixes, older phonological variants) of medieval Dutch (see Booij, 1996; van Loey, 1969). In modern Dutch, the absence or presence of linking phonemes is fairly unpredictable, and often has to be learned by heart. Nevertheless, the linking phonemes *-s* and schwa productively appear in novel compounds, which shows that compounds with linking phonemes are part of the living grammar of Dutch.

The linking phoneme with which we are concerned is the schwa. In the standard language, this linking phoneme is homophonic with two suffixes, *-e* and *-en*. The suffix *-e* appears almost exclusively on adjectives as an agreement marker without any semantic contribution of its own. The suffix *-en* appears predominantly as a completely regular and extremely productive inflectional affix on nouns and verbs, in which case it contributes the semantics of plurality (see Baayen, Burani, & Schreuder, 1997a; Baayen, Dijkstra, & Schreuder, 1997b; Booij, 1993).[1]

Orthographically, the schwa in compounds is realised either as *-e* or as *-en*. Until 1996, the Dutch spelling conventions prescribed that noun–noun compounds with the linking schwa should be written as *-en* in the case that the first constituent is most naturally interpreted as a plural. For instance, since *boekenkast* ("bookcase") is a case for more than one book, the spelling required writing the linking schwa as the plural suffix *-en*. Conversely, compounds for which the first constituent evidently is a singular were to be written with a single *-e*. For instance, since *slangebeet* ("snakebite") denotes the bite of one snake, and since one bite can only be inflicted by a single snake, the spelling with the plural suffix was prohibited.

Obviously, these former spelling rules were often difficult to apply in practice (e.g. is "grapejuice" the juice of one or of more than one grape?). Not surprisingly, among the new spelling conventions imposed by the Dutch Government in the autumn of 1996, we find a new set of rules for spelling the linking schwa. For our compounds, the rule now is always to write the linking schwa as *-en*. This new rule is based on the theoretical assumption that the linking schwa is a meaningless element that, as a relic of the older morphological system, no longer plays any functional role in compounds.

[1]Gordon (1985) claimed that the Dutch *-en* plural is irregular. Building has argument on a personal communication, his theoretical framework of level-ordered morphology forced him to conclude that, because the Dutch *-en* plural freely occurs on the left-hand members of nominal compounds, these plural forms must be irregular. This theoretically driven conclusion is incorrect, however. The Dutch plural suffixes *-en* and *-s* are fully productive and regular (see van Marle 1985).

The choice for always using *-en* rather than *-e* in the orthography is motivated by the consideration that this choice leads to the smallest number of spelling changes in type and token lists of Dutch compounds.

The new spelling rule reflects a change in the linguistic analysis of the linking schwa. The older spelling system was based on the conviction that this schwa could express plurality; in other words, that it could be exactly the same thing as the plural suffix. The new spelling system rejects this analysis and regards the schwa as a meaningless linking phonema. However, this new analysis not universally accepted. Booij (1993, 1996), for instance, points out that Dutch compounds allow plural phrases as their first constituent (*oudemannenhuis*, “old men’s home”; *drielandenpunt*, “place where three countries meet”). He also calls attention to the “flavour of plurality” that the *-en* brings to mind in compounds such as *boekenkast* (“bookScase”). The aim of this study was to investigate whether the linking schwa, when written as *-en*, is indeed processed as the plural suffix, as claimed by Booij (1996) and the Woordenlijst (1954), or whether it is a truly meaningless sequence of graphemes only. Note that our experiments were carried out at the time that the new spelling rules had just been officially established. Our participants had no actual experience with the new spelling. Hence it is impossible that experience with the new spelling could influence our results.

THEORETICAL FRAMEWORK

From a psycholinguistic perspective, the possibility that writing the linking schwa as the plural suffix will induce plural semantics is to be taken seriously. There is experimental evidence to suggest that monomorphemic words beginning or ending with a string that is identical to a prefix or a suffix require longer processing times in reading than control words, due to an initial attempt to parse such words (e.g. Taft, 1981). Moreover, Caramazza, Laudanna and Romani (1988), Laudanna, Burani and Cermele (1994) and Laudanna and Burani (1995) have shown that affixes attached to nonwords slow down nonword response latencies, which indicates that these affixes have been recognised.

We explore the possibility that *-en* is indeed identified as the plural suffix within the theoretical framework of a parallel dual-route model, as outlined by Schreuder and Baayen (1995) and Baayen et al. (1997b). According to this model, complex words are processed by two routes that operate in parallel: a direct route that directly looks up meanings on the basis of full-form access representations, and a parsing route that identifies constituents during the early stage of perceptual segmentation and compositionally computes the meaning of the complex whole during the subsequent stages of more central lexical processing. For a compound such as *boekenkast*, an access representation (if present) for the compound as a whole may become activated, and will in turn activate the meaning "bookcase".

At the same time, the constituents *boek*, *-en* and *kast* may be identified, and the parser will then attempt to determine the intended meaning compositionally. Our model claims that the speed with which an access representation reaches threshold activation level is inversely proportional to its frequency of use. Since the plural suffix *-en* is the constituent with the highest frequency of use in the kind of compounds at hand (in fact, it is one of the highest-frequency affixes in Dutch), our model predicts that it should be the first constituent to become available for further lexical processing. Since Baayen et al. (1997b) show that many noun plurals have their own access representations, a third possibility is that the parsing route proceeds, again in parallel, on the basis of the full form *boeken* and the simplex word *kast*.

Our hypothesis, therefore, is that *en* and the full-forms of plural constituents are identified in compounds such as *boekenkast* and *slangenbeet*, and that their presence in the orthographic input will lead to the activation of plural semantics.

To show that plural semantics are indeed activated when *-en* is present in a compound, we first need to rule out the possibility that potential semantic effects are in fact due to differences in orthographic form arising at the early stages of perceptual identification. Experiment 1, therefore, investigated to what extent perceptual identification is affected by adding or dropping the *n* in the orthography. If the presence or absence of the *-en* is found not to affect response latencies in a task that is primarily sensitive to the early stages of identification, then we know that possible effects observed in tasks known to tap into more central aspects of lexical processing cannot be ascribed to a confound with perceptual identification.

EXPERIMENT 1

Experiment 1 investigated the effect of orthographic changes on the early stages of perceptual identification by means of the progressive demasking task. This technique, developed by Grainger, Segui and Jacobs (Grainger & Segui, 1990; Grainger & Jacobs, 1996), is a visual variant of auditory perception in noise. In this task, letter strings and a mask are presented alternately on a computer screen in a series of cycles. In the initial cycles, the letter string is presented only very briefly. As the cycles proceed, the presentation times of the mask decrease, while the presentation time of the target string increases. The perceptual effect on the observer is as if the string slowly emerges from the mask. As soon as a participant can identify which string is actually presented, the response button is pressed, after which string and mask disappear. Note that this task does not require participants to distinguish between words and nonwords. The task is restricted to identifying letter strings in noise only. Following response execution, participants are required to write down the letter string they have identified. In this way, the accuracy of the participants can be monitored. Due to the extended presentation over time—one cycle lasts 300 msec and several cycles are needed for the target string to become visible—response latencies may be as long as 3 sec. Grainger and Segui (1990) and Grainger and Jacobs (1996) have shown that this task is primarily sensitive to the processes that take place during early perceptual identification.

We have used this task to assess whether the presence or absence of the *-n* in the visual input affects identification latencies. Experiment 1 had three conditions. In the first condition, we examined the effect of adding the *-n* as is now required by the new spelling rules for words such as *slangenbeet*, "snake bite" (formerly *slangebeet*). In the second condition, we investigated what the effect of a different spelling change would have been been, namely dropping the *-n* in compounds such as *boekenkast*, words for which the *-n* appears in both the old and the new spelling. In our third condition, we examined the potential effect on perceptual identification of a one-letter change in the spelling of the vowel of the first constituent. To eliminate possible effects of changes in the phonology, we limited our attention to spelling changes that left the pronunciation unchanged, as in *gaudvis*, the misspelling of *goudvis* ("goldfish"). This condition was in effect a control condition, necessary to show that progressive demasking is sensitive enough to pick up orthographic changes of one letter.

Given our parallel dual-route model, we expected the following pattern of results. First, consider our control condition with words of the type *gaudvis*. Because *gaud* is a possible but non-existent word in Dutch, the parsing route will be slowed down or even blocked. The full-form route will also be slowed down, due to the mismatch between the visual stimulus and the visual access representation for *goudvis*. Because both access routes are slowed down, we expect misspellings such as *gaudvis* to be difficult to identify during the early stages of visual identification compared to the correctly spelled form *goudvis*.

Next, consider the effects of adding or dropping the *-n*. The addition of the *-n* required by the new spelling for *slangenbeet* results in a possible sequence of morphemes that fully spans the input: the noun stem *slang*, the suffix *-en* and the noun stem *beet*. Similarly, dropping the *-n* in *boekenkast* leads to a complete segmentation *boek*, *-e* and *kast*. Consequently, we did not expect the parsing route to be slowed down during the early process of visual identification and segmentation due to the presence of a non-existent constituent.

Adding or dropping the *-n* also affects the match between the visual input and the access representations of the full forms. Given the recency of the spelling reform, it is unlikely that an access representation for the new spelling of words such as *slangenbeet* is available. Thus, *slangenbeet* mismatches with the access representation *slangebeet* and, similarly, the incorrect spelling *boekekast* mismatches with the access representation for the correct spelling, *boekenkast.* Although this mismatch may slow down the full-form route, the early segmentation process is, as argued above, not slowed down. Hence, we expected that adding or dropping the *-n* would not delay identification to the same extent as misspelling the vowel of the first stem.

Methods

Participants. Nineteen paticipants, mostly undergraduates at Nijmegan University, were paid to take part in the experiment. All were native speakers of Dutch.

Materials. Three sets of noun–noun compounds were constructed. The first set consisted of 38 compounds of the type *slangenbeet*, words formerly written without the *-n*. The second set comprised 38 compounds of the type *boekenkast*, words written with an *n-* both in the former and in the new spelling. The third set contained 38 compounds of the type *goudvis*, words that do not contain a linking phoneme. All words had a frequency in the range 1–8 per million.[2] Their mean length was 9.5 letters. For each set of words, we constructed a parallel set of misspelled words. For set 1, the misspelling consisted of dropping the *-n*. By writing *slangebeet* instead of *slangenbeet*, the word is effectively presented in the former, now incorrect, spelling. For set 2, the misspelling likewise consisted of dropping the *-n*. However, *boekenkast* has never been written as *boekekast.* Hence, these words are genuinely misspelled according to both the former and the present spelling conventions. For set 3, the misspelling consisted of writing the vowel phoneme of the first constituent with an incorrect digraph: *goudvis* was misspelled as *gaudvis*, and *rozenkrans* as *roozenkrans*. Crucially, the pronunciation of the misspelled words is not affected by the orthographic change. Thus, this experiment consisted of three sub-experiments, each of which examined the effect of an orthographic change in a given group of words. Note that the only interesting comparisons are within a given group of words, where each pair of compounds (correctly versus incorrectly spelled) is its own control with respect to the different factors that affect lexical processing.

[2]For nominal compounds, the frequency range 1–8 per million covers the central part of the frequency distribution, excluding high-frequency outliers as well as very low-frequency, rarely occurring formations. This frequency range allows us to generalise to the set of normal, non-exceptional compounds.

A participant saw 19 words from each of the resulting six sets. A given participant had to respond to either the correct spelling of an item or to its misspelling, but never to both. In addition, each participant also saw 16 filler compounds with a spelling error in the second constituent. The experiment was preceded by a practice session with 11 items of the types described above.

Procedure. The participants were tested individually in sound-proof experimentation booths. The words were presented on Nec Multisync colour monitors in white upper-case 36-point Helvetica letters on a dark background, in alternation with a pattern mask consisting of a series of hash marks of equal length as the words themselves. On each successive cycle, the presentation of the word was increased by 16 msec, and the presentation of the mask was decreased by 16 msec. The total duration of each cycle remained constant at 300 msec. On the first cycle, the mask was presented for 284 msec and the word for 16 msec. On the second cycle, the words were presented for 32 msec, and so on. There was no interval between cycles. The cycles continued until the participant pressed the response key to indicate that he or she had recognised the word. The screen went blank after response initiation. Response latencies were measured from the beginning of the first cycle. Following their response, participants were asked to write down the word they thought they had recognised. In the instructions, we made clear that the materials contained misspelled words. Subjects were told explicitly to report exactly what they had seen, and to write down these words with the spelling error if present.

Results and Discussion Mean response latencies and errors were calculated across participants and items. The means by participant are listed in Table 1. For each type (SLANGENBEET , BOEKENKAST and GOUDVIS), we

TABLE 1
Mean Identification Latencies (msec) by participants in Experiment 1 (Error Percentages in Parentheses; Standard Error of Difference Scores of Response Latencies in Square Brackets)

	Spelling		
Type	*Correct*	*Incorrect*	*Incorrect − Correct*
SLANGENBEET	2761 (4.2%) *slangenbeet*	2691 (4.2%) *slangebeet*	−69 (0.0%) [37]
BOEKENKAST	2800 (2.2%) *boekenkast*	2838 (3.4%) *boekekast*	38 (1.2%) [56]
GOUDVIS	2695 (1.7%) *goudvis*	2944 (2.8%) *gaudvis*	249 (1.1%) [68]

carried out paired *t*-tests that compared the response latencies for the correct and incorrect spelling. For SLANGENBEET , paired two-tailed *t*-tests by participants and by items did not reveal a significant difference [$t_1(18) = 1.9$, $P > 0.07$; $t_2(37) = 0.9$, $P > 0.3$]. For BOEKENKAST, paired *t*-tests yielded a similar result [$t_1(18) = 0.7$, $P > 0.5$; $t_2(37) = 0.9$, $P > 0.3$]. For GOUDVIS, misspelling the first vowel resulted in significantly slower identification of the misspelled form [$t_1(18) = 3.7$, $P < 0.01$; $t_2(37) = 5.0$, $P < 0.01$]. The error scores did not reveal any significant differences.

We may conclude that adding or dropping the *-n* does not affect the speed of early visual identification. On the other hand, changing the spelling of the initial vowel of the first constituent leads to an average delay in progressive demasking of some 250 msec. Recall that participants were explicitly asked to write down after response execution exactly the string that they had identified. Responses were taken into account as correct only when participants wrote down the exact string as presented in the experiment. The way in which the linking schwa is spelled, apparently, is irrelevant for response times and errors in perceptual identification.

It is important to realise that string familiarity by itself cannot be used to explain these results, since only changes to the base of a compound lead to longer identification times, while changes to the linking graphemes do not. For familiar *boekenkast* and unfamiliar *boekekast*, and likewise for unfamiliar *slangenbeet* and familiar *slangebeet*, identification times were not affected by the familiarity of the string itself. Irrespective of whether the direct route is involved, and irrespective of whether access representations require a complete match with the visual input to fire or not, the emergence of a delay for words such as *gaudvis* only must find its origin in the parser detecting anomalous combinations of pseudo-words and legal morphology.

Since the presence or absence of the *-n* does not appear to affect the earliest stages of lexical processing, we next considered to what extent its presence in words such as *slangenbeet*, words in which the *-n* has recently been introduced by the new spelling rules, affects more central lexical processing. This issue was addressed in Experiment 2. Experiment 3 investigated what the effect of the other logically possible spelling change might have been; namely, when the rules would have prescribed dropping the *-n* from words such as *boekenkast*.

EXPERIMENT 2

We have seen that adding the *-n* to words such as *slangebeet* does not affect the time requires for visual identification. The addition of the *-n*, however, leads to a sequence of morphemes, *slang*, *-en* and *beet* (“snake + PLURAL + bite”), which might be recognised as such by the parsing route. According to our parallel dual-route model, the parsing route will identify the plural suffix *-en*, and will activate its semantic and syntactic representations in the central lexicon. Note that *-en* is one of the most frequent morphemes in Dutch, so that it is especially likely to be detected.

These considerations led us to expect that the *-en* plural would activate the semantics of plurality for a singular compound such as *slangenbeet*, the plural of which is *slangenbeten*, “snakebites” (literally, “snakesbites”). We were able to test whether the parser indeed gives rise to plural semantics for singular compounds by asking participants to make number decisions on words such as *slangebeet* and *slangenbeet*. For both words, the correct response is “singular”, but for *slangenbeet* a longer decision latency is predicted due to interference of the plural reading made available by the parsing route.

Methods

Participants. Twenty-eight participants, mostly undergraduates at Nijmegan University, were paid to take part in the experiment. All were native speakers of Dutch.

Materials. Fifty singular noun compounds of the type *slangebeet* were selected as experimental items. Their mean length was 10.7 letters, and their mean frequency was in the range 1–8 per million. Each of these compounds was presented in two forms: with and without the *-n*. A given participant saw 25 compounds with the *-n* and 25 compounds without the *-n*, and was never exposed to variants of the same compound.

Fifty singular filler noun compounds were added, together with 100 plural filler compounds. The 50 singular compounds comprised 14 nouns for which the second constituent ended in *-en* without being a plural (e.g. *badlaken*, “bathing towel”), 9 nouns with *-s* as linking phoneme (e.g. *slagersmes*, “butcher’s knife”) and 27 compounds without a linking phoneme (e.g. *oorbel*, “ear-drop”). This choice of singular compounds served the purpose of masking the relevance of the *-en* manipulation. Of the 100 plural compounds, 10 ended in a Latinate plural (e.g. *muziekcritici*, “music critics”), 54 ended in the Germanic *-en* plural and 36 ended in the Germanic *-s* plural. The choice of the plural filler material aimed at forcing the participants into deeper processing than just monitoring the stimuli for the final two letters. No function words, simplex words or other kinds of complex words were used in the experiment. We opted for homogeneous, “blocked” lists with compounds only so as to avoid potential complications due to task strategies induced by the properties of filler materials in heterogeneous lists.

Procedure. The participants were tested in groups of three in sound-proof experimental booths. They received instructions to press the right response button when the noun compound presented on the screen was a plural, and to press the left response button when this compound was a singular. The written instructions presented various examples of the kind of materials in the experiment and the required responses. Subjects were requested to respond as fast and accurately as possible.

Each trial consisted of the presentation of a fixation mark (asterisk) in the middle of the screen for 500 msec, followed 50 msec later by the stimulus centred at the same position. The stimuli were presented on Nec Multisync colour monitors in white upper-case 36-point Helvetica letters on a dark background. The stimuli remained on the screen for 1500 msec. Time-out occurred 2000 msec after stimulus onset. The total duration of the experiment was approximately 15 min.

Results and Discussion

A comparison of the response latencies to singulars spelled with and without the *-n* revealed that the presence of the *-n* slowed down the response latencies by some 50 msec. The mean latency by participants for the type *slangenbeet* was 738 msec; for the type *slangebeet*, the mean latency was 688 msec. The standard error of the mean difference was 10.0 msec. The corresponding error percentages were 2.7% and 2.5%, respectively. The difference in response latencies was significant [$t_1(27) = 5.0$, $P < 0.01$; $t_2(49) = 2.9$, $P < 0.01$]. The difference between the error percentages was not significant. Note that the observed difference cannot be traced to the familiarity of the string in the early stages of visual identification, since Experiment 1 showed that the presence or absence of *-n* did not affect visual identification times in progressive demasking. Also note that we are dealing with an interference effect. Any task-specific strategy would be aimed at trying to ignore the *-n* following the first constituent. In spite of whatever strategies our participants may have employed, the spelling of the linking phoneme nevertheless influenced their response latencies.[3] We therefore conclude that the parsing route indeed delivers the plural reading when the linking phoneme is spelled as the *-en* plural, as predicted by our parallel dual-route model. The "flavour of plurality" ascribed by Booij (1996) to compounds written with *-en* as orthographic realisation of the linking schwa is a direct consequence of the activity of the parsing route.

For completeness, we should add some refinements on the precise way in which the activity of the parsing route may lead to the observed plural

[3]One reviewer suggested that the use of blocked lists with compounds only and no simplex words might have led our participants to rely heavily on the parsing route. In the light of the observed interference effect of the plurality of the left member of our singular compounds, it seems more likely that participants would try to rely on the direct route to avoid plural interference—without parsing, no plural interference could arise.

interference. Thus far, we have argued that the identification of the plural suffix leads to the activation of plural semantics, and that it is these plural semantics that lead to a semantic conflict, which in turn slows down response latencies in number decision. However, Baayen et al. (1997b) have shown that *-en*, when attached to nouns, gives rise to a subcategorisation conflict that requires substantial processing time to be resolved. (This suffix occurs predominantly with verbs, for which no such conflict is observed.) Hence, it is possible that the observed plural interference effect arises in part or even fully because of this subcategorisation conflict. Note that this explanation also hinges on the suffix *-en* being detected in the input.

Another way in which the plural interference effect might arise in our dual-route model is as follows. Baayen et al. (1997b) showed that noun plurals in *-en*, because of the aforementioned subcategorisation conflict, very often have their own access representations. Hence, a form such as *slangenbeet* might be parsed into its own immediate constituents, the plural *slangen* and the singular *beet*. The plural *slangen* would then activate its semantics, including the semantics of plurality. Again, plural interference arises. Note that this explanation also hinges on *-en* not being a meaningless linking sequence in the orthography. Instead, it is an essential part of the access representations of full-form noun plurals.

EXPERIMENT 3

Experiment 2 investigated the effects of the new spelling rule for words such as *slangenbeet*. What would the consequence be of the mirror image rule to write the linking schwa consistently as *-e* without the *-n* for all compounds (*slangebeet*, *boekekast*)? In Experiment 3, we used the number decision task to investigate whether *boekekast* is processed faster than *boekenkast*. Given the results of Experiment 2, one might expect that number decision on *boekenkast* takes more time than for *boekekast*, because the plural suffix and the plural form itself are not present in *boekekast*.

Methods

Participants. Twenty-two participants, mostly undergraduates at Nijmegen University, were paid to take part in the experiment. All were native speakers of Dutch.

Materials. Thirty-six singular noun compounds of the type *boekenkast* were selected as experimental items. Their mean length was 10.4 letters, and their frequency ranged from 1 to 8 per million. Each of these compounds was presented in two forms: with and without the *-n*. A given paticipant saw 18 compounds with the *-n* and 18 compounds without the *-n* and was never exposed to variants of the same compound.

Thirty-eight singular filler noun compounds were added, together with 76 plural filler compounds. The 38 singular compounds comprised 11 nouns for which the second constituent ended in *-en* without being a plural, and 27 other singular noun compounds. The set of plural fillers comprised 33 compounds with the *-en* ending, 35 with the *-s* plural ending and 8 with a Latinate plural ending. Of all fillers, 12 compounds contained the linking phoneme *-s*.

Procedure. The procedure was identical to that of Experiment 2. In this experiment, however, a slightly smaller font size was used (26-point Helvetica) to facilitate foveal processing of the rather long compounds used.

Results and Discussion To our surprise, a comparison of the response latencies to singulars spelled with and without the *-n* revealed that dropping the *-n* from the normal spelling did not affect the number decision latencies. The mean latency by participants for the type *boekenkast* was 729 msec; for the type *boekekast*, the mean latency was 730 msec. The corresponding error percentages were 4.9% and 2.2%, respectively. None of the differences were significant [response latencies: $t_1(21) < 1$; $t_2(35) < 1$; error scores: $t_1(21) = 1.7$, $P > 0.10$; $t_2(35) = 1.87$, $P > 0.07$].

The absence of a significant difference between the response times for *boekekast* and *boekenkast* suggests that either plural semantics are activated for both kinds of compounds, or that plural semantics are not activated at all for both types of words. Given the results of Experiment 2, it is unlikely that words such as *boekenkast* do not give rise to the activation of plural semantics. This leaves us with the conclusion that apparently plural semantics are activated for words such as *boekekast*, even though these semantics cannot be obtained via the parsing route—the plural suffix *-en* is not present in the signal. Within the framework of our parallel dual-route model, we are led to conclude that apparently the spelling variant *boekekast* is sufficiently similar to the full-form access representation of *boekenkast* to allow the meaning of *boekenkast* to be activated.

Crucially, we assume that the semantic representation of words of the type *boekenkast* includes plural semantics. Here we follow linguists such as Booij (1993, 1996) and De Vries and Te Winkel (1884), who have argued extensively that the left-hand members of compounds like *boekenkast* are genuine plurals. In fact, this interpretation motivated the old spelling conventions—all our participants, just as all other inhabitants of the Netherlands and Flanders, were explicitly taught to write the linking schwa as *-en* in *boekenkast* because its semantics imply plurality for the first constituent (“a case for books”), and to write the schwa as *-e* in *slangebeet* because the first constituent is logically by necessity singular (“a bite by a single snake”).

These considerations led to the following interpretation of Experiments 2 and 3. In Experiment 2, the direct route never activated plural semantics, even in those cases where the *-n* was present in the orthography. In such cases, the access representation of the well-established variant without the *-n* provided access to the word's meaning, which did not include plural semantics. The introduction of the *-n* in the spelling, however, allowed the parsing route to detect the embedded plural or the plural suffix. Hence the parsing route gives rise to the plural interference effect. In Experiment 3, the direct route always activated plural semantics, even when no *-n* was present in the signal, because words such as *boekenkast* have intrinsic plurals as their left-hand members. Hence no difference is observed between the response latencies for *boekenkast* and those for *boekekast*.[4]

To further support this interpretation of our experimental results, we next investigated speakers' intuitions concerning the plurality of the first constituents in Dutch compounds as a function of the presence or the absence of the *-n*.

EXPERIMENT 4

In Experiment 4, subjects were shown words such as *boekenkast* and *slangenbeet* both written with and without the *-n*. They were asked to rate the first constituent of these words on a 7-point scale for plurality. To see why a scale for plurality makes sense for our data, consider the following compounds:

bosbessensap	blueberry juice
mandarijnensap	tangerine juice
sinaasappelsap	orange juice

[4]A reviewer suggested an alternative explanation for the results of Experiments 2 and 3, following the theory of Baayen et al. (1997b). The plural constituents of the target singular compounds in Experiment 2 have a lower average surface frequency (472 per 42 million) than those in Experiment 3 (1701 per 42 million). The longer response latencies in Experiment 2 to compounds with plurals would then arise due to the failure of the direct route to complete lexical access before the parsing route, which itself would be costly in terms of time due to the subcategorisation ambiguity of the *-en* suffix. What we have interpreted as a plural interference effect would then be a subcategorisation ambiguity effect. In Experiment 3, the higher frequencies of the plural constituents would allow the direct route to recognise these plurals before the parsing route. Hence no ambuiguity effect would arise in Experiment 3.

We consider this alternative explanation as unconvincing, for two reasons. First, the average plural frequency for which Baayen et al. (1997b) observed a possible subcategorisation conflict was 1 per million. The plurals in Experiment 2 are from a much higher frequency range (11 per million), for which their experimental results do not suggest that a subcategorisation conflict takes place. Secondly, *post-hoc* correlations between the logarithmically transformed frequencies of the plural constituents and the reaction times did not reveal any reliable correlation in Experiments 2 and 3. Hence, it is unlikely that the response latencies would be crucially determined by the frequency of the plural constituents.

For *bosbessensap*, it is fairly obvious that this juice is made of many blueberries. Conversely, orange juice often comes in quantities that could very well come from a single orange. This is made explicit in the spelling with a singular form, *sinaasappel*. But for tangerine juice, it is less clear whether a single tangerine or more tangerines are required to produce a normal quantity of juice. The old spelling opted for the plural interpretation, but it will be clear that there is considerable room for uncertainty here. This kind of uncertainty with respect to the appropriate number for the left-hand constituent is one of the reasons that has led to the new spelling system, which eliminates this uncertainty for the writer.

Note that while the previous experiments elicited responses to the compounds as a whole, the present experiment focused on the first constituent, be it in the context of the complete compound. The crucial prediction of this experiment concerned the relative magnitude of the effect of the presence or absence of *-n*. We predicted that this effect would be smaller for words of the type *boekenkast* than for words of the type *slangenbeet*.

There are two factors which might influence the plurality rating of the first constituent. The first is the presence or absence of the *-n*. The presence of the *-n* will lead to higher plurality ratings for both word types. The second factor concerns the stored meaning of the compound, which, according to our hypothesis, contains the semantics of plurality for words of the type *boekenkast* only. For words of the type *slangenbeet*, the current spelling with the *-n* is new and unfamiliar, and the stored semantic representation is one in which the first constituent is viewed as a natural singular. Hence, the overall effect of the presence of the *-n* will be larger for words of the type *slangenbeet*. When participants see the familiar former spelling *slangebeet*, no semantics of plurality are activated. However, the form *slangenbeet* allows the parsing route to activate the semantics of the plural suffix *-en*. Hence, the contrast between *slangebeet* and *slangenbeet* is the maximal contrast possible between singular and plural. Conversely, both *boekekast* and *boekenkast* will activate plurality semantics. In this case, the overall effect of the manipulation of *-n* will be between different degrees of plurality.

Methods

Participants. Thirty-three students of Dutch linguistics participated in the experiment. All were native speakers of Dutch.

Materials. Forty-eight singular noun compounds of the type *slangenbeet* were selected as experimental items, and 29 singular noun compounds of the type *boekenkast*. Each of these compounds were presented in two forms:

with and without the *-n*. A given participant saw 24 compounds of the type *slangenbeet* with the *-n* and 24 compounds without the *-n*. Similarly, each participant saw 15 compounds of the type *boekenkast* the *-n* and 14 compounds without the *-n*. A participant was never exposed to spelling variants of the same compound. Finally, the experiment contained 20 filler compounds with the linking grapheme *-en*.

Procedure. The participants were asked to rate on a 7-point scale their estimation of the plurality of the first constituent of the compounds. A rating of 1 indicated "certainly singular" and a rating of 7 "certainly plural". The participants received explicit instructions to ignore the spelling (and the spelling errors) and to concentrate purely on the plural semantics of the first constituent.

Results and Discussion

Mean plurality ratings were calculated by participants and by items, as well as the mean difference scores within each word type, as shown in Table 2. As expected, dropping the *-n* from *slangenbeet* resulted in a larger decrease in plurality (1.57) than removal of the *-n* for *boekenkast* (1.12). This interaction was significant in an analysis of variance by participants [$F(1,23) = 4.6$, MSe $= 0.27$, $P < 0.04$] as well as by items in an analysis of variance with spelling variants as a within-item factor [$F(1,75) = 6.9$, MSe $= 0.32$; $P < 0.02$). Significant main effects of spelling and word type were also observed [spelling: $F_1(1,23) = 64.2$, MSe $= 1.54$, $P < 0.001$; $F_2(1,75) = 195.2$, MSe $=$ 0.32, $P < 0.001$; word type: $F_1(1,23) = 31.5$, MSe $= 1.37$, $P < 0.001$); $F_2(1,75)$ $= 70.3$, MSe $= 0.32$, $P < 0.001$].

The larger effect of removing the *-n* from *slangenbeet* compared to *boekenkast* supports our contention that the semantic representation of *boekenkast* contains the plural representation of the first constituent, irrespective of its spelling. In the old spelling system, *slangenbeet* was written without the *-n* with the explicit aim of avoiding the plural reading for the first

TABLE 2
Mean Plurality Ratings by Participants in Experiment 4

	Spelling		
Type	*Correct*	*Incorrect*	*Difference*
SLANGENBEET	3.92 *slangenbeet*	2.35 *slangebeet*	1.57
BOEKENKAST	5.72 *boekenkast*	4.60 *boekekast*	1.12

constituent. For our participants, who are accustomed to the old spelling, adding the *-n* to *slangebeet* has the effect of changing a singular into a plural. Conversely, dropping the *-n* from *boekenkast* has a smaller effect. Under the old spelling rules, speakers of Dutch were taught to write the *-n* in *boekenkast* because the first constituent was felt to be a natural plural. This experiment has shown that, even when the plurality of the first constituent is no longer overtly marked by the *-n*, the plural interpretation nevertheless remains more natural than the singular interpretation. Removal of the *-n* from *boekenkast* does not singularise the first constituent to the same extent that adding the *-n* pluralises the first constituent of *slangebeet*.

GENERAL DISCUSSION

In this study, we addressed the functional role of the orthographic realisation of the linking schwa in Dutch nominal compounds. From a diachronic perspective, the linking schwa is a historical relic of a now obsolete morphological system. Synchronically, however, it is homographic and homophonic with the high-frequency inflectional affixes *-e* and *-en*. Are plural semantics activated in the mental lexicon when the linking schwa is written as the plural suffix *-en*?

Experiment 1 (progressive demasking) showed that perceptual identification is not affected by whether the linking schwa is realised as *-en* or *-e*. While spelling changes affecting the vowel of the first constituent of compounds severely affect their string familiarity and lead to longer identification latencies, no such effect could be observed for spelling changes affecting the linking schwa.

Experiment 2 (number decision) showed that changing the orthographic realisation of the linking schwa from *-e* to *-en* induces the activation of plural semantics. Writing the linking schwa in the orthographic form of the plural suffix leads to an interference effect caused by the automatic parsing of the plural suffix and the activation of its meaning.

Experiment 3 focused on compounds for which the linking schwa is realised as *-en* both in the old and in the new spelling system. Number decision latencies did not reveal a significant difference for the two spelling variants. Our hypothesis is that, for these compounds, which traditionally have been interpreted (and taught) to have a plural interpretation for the first constituent, the direct route leads to the activation of the full semantics of these compounds, including the plurality reading, hence causing equal interference for both spelling variants.

The results of Experiment 4 (plurality rating) support this hypothesis. The effect of the plural suffix *-en* on the plurality rating of the first constituent is larger for the words that traditionally were written with *-e* as orthographic realisation of the schwa. These words, traditionally interpreted as having a singular first constituent, reveal the largest effect of pluralisation when the *-en* plural suffix is present in their orthographic form. This experiment showed that, in Dutch, the first constituents of nominal compounds can have plural semantics as part of their central semantic representations.

We conclude that the linking schwa is not a meaningless phoneme for those words where it is orthographically realised as *-en*—it is the plural suffix itself. Since the new spelling requires the ubiquitous use of *-en* as orthographic realisation of the linking schwa, and given our experimental results, we expect that, in the years to come, the plural interpretation of the left-hand constituent will eventually become commonplace for compounds with a linking schwa. In this way, the process of the functional reinterpretation of the schwa as a plural suffix instead of as a (meaningless) relic of the obsolete morphological system of medieval Dutch will be completed. In roughly 15 years, when participants have become available for testing who have only known the new spelling, we will be able to test this prediction experimentally: Then, *slangebeet* and *slangenbeet* should reveal identical response latencies in number decision.

Our experimental results provide further support for our parallel dual-route model of morphological processing. In this model, the two routes for lexical access—the parsing route and the direct access route—operate in parallel from stimulus onset. Experiment 2 showed that the parsing route delivers a plural interpretation for compounds whose orthography has been changed to include *-en*. From the results of Experiment 1, we know that perceptual identification is not affected by this change; from the results of Experiment 3, we know that the full-form route provides access to the centrally stored semantic representation of the compound, irrespective of the orthographic realisation of the linking schwa. If the parsing route is only invoked upon failure of the direct route, as suggested by Caramazza et al. (1988), then the plural interference effect observed in Experiment 2 would remain unexplained. Lexical access would then be achieved on the basis of the full-form representation, which, given the results of Experiment 1, is not sensitive to the way the linking schwa is written. But, if access is completed on the basis of the full form, activating singular semantics only, why would the parser subsequently be called into action to deliver plural semantics when this is dysfunctional for the task at hand, number decision on a full compound? We conclude that the parsing route is an autonomous process that operates from stimulus onset independently of whether a full-form access representation is available.

At the same time, the results of Experiment 3 show that the direct route also operates independently of the parsing route. Visual access representations appear to be robust with respect to minor mismatches in compounds at the constituent boundaries, and activate the full semantics of compounds, including the plural semantics of the first constituent, even in the absence of the plural suffix in the visual input. As argued by Baayen et al. (1997b), the opposition between rules and representations as an absolute dichotomy in models of morphological processing is unfruitful and unnecessary.

Finally, the moral of this study is that spelling changes involving the introduction of homographs of productive affixes in the orthography may have unexpected effects on lexical processing. While it is possible to regard the linking schwa as a meaningless element without suffixal status, our results show that the parsing system delivers the plural meaning when the linking schwa is written as the plural suffix. Paradoxically, we expect that, in the long term, the autonomous parsing route will lead to a change in the grammar of Dutch, such that the linking schwa will become completely identical to the plural suffix.

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APPENDIX

Words used in Experiment 1 (mean identification latencies in msec)

The type SLANGENBEET

beddegoed (bedclothes) 2623, beddengoed 2669; beremuts (bearskin) 2596, berenmuts 3451; bokkesprong (goat's jump) 2864, bokkensprong 3207; brilleglas (spectacle-glass) 2881, brillenglas 3249; denneboom (fir tree) 2499, dennenboom 2733; eikehout (oak wood) 2773, eikenhout 2900; flessehals (bottleneck) 2679, flessenhals 2952; ganzeveer (goose feather) 2357, ganzenveer 2992; geitekaas (goat's cheese) 2361, geitenkaas cheese 2654; hartewens (heart's desire) 2197, hartenwens 2688; hazelip (hare-lip) 2424, hazenlip 2638; hondepoep (dog-dirt) 2163, hondenpoep 2954; karrespoor (cart track) 2329, karrenspoor 2720; kattekwaad (mischief) 2469, kattenkwaad 2507; kerkeraad (church council) 2977, kerkenraad 3194; kippevel (hen skin) 2465, kippenvel 2826; klokketoren (bell tower) 2682, klokkentoren 3109; konijnehok (rabbit hutch) 2554, konijnenhok 2928; krullebol (curly head) 2911, krullenbol 2924; kurketrekker (cork screw) 3272, kurkentrekker 3126; lampekap (lamp shade) 2627, lampenkap 2617; leeuwedeel (lion's share) 3479, leeuwendeel 2791; mottebal (mothball) 2752, mottenbal 2623; notedop (nutshell) 2384, notendop 2594; ossekop (ox head) 2087, ossenkop 2381; paardebloem (dandelion) 2886, paardenbloem 2357; pannekoek (pancake) 2458, pannenkoek 2722; pennelikker (quill-driver) 3132, pennenlikker 2592; pottekijker (nosy) 2886, pottenkijker 2351; ruggegraat (back bone) 2721, ruggengraat 2757; ruitewisser (screen wiper) 3141, ruitenwisser 2856; schapemelk (sheep's milk) 3279, schapenmelk 2609; schroevedraaier (screwdriver) 3089, schroevendraaier 2823; slangebeet (snakebite) 2793, slangenbeet 2433; speldeknop (pin's head) 2815, speldenknop 2654; spinneweb (spider's web) 2457, spinnenweb 2522; vlaggestok (flag-staff) 2829, vlaggenstok 2345; zielepoot (pitiful person) 2557, zielenpoot 2439.

The type BOEKENKAST

aktetas (briefcase) 2568, aktentas 2443; boekerek (book-rack) 2832, boekenrek 2541; boerezoon (farmer's son) 2440, boerenzoon 2277; brievebus (letter box) 2597, brievenbus 2229; dieretuin (animal garden) 2617, dierentuin 2347; druivetros (bunch of grapes) 2785, druiventros 2528; duivetil (pigeon loft) 2977, duiventil 2699; engelehaar (angel's hair) 3232, engelenhaar 2548; erwtesoep (pea soup) 2899, erwtensoep 2473; gebaretaal (gesture language) 2821, gebarentaal 2830; gevarezone (danger zone) 2943, gevarenzone 2461; hekseketel (witches' cauldron) 3027, heksenketel 2645; heldedaad (heroic act) 2999, heldendaad 2882; kaartebak (card tray) 2592, kaartenbak 2472; klantekring (client circle) 3285, klantenkring 2906;

kleurefoto (colour photograph) 3037, kleurenfoto 2718; koleschop (coal shovel) 3177, kolenschop 2767; ladekast (chest of drawers) 2785, ladenkast 2588; lappepop (ragdoll) 3028, lappenpop 3102; lessetabel (timetable) 3833, lessentabel 3912; lippestift (lipstick) 2795, lippenstift 3535; mierehoop (ant hill) 2895, mierenhoop 2866; plankekoorts (stage fright) 3092, plankenkoorts 2940; platespeler (record player) 2907, platenspeler 2833; rattevanger (rat catcher) 2738, rattenvanger 3078; rokkejager (woman chaser) 2498, rokkenjager 2899; rollespel (role-play) 2642, rollenspel 2628; schoenedoos (shoebox) 2649, schoenendoos 2758; sterrebeeld (constellation) 2496, sterrenbeeld 2707; takkebos (faggot) 2614, takkenbos 3055; tentekamp (tents encampment) 2844, tentenkamp 2979; toetsebord (keyboard) 2563, toetsenbord 2978; vlammezee (sea of flames) 2935, vlammenzee 2922; warehuis (department store) 2190, warenhuis 2664; wespenest (wasps' nest) 2681, wespennest 2666; wolkedek (cloud cover) 3056, wolkendek 2701; woordestrijd (verbal combat) 2746, woordenstrijd 3230; zakeleven (business life) 3230, zakenleven 3045.

The type GOUDVIS

autoweg (motorroad) 1957, outoweg 3066; bewijslast (burden of proof) 2823, beweislast 3341; bijenkorf (beehive) 2355, beienkorf 3149; blauwdruk (blueprint) 2552, blouwdruk 2983; bouwsteen (building stone) 2499, bauwsteen 2905; cameraploeg (camera crew) 2911, caameraploeg 3619; damesblad (women's magazine) 2316, daamesblad 3185; galabal (state ball) 2960, gaalabal 3350; glazenwasser (window cleaner) 2481, glaazenwasser 2761; goudvis (goldfish) 2423, gaudvis 2268; hamerslag (hammer-blow) 2695, haamerslag 2968; havermout (rolled oats) 2406, haavermout 2878; hemelbed (four-poster) 2363, heemelbed 3085; hotelgast (hotel guest) 2425, hootelgast 3212; ijzervreter (fire-eater) 3305, eizervreter 3759; kamerjas (dressing gown) 2033, kaamerjas 2887; kogelgat (shot-hole) 2426, koogelgat 3114; kouseband (garter) 2282, kauseband 2604; krijtgrond (chalky soil) 2985, kreitgrond 3247; leverkwaal (liver trouble) 3039, leeverkwaal 3127; matrozenpak (sailor suit) 2770, matroozenpak 2689; molenwiek (mills-wing) 2691, moolenwiek 2826; pepermunt (peppermint) 2608, peepermunt 2572; pijptabak (pipe-tobacco) 2867, peiptabak 2838; radiomuziek (radio music) 3193, radioomuziek 3175; rauwkost (raw vegetables) 2595, rouwkost 2447; rozenkrans (garland of roses) 2590, roozenkrans 2726; scheidslijn (dividing line) 3173, schijdslijn 2889; schoudertas (shoulder-bag) 3192, schaudertas 3055; slijmvlies (mucous membrane) 2875, sleimvlies 2856; tafelpoot (table leg) 2601, taafelpoot 2826; tijdbom (time bomb) 2798, teidbom 3044; touwladder (rope ladder) 2800, tauwladder 2833; treinstel (train carriage) 2896, trijnstel 2620; trouwring (wedding ring) 2606, trauwring 2532; vogelkooi (bird cage) 2895, voogelkooi 2464; waterkant (waterside) 2753, waaterkant 2864; wijzerplaat (dial-plate) 3116, weizerplaat 2993.

Words used in Experiment 2 (mean number decision latencies in msec)

bananenschil (banana peel) 830, bananeschil 671; beddengoed (bedclothes) 910, beddegoed 614; berenmuts (bearskin) 799, beremuts 695; bessenstruik (currant bush) 769, bessestruik 642; bokkensprong (goat's jump) 881, bokkesprong 680; brillenglas (spectacle-glass) 874, brilleglas 647; dennenboom (fir tree) 797, denneboom 656; druivensuiker (grape sugar) 759, druivesuiker 662; eikenhout (oak wood) 693, eikehout 573; flessenhals (bottleneck) 839, flessehals 755; ganzenveer (goose feather) 736, ganzeveer 591; geitenkaas (goat's cheese) 925, geitekaas 658; hanenkam (cock's comb) 677, hanekam 632; hartenwens (heart's desire) 866, hartewens 717; hazenlip (hare-lip) 728, hazelip 566; hertenleer (venison leather) 755, herteleer 663; hondenpoep (dog-dirt) 783, hondepoep 611; karrenspoor (cart track) 817, karrespoor 614;

kattenkwaad (mischief) 717, kattekwaad 570; kerkenraad (church council) 884, kerkeraad 690; kersenpit (cherry stone) 650, kersepit 578; kippenvel (hens skin) 754, kippevel 575; klokkentoren (bell tower) 996, klokketoren 819; konijnenhok (rabbit hutch) 692, konijnehok 665; krullenbol (curly head) 701, krullebol 626; kurkentrekker (corkscrew) 757, kurketrekker 688; lampenkap (lampshade) 705, lampekap 684; leeuwendeel (lion's share) 766, leeuwedeel 885; mattenklopper (carpetbeater) 736, matteklopper 746; mottenbal (mothball) 663, mottebal 686; notendop (nutshell) 634, notedop 640; ossenkop (ox head) 650, ossekop 827; paardenbloem (dandelion) 658, paardebloem 653; pannenkoek (pancake) 619, pannekoek 619; pennenlikker (quill-driver) 796, pennelikker 885; pottenkijker (nosy) 671, pottekijker 688; ruggengraat (backbone) 636, ruggegraat 715; ruitenwisser (screen wiper) 717, ruitewissser 790; schapenmelk (sheep's milk) 722, schapemelk 756; schroevendraaier (screwdriver) 718, schroevedraaier 740; slakkenhuis (snale shell) 690, slakkehuis 962; slangenbeet (snakebite) 652, slangebeet 754; speldenknop (pin's head) 699, speldeknop 688; spinnenweb (spider's web) 587, spinneweb 740; sterrenbeeld (constellation) 647, sterrebeeld 669; tandenstoker (toothpick) 617, tandestoker 700; vlaggenstok (flag-staff) 795, vlaggestok 703; vossenhol (fox hole) 583, vossehol 582; zielenpoot (pitiful person) 658, zielepoot 659; zwijnenstal (cesspit) 670, zwijnestal 701.

Words used in Experiment 3 (mean number decision latencies in msec)

aktentas (briefcase) 686, aktetas 713; boekenrek (book rack) 604, boekerek 777; boerenzoon (farmer's son) 629, boerezoon 629; brievenbus (letter box) 674, brievebus 688; dierentuin (animal garden) 615, dieretuin 707; druiventros (bunch of grapes) 709, druivetros 769; duiventil (pigeon loft) 734, duivetil 763; engelenhaar (angel's hair) 781, engelehaar 775; erwtensoep (pea soup) 670, erwtesoep 644; gebarentaal (gesture language) 670, gebaretaal 811; gevarenzone (danger zone) 723, gevarezone 852; heksenketel (witches' cauldron) 701, hekseketel 773; heldendaad (heroic act) 719, heldedaad 714; kaartenbak (card tray) 712, kaartebak 645; klantenkring (client circle) 725, klantekring 830; kleurenfoto (colour photograph) 623, kleurefoto 772; kolenschop (coal shovel) 672, koleschop 826; ladenkast (chest of drawers) 650, ladekast 671; lappenpop (ragdoll) 719, lappepop 628; lippenstift (lipstick) 739, lippestift 618; mierenhoop (ant hill) 740, mierehoop 750; plankenkoorts (stage fright) 967, plankekoorts 898; platenspeler (record player) 776, platespeler 714; rattenvanger (rat catcher) 852, rattevanger 679; rokkenjager (woman chaser) 715, rokkejager 667; rollenspel (role-play) 793, rollespel 658; schoenendoos (shoebox) 715, schoenedoos 731; sterrenbeeld (constellation) 687, sterrebeeld 658; takkenbos (faggot) 837, takkebos 662; tentenkamp (tents encampment) 772, tentekamp 711; toetsenbord (keyboard) 662, toetsebord 624; vlammenzee (sea of flames) 768, vlammezee 843; warenhuis (department store) 653, warehuis 761; wolkendek (cloud cover) 788, wolkedek 664; woordenstrijd (verbal combat) 828, woordestrijd 724; zakenleven (business life) 980, zakeleven 921.

Words used in Experiment 4 (mean plurality ratings on a 7-point scale)

The type SLANGENBEET

bananenschil (banana peel) 2.92, bananeschil 1.50; beddengoed (bedclothes) 4.17, beddegoed 3.67; berenmuts (bearskin) 3.42, beremuts 1.42; bessenstruik (currant bush) 6.42, bessestruik 5.67; bokkensprong (goat's jump) 4.17, bokkesprong 1.75; brillenglas (spectacle-glass) 3.42, brilleglas 1.75; dennenboom (fir tree) 4.08, denneboom 1.67; druivensuiker (grape sugar) 5.58, druivesuiker 4.00; eikenhout (oak wood) 3.50, eikehout 2.33; erwtensoep (pea soup) 6.08, erwtesoep 4.42; flessenhals (bottle neck) 3.58, flessehals 1.17; ganzenveer (goose feather) 3.08, ganzeveer 1.25; geitenkaas (goat's cheese) 4.83, geitekaas 2.42; hanenkam (cock's comb) 2.17, hanekam 2.00; hartenwens (heart's desire) 3.00, hartewens 1.58; hazenlip (hare-lip) 2.33, hazelip 1.25; hertenleer (venison leather) 4.08, herteleer 2.58; hondenpoep (dog-dirt) 3.08, hondepoep 2.58; karrenspoor (cart track) 4.50, karrespoor 2.92; kattenkwaad (mischief) 4.58, kattekwaad 2.33; kerkenraad (church council) 4.67, kerkeraad 3.00; kersenpit (cherry stone) 2.92, kersepit 1.67; kippenvel (hen skin) 4.08, kippevel 2.75; konijnenhok (rabbit hutch) 4.58, konijnehok 2.75; krullenbol (curly head) 6.75, krullebol 4.00; kurkentrekker (corkscrew) 4.58, kurketrekker 3.33; lampenkap (lampshade) 2.75, lampekap 1.50; leeuwendeel (lion's share) 4.00, leeuwedeel 1.92; mottenbal (mothball) 4.58, mottebal 4.17; notendop (nutshell) 2.50, notedop 1.50; ossenkop (ox head) 2.00, ossekop 1.58; paardenbloem (dandelion) 3.58, paardebloem 1.92; pannenkoek (pancake) 2.58, pannekoek 2.58; pennenlikker (quill-driver), 3.33, pennelikker 2.08; pottenkijker (nosy) 4.43, pottekijker 2.75; ruggengraat (backbone) 2.33, ruggegraat 1.42; ruitenwisser (screen wiper) 3.50, ruitewisser 2.17; schapenmelk (sheep's milk) 4.75, schapemelk 3.17; schroevendraaier (screwdriver) 5.33, schroevedraaier 4.00; slakkenhuis (snale shell) 3.08, slakkehuis 1.67; slangenbeet (snakebite) 2.67, slangebeet 1.42; speldenknop (pin's head) 3.67, speldeknop 1.25; spinnenweb (spider's web) 3.00, spinnenweb 1.50; tandenstoker (toothpick) 6.00, tandestoker 2.75; vlaggenstok (flag-staff) 3.17, vlaggestok 1.42; vossenhol (fox hole) 5.58, vossehol 3.25; zielenpoot (pitiful person) 2.33, zielepoot 1.42; zwijnenstal (cesspit) 6.58, zwijnestal 2.50.

The type BOEKENKAST

boekenrek (book rack) 6.75, boekerek 5.50; brievenbus (letter box) 6.17, brievebus 4.25; dierentuin (animal garden) 6.83, dieretuin 6.33; druiventros (bunch of grapes) 6.58, druivetros 4.83; duiventil (pigeon loft) 6.75, duivetil 5.58; gebarentaal (gesture language) 6.67, gebaretaal 5.92; gevarenzone (danger zone) 3.92, gevarezone 3.50; kaartenbak (card tray) 6.75, kaartebak 5.33; kleurenfoto (colour photograph) 5.25, kleurefoto 3.67; kolenschop (coal shovel) 5.83, koleschop 2.83; ladenkast (chest of drawers) 5.33, ladekast 4.58; lappenpop (ragdoll) 5.50, lappepop 3.33; lippenstift (lipstick) 3.33, lippestift 2.83; mierenhoop (ant hill) 7.00, mierehoop 5.92; plankenkoorts (stage fright) 5.08, plankekoorts 4.33; platenspeler (record player) 5.08, platespeler 4.00; rattenvanger (rat catcher) 5.50, rattevanger 6.25; rokkenjager (woman chaser) 5.33, rokkejager 4.17; rollenspel (role-play) 5.00, rollespel 4.92; schoenendoos (shoebox) 5.00, schoenedoos 3.25; sterrenbeeld (constellation) 4.08, sterrebeeld 4.42; takkenbos (faggot) 6.00, takkebos 5.42; tentenkamp (tents encampment) 6.42, tentekamp 4.42; toetsenbord (keyboard) 5.75, toetsebord 5.58; vlammenzee (sea of flames) 6.75, vlammezee 4.67; warenhuis (department store) 4.50, warehuis 4.58; wolkendek (cloud cover) 5.83, wolkedek 5.17; woordenstrijd (verbal combat) 6.25, woordestrijd 5.17; zakenleven (business life) 5.08, zakeleven 2.42.