Verpleegsters, ambassadrices and *masseuses*

Stratum differences in the comprehension of Dutch words with feminine agent suffixes*

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1. Introduction

The vocabulary of Dutch shows traces of contact with a wide range of languages including classical Greek, Latin, Hebrew, Arabic and French. In the description of the vocabulary from a synchronic point of view, information about the origin of words does not play a role. However, the dichotomy of the native and non-native strata is indispensable, cf. De Haas and Trommelen (1993: 11–13), Booij (2002a: 94–5). Native bases combine freely with native affixes (1a) and non-native bases likewise combine with non-native affixes (1b). Various native affixes also attach to non-native bases (1c). However, non-native affixes hardly ever combine with native base words (1d).

(1) a. *Native bases and affixes*
on+zuiver 'impure', ver+huis 'move-home', zuiver+heid 'pureness', huis+elijk 'domestic'

b. *Non-native bases and affixes*
in+stabiel 'instable', de+stabil+iseer 'destabilize', musik+al+iteit 'musicality', stabil+iteit 'stability'

c. *Non-native bases and native affixes*
on+stabiel 'instable', ver+typ+en 'to mistype', stabiel+heid 'stableness', activ+eer+baar 'activatable'

d. *Native bases and non-native affixes*
*in+zuiver 'impure', *de+huis '?dehome', *zuiver+iteit 'purity', *ver+huis+iseer '?cause-to-move-house'

Further evidence for a synchronic dichotomy of the Dutch vocabulary comes from phonology. Native morphemes have only one full vowel and use a restricted set of

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consonant clusters, whereas non-native morphemes may contain more than one full vowel and show fewer restrictions in the phonotaxis of consonant clusters (cf. Van Heuven, Hijzelendoorn and Neijt 1994). This stratal distinction is also reflected in the orthography of Dutch, that uses 'non-native' letters such as *x* and *qu* only in the non-native vocabulary. Stratal differences have been accounted for by levels of rule application (cf. Siegel 1974, Zwarts 1975, Kiparsky 1982, and Van Beurden 1987). However, this approach leads to ordering paradoxes, since non-native suffixation of words with native prefixation occurs, see Booij (2000).

Non-native complex words have various properties that are reminiscent of simplex words. First, prefixation with *ge-*, a very productive process, is possible in non-native prefixed words, but not in native prefixed words (De Haas and Trommelen 1993: 12), cf.:

(2) a. ge+de+marqueerd 'demarked', ge+ante+dateerd 'antedated'
b. *ge+be+merkt, *ge+ver+huisd, *ge+her+dacht, *ge+her+vertaald
c. bemerkt 'noticed', verhuisd 'moved home', herdácht 'commemorated/ celebrated' or hérdacht 'reconsidered', hervertaald 're-translated'

An exception to (2b) are complex verbs with *her-* such as *geherwaardeerd* and *geheranalyseerd* ('re-valued' and 'reanalysed'), that pattern with the non-native complex verbs for reasons unknown to us. Apart from this, (2) suggests that complex non-native words are simplex for past participle formation.

Another indication that the internal structure of native formations differs in a non-trivial way from the internal structure of non-native formations is provided by the distribution of word stress (Neijt and Zonneveld 1981: 220 and Van Beurden 1987: 27). Non-native complex words behave with respect to stress assignment rules as if they were simplex, cf. (3).

(3) *Simplex:* Mohámmed, stupíde
Complex: mòhammedáan, stùpiditéit

A final indication of the different internal structure of non-native complex words comes from spelling. Dutch orthography is a morpheme based system, but complex words that consist of non-native morphemes are spelled as if they were simplex (Nunn 1998: 92–95):

(4) a. *Native affixation*
troch**ee** – troch**eeërig** 'trochee, trochee-minded'
lim**ie**t – lim**ie**ten 'limit, limits'
b. *Non-native affixation*
troch**ee** – troch**e**ïsch 'trochee, trochaic'
lim**ie**t – lim**i**teer 'limit, to limit'

The morphemic status of the base is respected in (4a) but not in (4b). Historically, this spelling convention probably arose due to the borrowing of full words rather than stems. Of course, data from orthography must be used with care, since written language is governed by a set of principles superimposed on the spoken language. Nevertheless, the orthographic variability in the spelling of non-native stems in Dutch suggests that at the very least the morphemic status of these stems is less obvious to speakers of Dutch.

As pointed out by Booij (2002b: 186), Dutch native and non-native morphology differ in the use of phonologically cohering and non-cohering affixation. An affix is cohering if it forms a single prosodic word with its base. A non-cohering affix forms a word on its own. Native suffixes are either cohering or not, whereas "the non-native suffixes of Dutch are all cohering, i.e., they form one prosodic word with the stem to which they attach. Their phonological behaviour (syllabification, type of phonotactic patterns, location of main stress on the last stressable syllable of the word) is identical to that of simplex words." (Booij o.c.: 187). The distinction between cohering and non-cohering affixation largely coincides with the distinction between complex words in which the transition from base to affix is salient in terms of transitional probabilities versus words in which this transition is not salient. Hay (2000) and Hay and Baayen (2002) have shown that morphological categories with low transitional probabilities between base and affix tend to be more productive than morphological categories with high transitional probabilities. For instance, if the transition from the final segments of the base into the first segment of the suffix typically occurs within morphemes, then that suffix is more likely to be seen as unanalysable part of a simplex word. Conversely, if the transition from the base into the suffix hardly ever occurs within morphemes, then this may help listeners and readers to parse the word into its constituents. Interestingly, all non-native suffixes of Dutch listed by Booij (2002b: 188) are vowel-initial. Hence, their transitional probabilities from the base into the suffix will tend to be very high, resulting in words that are difficult to parse as they resemble simplex words.

Non-native complex words thus pose an interesting problem for linguistic description. On the one hand, their structure invites analysis (see e.g. Lüdeling, Schmid and Kiokpasoglou 2002). On the other hand, the question arises to what extent the structure that linguists can discern might be functional for the processes guiding language comprehension (see e.g. Wheeler and Schumsky 1980). The issue was discussed by Schultink (1978) and Uhlenbeck (1979). While Schultink proposed a fine-grained analysis of non-native suffixes forming feminine agent nouns, Uhlenbeck argued that such fine-grained structure does not reflect any psychological reality.

The present study addresses the question raised by Uhlenbeck by means of a series of experiments. Our aim is to establish to what extent the morphological structure of the non-native stratum of Dutch is psychologically real compared to the morphological structure of the native stratum of Dutch. Feminine agent nouns offer an excellent opportunity to address this question because they express exactly the same semantic function in both strata. In addition, both strata offer several suffixes that lend themselves for further experimental inquiry. Experiment 1 addresses the question of the parsibility of native and non-native suffixes. Following the methodology of Laudanna and Burani (1995), we presented complex pseudo-words in a visual lexical decision experiment. These complex pseudo-words consisted of either a native or a non-native pseudo-base coupled with a native or non-native existing feminine agent suffix. We expect that stratum distinctions are relevant in two ways. First, native suffixes will be easier to recognize than non-native suffixes, because of characteristics such as phonological and semantic transparency, frequency and productivity. This will make the pseudo-word more word-like, and therefore more difficult to reject. Second, pseudo-words formed with a base and a suffix of the same stratum are more difficult to reject than pseudo-words formed with a base and a suffix from different strata, because usually complex words contain morphemes form the same stratum. For this reason, within-stratum pseudo-words will be more word-like. Notice that this effect depends on recognition of the suffix, which we hypothesize to be easier for pseudo-words with a native suffix.

2. Experiment 1

Participants. 30 participants, mostly undergraduates at Nijmegen University, were paid to take part in this experiment. All were native speakers of Dutch.

Materials. We orthogonally contrasted two factors: the stratum, native versus non-native, of the base and the suffix. We constructed 120 pseudo-words, equally divided over the 4 different combinations. The 60 pseudo-bases for the non-native stratum were created by combining parts of existing non-native roots, using letter combinations that are specific to the non-native stratum (see Van Heuven et al., 1994). Examples are *elict, crytan*, and *auxor*. The 60 pseudo-stems for the native stratum were created by changing a number of phonemes in randomly selected existing words of Dutch, without violating the phonotactic and orthographic constraints that govern Dutch words. Examples are *bloer, dranel*, and *polk*.

We combined each base with two suffixes, an existing suffix from the native stratum (*-ster*, *-es*, and *-in*) and an existing suffix of the non-native stratum (*-rice*, *-euse*, and *-ica*). Each suffix was attached to 10 native stems and 10 non-native roots.

We printed two lists with 60 pseudo-words, such that each pseudo-base occurred only once in a given list. If a pseudo-stem occurred with a native suffix in the one list, it occurred with a non-native suffix in the other list, and vice versa. We paired the pseudo-words in this lexical decision experiment with 60 existing words, most of which were target words of Experiment 2. The experiment was preceded by 30 practice items, 15 words and 15 pseudo-words, with similar properties as the experimental materials.

Procedure. Participants were tested in groups of three in noise-proof experimental booths. They received standard lexical decision instructions. Each trial consisted of the presentation of a fixation mark (asterisk) in the middle of the screen during 500 ms, followed after 50 ms by the stimulus centered at the same position. Stimuli were presented on Nec Multisync color monitors in white upper-case 36 point Helvetica letters on a dark background. Stimuli remained on the screen for 1500 ms. Time-out occurred 2000 ms after stimulus onset. The total duration of the experiment was approximately 20 minutes.

Results. One target pseudo-word turned out to miss the final native suffix. This item and its paired variant with a non-native suffix were excluded from the data set. All remaining data points were retained for the analysis, because error rates were low, both by item and by subject. See Table 1.

A linear mixed effects model (henceforth LME, Pinheiro and Bates 2000; see also Baayen, Tweedie, and Schreuder 2002) fitted to the data revealed a main effect of the stratum of the base ($F(1,1683)=6.83$, $p=0.0090$) and an interaction of the stratum of the base and that of the suffix ($F(1,1683)=15.57$, $p=0.0001$). No significant contribution could be observed for the stratum of the suffix ($F(1,1683) < 1$). In other words, pseudo-words with non-native base forms elicited on average shorter response latencies (649 ms) than pseudo-words with native base forms (669 ms), but these averages have to be adjusted for the stratum of the suffix, leading to the cell means shown in Table 1. The logistic regression analysis of the numbers of correct and incorrect responses revealed only a significant interaction of the stratum of the base and the stratum of the suffix ($\chi^2_{(1)}=5.445$, $p=0.020$).

What this experiment shows is that the stratum of the base affects morphological processing as reflected in response latencies, but only when the suffix belongs to the native stratum. A difference in the stratum of the base does not matter for

Table 1. Reaction times (RT) and error percentages averaged over the complete data set for native and non-native bases and suffixes

Stratum Base	Stratum Suffix	Example	mean RT	mean Error
native	native	luiverin	679	4%
non-native	non-native	ectranice	663	3%
native	non-native	luiverica	658	2%
non-native	native	ectranes	634	2%

words with non-native suffixes. Conversely, the stratum of the base is important when the suffix belongs to the native stratum. If a native suffix is attached to a native pseudo-base, the resulting string is difficult to reject as real word of Dutch. But if a native suffix is attached to a non-native base, the combination can be rejected quickly.

We interpret this as indicating that the native suffixes, but not the non-native suffixes in our experiment, are detected by the processing system. If a native suffix is detected, and if at the same time the base has the phonotactic structure of a native base word, the orthographic string is very word-like and hence difficult to reject as a word of Dutch. This leads to long response latencies. On the other hand, if the native suffix is attached to a stem that has the phonotactic characteristics of a non-native base, an unusual situation is encountered. The situation is unusual because, although native suffixes may attach to non-native base words (as, e.g., in *serveerster*, 'female waiter'), they generally attach to native base words (roughly 2.5% of the words with the suffix *-ster* have a non-native base). The low probability of combinations of a native suffix with a non-native base makes strings like *ectranes* very un-word-like, allowing participants to reject such strings quickly.

The next experiment addresses the question of how existing words with suffixes creating female agent nouns are processed. The method used is lexical decision, as in experiment 1. We expect that native formations are morphologically more transparent than non-native formations, and that the reaction times correlate better with the family size of the base in native complex words than in non-native complex words. The family size of a word or affix is the number of different complex words in which this word or affix occurs. Complex words based on constituents with a large family size are processed faster than complex words based on constituents with a smaller family size, cf. De Jong (2002).

3. Experiment 2

Participants. 30 participants, mostly undergraduates at Nijmegen University, were paid to take part in this experiment. All were native speakers of Dutch.

Materials. Fifty-one words served as targets in this experiment. Thirty-one of these words were feminine agent nouns from the non-native stratum, the other twenty words belonged to the native stratum. Frequency and family size counts were obtained from the CELEX lexical database. The family size of a word is the number of different morphological forms available in the corpus. This measure predicts language behavior better than frequency, cf. De Jong (2002). Nine fillers brought the total number of words to 60, matching the 60 pseudo-words described for Experiment 1.

Procedure. The procedure was identical to that of Experiment 1.

Results and Discussion. One non-native noun was misspelled, and removed from the data set. Fourteen words elicited error rates of 30% or higher, and were discarded in the analyses of the response latencies. The remaining 13 native and 23 non-native words in the data set matched approximately with respect to the ranges of log frequency and log family size (native frequency: 4.8, native family size: 4.0; non-native frequency: 5.0, non-native family size: 4.8), but they did not match with respect to mean log frequency (native: 3.2; non-native: 3.8) and log family size (native: 2.5, non-native: 1.8). Because the sets of native and non-native words have different frequential properties, we analyse the two sets separately using linear regression. An LME analysis of the responses to the native nouns revealed main effects of frequency ($F(1{,}334)=28.76$, $p<0.0001$) and family size ($F(1{,}334)=13.63$, $p=0.0003$), as well as an interaction between these two factors ($F(1{,}334)=17.60$, $p<0.0001$). Response latencies are shorter for words with higher frequencies and larger families. The random effects level of the LME model revealed individual differences between the participants with respect to word frequency (standard deviation: 42.92; log-likelihood ratio 34.3, $p<0.0001$).

The corresponding analysis for the non-native nouns revealed a facilitating significant main effect of frequency ($F(1{,}587)=86.34$, $p<0.0001$) and a facilitating effect of family size approaching significance ($F(1{,}587)=3.34$, $p=0.0682$). The random effects level of the model again showed that the participants differed with respect to the extent to which they are sensitive to the frequency manipulation (standard deviation 17.29; log-likelihood ratio 9.51, $p=0.0086$).

A comparison of the 95% confidence intervals for the coefficients of the LME models for the native and non-native nouns revealed that the effects of frequency and family size are much stronger, and significantly so, for the native nouns (see Table 2). Note that the confidence interval for family size for the non-native nouns includes 0, indicating that the family size effect for non-native nouns is small and possibly non-existent.

Logistic regression analyses of the numbers of correct and incorrect responses for the native and non-native nouns revealed significant effects of frequency ($\chi^2_{(1)}=14.83$,

Table 2. The 95% confidence intervals for the coefficients for family size and lemma frequency for the native and non-native nouns in Experiment 2.

	native nouns			**non-native nouns**		
	lower	**estimate**	**upper**	**lower**	**estimate**	**upper**
family size	−259.58	−184.93	−110.28	−20.19	− 9.73	0.73
frequency	−333.83	−240.11	−146.39	−64.07	−52.72	−41.38

$p=0.0001$) and family size ($\chi^2_{(1)}=21.32$, $p<0.0001$) for the native words, and an effect of family size only for the non-native nouns ($\chi^2_{(1)}=15.12$, $p=0.0001$).

What this experiment shows is that the effects of frequency and family size in the reaction times are larger for native words than for non-native words. The error data reveal a similar pattern. We interpret these results as indicating that non-native nouns have less well-established representations (as indicated by the reduced frequency effects) and that non-native nouns are only superficially embedded in the network of morphosemantic relations.

Our final experiment addresses the generalisability of the results obtained thus far, which are based on a very limited set of suffixes. It might be argued that we have been measuring differences between individual suffixes rather than differences that find their origin in a difference between the native and non-native strata of Dutch. Experiment 3 therefore considers the full range of suffixes. The very different properties of the suffixes involved necessitate the use of a regression design. We have opted for using the 625 female agent nouns listed in CELEX. Given this large number of words, for practical reasons, we made use of a subjective frequency rating task instead of visual lexical decision. We expect that a higher frequency and a larger family size of the base of native complex words, but not of the base of non-native complex words, correlate with higher subjective frequency ratings. With this number of items, a small number of participants is sufficient to obtain statistical power.

4. Experiment 3

Participants. 7 participants, mostly undergraduates at Nijmegen University, took part in this experiment. All were native speakers of Dutch.

Materials. We selected all feminine agent nouns listed in the Dutch lemma lexicon of the CELEX lexical database, which resulted in a list of 625 nouns, with in all 18 different suffixes, of which four belong to the native stratum (*-ster, -es, -in, -se*) and fourteen to the non-native stratum (*-ette, -euse, -esse, -a, -ica, -ice, -ienne, -iere, -ina, -ine, -ita, -itsa, -rice, -trix*). Seven lists were constructed, in which these 625 words appeared in a different random order.

Procedure. The participants were asked to rate the words on a seven-point scale. They were instructed to estimate the frequency of these words in the language community, and to abstract away from their own familiarity with these words, which might be biased due to their own specific interests.

Results and Discussion. Of the 625 nouns in the rating, 423 were derived words and 202 were compounds. We discarded the compounds in our analyses, as subsequent research by De Jong, Feldman, Schreuder, Pastizzo, and Baayen (2002) revealed that compounds behave differently with respect to family counts from derived words. A regression analysis with by-item rating (averaged over the seven ratings of the participants) as a function of lemma frequency, family size, stratum, and suffix, revealed a main effect of frequency ($F(1,403)=541.2$, $p<.0001$; higher-frequency words elicited higher ratings), a main effect of family size ($F(1,403)=26.95$, $p<.0001$; words with a greater family were rated higher), as well as an interaction of family size, stratum, and suffix ($F(15,403)=3.8$, $p<.0001$). To understand this interaction, we carried out separate analyses of the native and non-native words. In the case of the native words, main effects emerged for frequency ($F(1,280)=394.0$, $p<.0001$), family size ($F(1,280)=9.6$, $p=0.0022$), and suffix ($F(3,280)=4.2$, $p=0.0065$). In the case of the non-native words, there was a main effect of frequency ($F(1,107)=133.6$, $p<.0001$) as well as a main effect of suffix ($F(13,107)=2.5$, $p=0.0045$). There was no significant main effect of family size ($F(1,107)=3.4$, $p=0.0675$), but an interaction of family size and suffix ($F(11,107)=2.24$, $p=0.0170$). This interaction shows that the effect of family size in the non-native stratum depends on the suffix. An inspection of the beta weights for the interaction terms suggests that the family size effect in the non-native stratum is carried most prominently by the suffix *-rice*, one of the two non-native suffixes that is not vowel-initial. In the set of native suffixes, *-ster* is the only suffix that is not vowel-initial. This suffix carries the family size effect better than -es, but not better than *-in*.

We conclude that experiment 3 provides further support for the conclusions derived from experiment 2, using a broader range of feminine agent suffixes. For native complex words, the subjective frequency ratings strongly correlate with family size of the base, for non-native complex words, the correlation found is not significant. The individual differences between suffixes need further investigation.

5. General discussion and conclusion

The present study addresses the psycholinguistic reality of the internal structure of non-native complex words in Dutch. To answer this question, we have used feminine agent nouns. In Dutch, various feminine agent suffixes are available, both in the native and in the non-native stratum and all these suffixes have the same semantic function. Experiment 1 revealed that Dutch subjects detect the presence of native suffixes, but not the presence of non-native suffixes in pseudo-words. When a native suffix is attached to a native pseudo-base, the resulting complex word is difficult to reject as an existing word. Conversely, when a native suffix is attached to a non-native pseudo-base, the resulting complex word is easy to reject as an existing word. Thus, experiment 1 documents the relevance of the stratal distinction for both the suffix and the base.

Experiments 2 and 3 further address the role of the base. Experiment 2 revealed robust frequency and family size effects for native words. For non-native words, a smaller but significant frequency effect could still be observed but there was no significant effect of family size. We interpret the family size effect as an indicator of the representation of morphological structure in the mental lexicon. More specifically, the greater relevance of family size for the native words suggests that the native feminine agent nouns are more tightly integrated in the network of morphological relations in the mental lexicon than are the non-native words. Because family size counts are highly correlated with the frequencies of the base words, and since base frequency effects are often interpreted as indicating on-line parsing, our results can also be interpreted as indicating parsing for native words, and full form retrieval for non-native words. Experiment 3 provides further support for these conclusions using the full set of feminine agent nouns available in the CELEX lexical data base. Subjective frequency ratings correlated with family size counts of native feminine agent words, but not of non-native feminine agent words, with the exception words in -*rice*, a non-cohering suffix. The relation between family size counts and the distinction between cohering and non-cohering affixation is an issue of further investigation.

The stronger word frequency and family size effects observed for native nouns is probably correlated with a difference in age of acquisition for the words in the native and non-native strata (De Jong 2002). Many non-native complex words are acquired late, often as late as the first year of secondary school. Thus, the non-native morphology suffers from a double disadvantage. First, many non-native complex words become useful for the speaker at a relatively late stage in the acquisition process and for many speakers they remain 'difficult' words. Second, the cohering nature of non-native suffixes renders parsing especially difficult. Not surprisingly, non-native feminine agent suffixes are far less productive than their native counterparts.

Although we agree with Schultink that words such as *ambassadrice* 'female ambassador' and *masseuse* 'idem' call for morphological analysis, just as native words such as *verpleegster* 'nurse', we also agree with Uhlenbeck that it is unlikely that some form of morphological decomposition of *ambassadrice* and *masseuse* would actually take place in the mental lexicon.

Note

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