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Development of rule-based verb spelling in Dutch students

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Although verb spelling is rule-based, it is a relatively difficult aspect of Dutch orthography. Assink (1985) was the first to show that Dutch verb spelling is affected by two factors, namely, frequency of occurrence of the verb and the context in which the verb appears. This study is a developmental follow-up on his work, in which students of two age groups and three different levels of education, that is, students from primary school, secondary school, and university students, participated. It appeared that frequency and context already affect spelling behavior in the early stages of learning to spell. These aspects are still prominent determinants in the group of most experienced and good spellers, albeit the relative contribution of each of the determining factors changed over time. The interpretation of these findings was that verb-spelling performance in Dutch is not just the result of its inherent difficulty, it is also affected by the fact that it requires continuous active monitoring of the spelling process, while being involved in a main literacy activity.

Spelling is more difficult than reading in almost all alphabetical languages, including Dutch. This is not only true for beginning readers and spellers, or children with dyslexia, experienced readers and spellers also read more words correctly than they can spell. It is unusual for experienced readers to be in a doubt about how to read the word '*quandary*', but when asked to spell, they might be in a '*quandery*' about the spelling of '*quandary*'. Bosman and Van Orden (1997) presented theoretically motivated reasons for the asymmetry between reading and spelling. An important linguistic reason is that relationships between phonemes and graphemes (decoding sounds into letters) are more inconsistent than relationships between graphemes and phonemes (decoding letters into sounds). Stated differently, in most alphabetic languages there are generally more possible spellings for a particular word than possible readings. For example, the English phoneme [i] is spelled EE in '*deep*' and EA in '*heap*', which

renders this phoneme in the word ending [ip] ambiguous for spelling but not for reading. An example from the Dutch language is the phoneme [au], which has four different spellings and one reading, AU in 'au' [ow/ouch], AUW in 'gauw' [quick], OU in 'kou' [cold], and finally OUW in 'mouw' [sleeve]. Another, more social, reason why spelling is more difficult than reading is that we are generally less engaged in spelling than in reading, which enhances the linguistically-based asymmetry between spelling and reading.

Thus, spelling is difficult because a speller has to solve the phoneme-grapheme ambiguities that the orthography presents to her or him. An incorrect choice of a grapheme usually leads to the spelling of a pseudohomophone, a word with phonology of an extant word but with illegal orthography (i.e., 'keap' is a pseudohomophone of the English word 'keep'). In some cases, however, the misspelling is a homophone of the intended spelling. Homophones are extant words with identical phonology, but with different, albeit legal, orthography (e.g., 'dear' and 'deer', or 'none' and 'nun' are English homophone pairs). The spelling of these homophones is semantically determined and can provide problems for the speller. Dutch also has a fair number of semantically-determined homophones (e.g., 'zij' [she] and 'zei' [said], or 'rauw' [raw] and 'rouw' [sorrow]), but unlike English, the majority of Dutch homophones are not found within the set of semantically-based homophones, but rather within the grammatically-determined homophones of verb spellings, which is a conjugational system. Dutch grammatically-determined spelling is not synonymous with verb spelling, but constitutes a major part of it.

The crucial difference between semantically-determined and grammatically-determined spellings is that grammatically-determined spellings are rule based, whereas semantically-determined spellings are not. This provides the conjugation of Dutch verb spelling with a distinct advantage: Apply the rules (correctly) and the spelling will be correct. Although grammatically-determined spellings are rule-based and thus in principle solvable, they often present more problems to Dutch readers and spellers than semantically-determined spellings (Assink, 1982, Sandra, Frisson, & Daems, 1999; van der Velde, 1956; van Heuven, 1978).

The first study on Dutch verb spelling that aimed at investigating factors that determine verb-spelling performance was performed by Assink (1985). Assink's empirical study was targeted at a notoriously difficult aspect of verb spelling in Dutch, the spelling of so-called 'weak-prefix verbs'. In 1982, Assink showed that weak-prefix verbs constituted one of the most difficult aspects of verb spelling even in very experienced spellers (i.e., university students).

Weak-prefix verbs present a specific difficulty, because the present tense singular is a homophone of the past participle. For example, the present tense singular of the weak-prefix infinitive 'gebeuren' [to happen] is 'gebeurt' [happens] and the past participle form is 'gebeurd' [(has/had) happened]; these two forms are homophonous to each other, because in Dutch a final 'd' is devoiced and is pronounced 't'. The fact that the grammatical contexts of these verbs determine the words' endings is not the only difficulty involved in spelling weak-prefix verbs. An additional problem is presented by the existence of weak verbs *without* a prefix, because the past participles of these verbs are generally formed by adding a prefix. For example, the present tense singular of the weak verb 'horen' [to hear] is 'hoort' [hears], but the past participle is 'gehoord' [heard]; the prefix 'GE' is put in front of the verb and a final 'd' is added in the majority of the cases. The fact that the majority of Dutch past participles are formed by adding a prefix at the beginning of the word and a 'd' at the end confuses many spellers when spelling the past participle of weak-prefix verbs (cf. Sandra et al., 1999). Not because they err in adding an additional prefix, as in 'gegebeurd', because all native speakers of Dutch know the proper past participle, but rather because prefixed verbs suggest that it is a past participle, and thus should have a final 'd', which could cause errors when in fact the weak-prefix verb is a present tense singular. More details on this aspect of Dutch verb spelling is presented in Assink (1985, 1987a)

The important question of Assink (1985) was: What makes the spelling of weak-prefix verbs in Dutch so difficult? After all, students in Dutch primary school are taught the rules that underlie grammatically-determined verb spelling, and consequent application of these rules always leads to the proper spelling. Is the rule too complex and are students unable to apply them or are specific factors affecting the spelling of weak-prefix verbs? Assink found that spelling performance of students attending a school for low-level vocational education, was affected by two factors, namely, frequency and syntactical context. If the present-tense-singular form of the weak-prefix verb (always requiring a final 't') was more frequent than its past-participle form (here always requiring a final 'd'), students were more inclined to spell the verb with final 't'. If on the other hand the past-participle form (i.e., final 'd') was more frequent than its present-tense-singular form (i.e., final 't'), students preferred a final 'd'. The manipulation of sentence context showed, that if the information regarding the syntactical status of the verb was such that it facilitated determining its status (facilitating context), that is, when the qualifying word stood next to the prefix verb, students were more likely to spell the weak-prefix verb

correctly than in the case the qualifying word was separated by one or more words (neutral context) or when the context provided conflicting information. In the conflicting-sentence contexts, the qualifying word could be separated by one or more words, and at the same time an irrelevant auxiliary verb, belonging to a subclause in the sentence, was placed close to the weak-prefix verb to be spelled. The irrelevant word provided misleading information regarding the syntactical status of the weak-prefix verb, causing students to misspell the weak-prefix verbs in a conflicting context (and in a neutral context) more often than in a facilitating context.

Although students' overall spelling performance was at chance level (51.8% correct), there were systematic influences of both word frequency and syntactical context on their verb-spelling performance, with the effect of frequency being strongest. Thus, these results indicate that students whose educational level is relatively low are *not* completely unaware of the fact that grammatical rules underlie the spelling of weak-prefix verbs. One of the questions that emerge from Assink's findings is: Is it enough for spellers to be fully aware of the rules underlying this specific problem in order to correctly spell weak-prefix verbs? If so, students with a high-educational level should not make any mistakes when spelling weak-prefix verbs, apart from random errors, whereas students who are still practicing the grammatical rules underlying verb spelling, might be affected by the syntactical context of the verb, and perhaps by the frequency of occurrence of the verbs.

Sandra et al. (1999, see also Frisson & Sandra, 2002) confirmed Assink's (1985) findings in a similar study (Experiment 2) with 18-year-old students from secondary school. Moreover, Experiment 1 of Sandra et al.'s study revealed similar findings for the spelling of another Dutch verb-spelling difficulty, the choice between the homophone pair '*treed*' and *treedt*'. The former is the first person singular present tense, '*ik treed*' [I tread] and the latter the second or third person singular present tense, '*jij of zij treedt*' [you or she treads].

The present study is based on the early work of Assink (1985). The main goal is to investigate the development of weak-prefix-verb spelling in three groups of spellers: Students attending primary education, who are in the process of learning the verb-spelling rules, students attending secondary education who should have mastered most of the verb-spelling rules, and students attending university, who should have perfect command of the grammatical rules underlying verb spelling. More specifically, my question is: Are context and frequency factors that only affect the onset of the acquisition of grammatically-based knowledge or do they constitute a fundamental aspect of verb

spelling in all Dutch spellers? Three additional issues concerning meta-cognitive knowledge were also investigated in the present study. The first pertained to students' awareness of their spelling skill regarding the spelling of weak-prefix verbs. It is expected that with increasing educational level, students' awareness of verb-spelling skill will increase. The second issue involved students' awareness of the obligatory application of rules. Proper verb spelling in Dutch requires conscious application of the grammatical rules, which leads to the expectation that students who said to have used the rules showing better verb-spelling performance than those who said they did not. The third topic concerned students' bias to spell a 'd' rather than a 't' at the end of weak-prefix verb in the case of present tense. Because the prefix in verbs suggests that the verb is actually a past participle, which is usually spelled with a final 'd', it is predicted that spellers who are still in the process of learning grammatically-based verb spelling are inclined to err on the side of final 'd' rather than final 't'.

Method

Participants

In this study participated three different groups of students from the Netherlands, who were all native speakers of Dutch. The first group consisted of students attending either Grade 5 or Grade 6 of one of five primary schools ($n = 87$, 45% boys and 55% girls, $M = 10$ years 8 months). The second group consisted of students attending a school for secondary education ($n = 119$, 45% boys and 55% girls, $M = 15$ years and 6 months). The third group consisted of first-year psychology students from the University of Amsterdam ($n = 405$, 34% men and 66% women, $M = 22$ years). All three groups were divided in a younger and an older sub-sample. Primary-school students who were 9 or 10 years old ($n = 33$) were considered young, whereas primary-school students who were 11 or 12 were considered old ($n = 54$). Secondary-school students who were 14 or 15 years old were considered young ($n = 54$), whereas secondary-school students who were 16 or 17 were considered old ($n = 64$). University students who were between 18 or 20 were considered young ($n = 206$), and those who were 21 or above were old ($n = 193$). The numbers of the sub-samples do not always add up to the total number of participants due to missing age values.

Materials and Procedure

The grammar test developed by Assink (1985) constituted the materials used in this study. The test consisted of 72 sentences each containing either the present-tense-singular form of a weak-prefix verb ($n = 36$, always requiring a final 't') or the past-participle form ($n = 36$, always requiring a final 'd'). The frequency variable had three conditions: Weak-prefix verbs that required the high-frequency variant of the homophone pair, weak-prefix verbs that required the low-frequency variant of the homophone pair, and weak-prefix verbs that required the variant of a homophone pair with equal frequencies. The frequency conditions are referred to as high-frequency, low-frequency, and equal-frequency, respectively (Uit den Bogaart, 1975, see for details Assink, 1985). Each condition contained 8 verbs, 4 required a final 't' (representing the present-tense-singular form) and 4 required a final 'd' (representing the past-participle form), making a total of 24 verbs. The syntactical-context variable also had three conditions: A facilitating-sentence context, in which the qualifying word was next to the weak-prefix verb to be spelled, a neutral context, in which there were one or more words between the qualifying word and the weak-prefix verb to be spelled, and a conflicting context, in which the qualifying word could be separated by one or more words, and at the same time an irrelevant auxiliary verb suggesting a past-participle, but actually belonged to a sub clause in the sentence, was placed close to the weak-prefix verb to be spelled. The test consisted of 24 facilitating-sentence contexts, 24 neutral-sentence contexts, and 24 conflicting-sentence contexts. A full orthogonal design was the result. In each context condition an equal number of high-frequency, equal-frequency, and low-frequency verbs occurred, half requiring a final 'd' and half a final 't'. The entire test is presented in the Appendix of Assink's 1985 publication.

The test was printed on three A4 sheets of paper with each sentence on a separate line and three dots at the end of the target verb to indicate where a 'd' or 't' was required. In the present study, two questions regarding meta-cognitive spelling knowledge were added at the end of the test. The first question was "How many of those 72 verbs that you had to spell do you think are wrong?" The second question was "Did you use a spelling rule, did you simply know the answer, or did you use both strategies to come up with the answer?"

The students in primary and secondary education were tested during a regular school hour. The experimenter gave them oral instructions, asking them to add either a 'd' or a 't' in the space left open following the target verb. All university students had to take the test during an evening to fulfill course requirements. They were presented with written instructions.

Results and Discussion

Before analyzing the data of each of the student groups separately, a comparison will be made between the mean numbers of errors of all three groups with regard to gender. A 2 (gender: male vs. female) \times 3 (student group: primary school vs. secondary school vs. university) ANOVA on the percentages correctly spelled verbs revealed significant main effects and no interaction ($F < 1$). Although the difference between male and female participants was only 2 items on a total of 72, the effect of gender revealed that girls or women ($M = 76.0\%$, $SE = 1.00$) outperformed boys or men (73.0% , $SE = 1.12$), $F(1, 604) = 4.01$, $p < .05$, *partial* $\epsilon^2 = .007$. The main effect of student group revealed a more substantial effect, $F(2, 604) = 157.91$, $p < .0001$, *partial* $\epsilon^2 = .34$. Subsequent contrasts revealed significant differences (all p 's $< .0001$) between all student groups, with a mean score of 56.6% ($SE = 1.59$) for primary-school students, a mean score of 79.0% ($SE = 1.36$) for secondary-school students, and a mean score of 88.0% ($SE = .77$) for university students. An independent sample t test on the mean score (56.6%) of the students from primary education revealed that their scores deviated significantly from chance level, $t(86) = 5.21$, $p < .0001$. Although gender appeared to affect the test scores, it was decided not to further investigate the role of gender, because it affected all three students group to the same degree, and the effect was rather limited.

An overall analysis of variance with student group as between-subjects factor, and frequency and context as within-subject factors yielded two crucial significant interactions: One between context and student group, ($F(4, 1216) = 9.12$, $p < .0001$, *partial* $\epsilon^2 = .029$), and the other between frequency and context ($F(4, 2432) = 3.72$, $p < .005$, *partial* $\epsilon^2 = .006$). The main effects of frequency ($F(2, 1216) = 19.85$, $p < .0001$, *partial* $\epsilon^2 = .032$) and of context, $F(2, 1216) = 120.40$, $p < .0001$, *partial* $\epsilon^2 = .165$) were also significant. These results indicated that separate analyses for each of the students groups were more appropriate. All subsequent analyses will be performed on the mean percentages correctly spelled verbs, to enable easy comparisons among different student groups. Each section starts with the presentation of the results of a 2 (age: young vs. old) \times 3 (frequency: high vs. equal vs. low) \times 3 (context: facilitating vs. neutral vs. conflicting) ANOVA on subjects' mean percentages correctly spelled verbs with age as between subjects factor, and frequency and context as within factors. Then the students' estimated number of errors will be correlated with their actual number of errors. Subsequently, the effect of strategy on the number of correct items will be investigated. Finally, the issue of bias towards using a 'd' rather than 't' will be tested.

Table 1. Mean percentages correct of all three students groups

| Frequency | Syntactical context | | | Total |
|---------------------------|---------------------|------------|-------------|------------|
| | Facilitating | Neutral | Conflicting | |
| Primary-school students | | | | |
| High | 60.1 (2.0) | 54.5 (1.9) | 56.4 (2.1) | 57.0 (1.6) |
| Equal | 60.1 (2.0) | 54.4 (1.6) | 56.4 (2.0) | 57.0 (1.5) |
| Low | 56.2 (2.2) | 51.6 (2.1) | 54.1 (2.2) | 54.0 (1.9) |
| Total | 58.5 (1.5) | 53.5 (1.3) | 55.7 (1.3) | 56.0 (1.2) |
| Secondary-school students | | | | |
| High | 88.0 (1.7) | 79.3 (1.7) | 78.4 (2.1) | 81.9 (1.6) |
| Equal | 88.6 (1.7) | 79.3 (2.2) | 76.1 (2.0) | 81.3 (1.8) |
| Low | 83.3 (1.8) | 74.5 (2.3) | 75.9 (2.3) | 77.9 (2.0) |
| Total | 86.6 (1.6) | 77.7 (1.8) | 76.8 (1.9) | 80.4 (1.7) |
| University students | | | | |
| High | 93.5 (0.6) | 88.2 (0.8) | 87.6 (0.8) | 89.8 (0.6) |
| Equal | 93.3 (0.7) | 89.6 (0.9) | 85.3 (0.9) | 89.4 (0.7) |
| Low | 91.4 (0.8) | 86.0 (1.0) | 86.0 (0.9) | 87.8 (0.8) |
| Total | 92.8 (0.6) | 87.9 (0.8) | 86.3 (0.7) | 89.0 (0.7) |

Note. SE in parentheses

Primary-school students

The upper section of Table 1 presents the mean percentages correctly spelled verbs of students in primary education in each of the experimental conditions. The analysis of variance indicated that none of the interaction effects reached significant levels. The main effect of age showed that older students ($M = 61.4\%$, $SE = 1.5$) had higher mean scores than younger ones ($M = 50.6\%$, $SE = 1.9$), $F(1, 85) = 19.94$, $p < .0001$, $partial \epsilon^2 = .19$. The main effect of frequency was not significant ($F(2, 170) = 1.61$, $p = .20$, $partial \epsilon^2 = .02$), but the main effect of context was $F(2, 170) = 10.19$, $p < .0001$, $partial \epsilon^2 = .11$. The significant quadratic trend of context revealed that the facilitating context was easier than both the neutral and the conflicting contexts, $F(1, 85) = 14.04$, $p < .0001$, $partial \epsilon^2 = .14$.

The correlation between the number of estimated errors and the actual number of errors was small and insignificant ($r = .04$, $p = .70$). In the group of primary-school students, 38% said to have used rules to spell the verbs, 3% indicated that they had orthographic knowledge, and 59% said to have used both strategies. Because only three students said to have used orthographic knowledge they were added to the group who used both strategies. A one-way ANOVA on the number of correctly spelled verbs with strategy as factor (rule application vs. both) revealed a non-significant effect of strategy, $F(1, 83) = 1.67$,

$p = .20$. An analysis of variance on the number of 'd'- and 't'-errors revealed a significant effect, $F(1, 86) = 68.69, p < .0001$. In 28% of the cases a 't' was spelled where a 'd' had to be added to the verb, whereas in 57% of the cases a 'd' was spelled where a 't' had to be added (65% 'd'-spellings, and 35% 't'-spellings).

To summarize, older primary-school students were better at verb spelling than younger ones. The frequency of the verbs did not affect students' performance, but the context in which they appeared did. A facilitating context led to better performance than a neutral or conflicting context. Meta-cognitive awareness with respect to verb spelling in this group was almost absent: No correlation between estimated number of errors and actual number of errors, and no effect of strategy use on the number of correctly spelled words. Although a substantial number of students attending primary education said to have used rules to spell the verbs, they were still more inclined to spell a 'd' rather than a 't'.

Secondary-school students

The middle section of Table 1 presents the mean percentages correctly spelled verbs of students in secondary education in each of the experimental conditions. The analysis of variance revealed significant main effects of frequency ($F(2, 232) = 8.94, p < .0001, \text{partial } \epsilon^2 = .07$) and of context ($F(2, 232) = 61.11, p < .0001, \text{partial } \epsilon^2 = .35$), but a non-significant effect of age ($F < 1$). The significant quadratic trend of frequency revealed that high-frequency and low-frequency verbs were both easier than low-frequency verbs, $F(1, 116) = 4.10, p < .05, \text{partial } \epsilon^2 = .03$. The significant quadratic trend of context showed that the facilitating context was easier than both the neutral and the conflicting contexts, $F(1, 116) = 28.37, p < .0001, \text{partial } \epsilon^2 = .20$.

The effect of context was qualified by the significant interaction effect between age and context, $F(2, 232) = 4.97, p < .01, \text{partial } \epsilon^2 = .04$. In the group of younger secondary-education students, the facilitating context was significantly easier than the neutral and the conflicting contexts (Fisher's *PLSD*, both p 's $< .0001$), whereas the neutral and conflicting contexts were equally difficult. In the group of older secondary-education students, the facilitating context was significantly easier than the neutral context (Fisher's *PLSD*, $p < .001$), which in turn, was significantly easier than the conflicting context (Fisher's *PLSD*, $p < .01$).

The effect of context was also qualified by a marginally significant interaction between frequency and context, $F(4, 464) = 2.01, p < .10, \text{partial } \epsilon^2 = .02$.

In both the facilitating and neutral condition a significant effect of frequency emerged, $F(2, 236) = 12.03, p < .0001$, and $F(2, 236) = 5.61, p < .01$, respectively. In the facilitating and neutral contexts, high-frequency verbs and equal-frequency verbs were significantly easier than low-frequency verbs (Fisher's *PLSD*, all p 's $< .01$), whereas the high-frequency and equal-frequency verbs were equally easy. The conflicting context did not show a significant effect of frequency, indicating that high-frequency, equal-frequency, and low-frequency verbs were equally difficult, $F(2, 236) = 1.68, p = .19$.

The correlation between the number of estimated errors and the actual number of errors was large and significant ($r = .60, p < .0001$). In the group of secondary-school students, 16% said to have used rules to spell the verbs, 14% indicated that they had orthographic knowledge, and 70% said to have used both strategies. A one-way ANOVA on the number of correctly spelled verbs with strategy as factor (rule application vs. orthographic knowledge vs. both) revealed a non-significant effect of strategy, $F < 1$. An analysis of variance on the number of 'd'- and 't'-errors yielded a significant effect, $F(1, 118) = 8.25, p < .005$. In 16% of the cases a 't' was spelled where a 'd' had to be added to the verb, whereas in 23% of the cases a 'd' was spelled where a 't' had to be added (54% 'd'-spellings, and 46% 't'-spellings).

To summarize, older secondary-school students were no better at verb spelling than younger ones. However, older students found facilitating contexts easier than neutral, which they considered easier than conflicting contexts, whereas younger students found neutral and conflicting contexts equally difficult, and more difficult than facilitating contexts. All students found high-frequency and equal-frequency verbs easier than low-frequency verbs, and they spelled verbs in facilitating contexts better than in neutral or conflicting students. The effect of verb frequency did, however, depend on the context in which the verb appeared. Only in the facilitating and neutral context were high- and equal-frequency verbs easier than low-frequency verbs. In the conflicting-context condition all frequency conditions were equally difficult. Development of meta-cognitive awareness in secondary-school students only emerged in their knowledge of the number of estimated errors, strategy use did not affect meta-cognitive awareness of overall spell skill. Moreover, they were more inclined to spell a 'd' rather than a 't'.

University students

The lower section of Table 1 presents the mean percentages correctly spelled verbs of students in first year of university in each of the experimental conditions. The analysis of variance revealed significant main effects of frequency ($F(2, 794) = 10.10, p < .0001, \text{partial } \epsilon^2 = .03$) and context ($F(2, 794) = 118.04, p < .0001, \text{partial } \epsilon^2 = .23$), and a significant interaction of frequency and context ($F(4, 1588) = 7.48, p < .0001, \text{partial } \epsilon^2 = .02$). The main effect of age was not significant nor were any of the remaining interactions. The marginally significant quadratic trend of frequency revealed that high-frequency and equal-frequency verbs were both easier than low-frequency verbs, $F(1, 397) = 3.57, p < .06, \text{partial } \epsilon^2 = .009$. The significant quadratic trend of context showed that the facilitating context was easier than both the neutral and the conflicting contexts, $F(1, 397) = 17.32, p < .0001, \text{partial } \epsilon^2 = .04$.

With respect to the interaction between frequency and context, significant main effects of frequency occurred in all three-context conditions, albeit the pattern diverged within conditions. In the facilitating and neutral conditions, high-frequency and equal-frequency verbs were equally easy to spell, and they were both easier than low-frequency verbs (Fisher's *PLSD*, both p 's $< .01$). In the conflicting condition, however, high-frequency verbs were easier than equal-frequency and low-frequency verbs (Fisher's *PLSD*, both p 's $< .05$), but the latter two conditions were equally easy.

The correlation between the number of estimated errors and the actual number of errors was large and significant ($r = .71, p < .0001$). In the group of university students, 29% said to have used rules to spell the verbs, 11% indicated that they had orthographic knowledge, and 60% said to have used both strategies. A one-way ANOVA on the number of correctly spelled verbs with strategy as factor (rule application vs. orthographic knowledge vs. both) revealed a significant effect of strategy, $F(2, 387) = 20.37, p < .0001$. Students who said to have used rules had significantly more verbs spelled correctly ($M = 93\%$) than those who said to have used both strategies ($M = 89\%$; Fisher's *PLSD*, $p < .02$), who, in turn, had significantly more verbs spelled correctly than those who said to have orthographic knowledge ($M = 78\%$; Fisher's *PLSD*, $p < .0001$). An analysis of variance on the number of 'd'- and 't'-errors revealed a non-significant effect, $F(1, 404) = 1.59, p = .21$. In 12% of the cases a 't' was spelled where a 'd' had to be added to the verb, whereas in 11% of the cases a 'd' was spelled where a 't' had to be added (50% 'd'-spellings, and 50% 't'-spellings).

To summarize, older university students were no better at verb spelling than younger ones. Both frequency and context affected verb-spelling performance

in this group. Students found high-frequency and equal-frequency verbs easier than low-frequency verbs, and they spelled verbs in facilitating contexts better than in neutral or conflicting students. The conflicting-context condition yielded largest difficulties, because equal-frequency verbs (and low-frequency verbs) were relatively difficult to spell, whereas in the neutral and facilitating conditions equal-frequency verbs (and high-frequency verbs) were relatively easy to spell. University students have relatively good meta-cognitive knowledge of their verb-spelling skill, as shown by the relative high correlation between estimated number of errors and actual number of errors, the fact that students who said to have used the rule strategy showing superior (but not perfect) spelling performance, and a similar tendency of spelling a 'd' or 't'.

General Discussion

The main issue in this study concerned the development of verb spelling in Dutch students, particularly the spelling of weak prefix verbs. As expected, verb-spelling performance increased with age. University students made fewer errors than students attending secondary education, who in turn, made fewer errors than students attending primary education. Although performance of the primary-school students was relatively low, their mean score was above chance level, indicating awareness of the rules underlying the spelling of weak-prefix verbs. Moreover, a comparison between the overall mean score of the primary-education students of the present study (56.5%) and those of the low-level-education students (51.8%), aged 16 to 18, from Assink's study (1985) showed that, without further practice verb-spelling skill deteriorates significantly, $t(200) = -2.54, p < .006$ (one-tailed).

Contrary to the expectation, verb-spelling performance of university students was far from perfect; only 12.8% of the students made no errors at all, and 26.7% of them made 1 or 2 errors. The average number of errors was 11.5%. In fact, 35% of this university population had more than 10% errors, which is a little better than a similar population investigated by Assink (1987b). In his sample of university students, 45% had more than 10% errors. It has to be noted that the verb-spelling test he used encompassed a larger variety of verb-spelling problems than the weak-prefix verbs used in this study.

With respect to age within each student group, it appeared that only the younger group in primary-education had significantly lower scores than the older students. This overall age effect disappeared in students who were

more advanced, that is, the secondary-education students and university students, indicating that a major part of the learning process occurs in primary education.

The overall effect of frequency differed in the three student groups. No effect of frequency emerged in the group of primary-education students, whereas students attending secondary education and university considered high-frequency and equal-frequency verbs easier than low-frequency verbs. The fact that verb frequency did not affect the spelling performance in primary-education students suggests that the frequency variable may not yet be applicable to this group of students. After all, verb frequency was based on a corpus of occurrence in adult literacy (Uit den Bogaart, 1975). Interestingly, in the sample of Assink, who studied secondary-education students attending a school for low-level vocational education, frequency affected the behavior of the students more than context did. This seems to contradict the present results, in which context had the stronger (in fact only) effect in the students attending primary school. However, as said frequency was based on an adult corpus, and Assink's sample (aged 16 to 18) has had ample opportunity to be exposed to literature that represents frequencies of adult corpora. Additionally, the fact that context had a lesser effect in Assink's sample also indicates that they either forgot how to apply the rule or were less aware of the rules underlying verb spelling. The fact that the primary-education students in the present study were affected by context underlines the assumption that they are busy learning about rule-based verb spelling.

The overall effect of context was identical in all three student groups and mimicked the results in Assink's (1985) original study: The facilitating context yielded better performance than the neutral and conflicting contexts, and the neutral and conflicting contexts appeared to be equally difficult. This finding suggests that the neutral context may not be neutral after all, because it does not seem to be more helpful than the conflicting context.

Note, however, that in the groups of secondary-education and university students frequency and context interacted. Students in secondary-education found high- and equal-frequency verbs easier than low-frequency verbs in the facilitating and neutral context only. In the conflicting-context condition all frequency conditions were equally difficult. Thus, when the context is actually providing conflicting information, performance of secondary-education students mimics that of primary-education students, who were not affected by frequency at all. University students showed frequency effects in all three context conditions: High-frequency verbs were easiest and low-frequency verbs

were hardest to spell. The distinction between contexts appeared on the equal-frequency verbs: In the facilitating and neutral condition they were equally easy as high-frequency verbs, but in the conflicting condition they were equally difficult as the low-frequency verbs.

The results of the analyses that investigated meta-cognitive awareness revealed that knowledge with respect to verb-spelling skill increased with level of education. Based on the correlational analyses it appeared that primary-school students were largely unaware of their level of verb-spelling skill, whereas secondary-education and university students knew how well they had done. The factor strategy use, a second measure of meta-cognitive awareness, indicated that students from primary and secondary school who said to have used the rule were no better than those who said to have orthographic knowledge and used the rule. University students who said to have used the rule showed superior verb-spelling performance, which confirms the assumption that rule knowledge is essential for correct verb spelling.

An interesting u-shaped pattern of development with respect to strategy use emerged from the comparison between students groups. Recall that, the only sound strategy to obtain a correct spelling for weak-prefix verbs is the application of verb-spelling rules. The majority of all student groups said to have used both strategies to complete the verbs, that is, they said to have applied the rule as well as used orthographic knowledge (59%, 70%, and 60%). In the group of primary-education students, a substantial number said to have applied the rule (38%). Rather than the expected steady increase of students applying the rule, a decrease was visible in the group of secondary-education students (16%), before it again showed an increase in the group of university students (29%). This pattern is most likely the result of educational practice. In primary education, much time is devoted to teaching the rules underlying verb spelling. In secondary education, the amount of time devoted to verb spelling decreases substantially, because students are expected to know the rules by then. University students do not receive any verb-spelling instruction. The fact that an increased number indicated to have used the rules is expected, because only the best-educated students from secondary education will enter university. Note, however, that rule application in university students did not lead to perfect verb-spelling performance: Students who said to have used the rule still made 7% errors (5 out of 72).

A final test for the development of meta-cognitive awareness is provided by a change in tendency to spell a final 'd' rather than a 't'. The appearance of Dutch weak-prefix verbs suggests that it is a past participle, which in turn rais-

es the suggestion that it should be spelled with final 'd'. Both primary-education and secondary-education students were more inclined to spell a 'd' rather than a 't', albeit this tendency was stronger in the former than in the latter group. The 'd'-spelling tendency disappeared in the group of university students, indicating increasing awareness of the fact that weak-prefix verbs are not necessarily spelled with final 'd'.

An important conclusion drawn from this study is that a rule-based skill taught in primary education still presents substantial problems in even the highest-educated students. Although meta-cognitive awareness regarding verb spelling does increase with educational level, it is no guarantee for perfect verb-spelling performance. In fact, increasing educational level shows a subtle vulnerability of the rule-based spelling skill: Syntactical context as well as verb frequency affected spelling performance of Dutch homophone verbs. A similar vulnerability has been demonstrated by Assink, van Doorn-van Eijnsden, and van Hees (1982) in the spelling of semantically-determined homophones. Both frequency of the homophone and semantic context affected spelling performance of low-level-education students aged 12 to 16. High-frequency homophones were spelled better than low-frequency homophones when the semantic context revealed little information, whereas in an unequivocal semantic context, high- and low-frequency semantically-determined homophones were equally easy to spell.

If verb-spelling skill remains vulnerable throughout the life of the majority of Dutch people, the question that requires an answer is: Does the Dutch educational practice have to reconsider the way they teach verb spelling or will verb spelling always be problematic, because of its inherent difficulties? I shall finish this paper with a tentative answer.

How verb spelling should be instructed has been a hotly-debated issue in the Dutch literature. Two major instruction methods have been used and tested: The analogy approach and the algorithmic approach. Students who learn verb spelling with the analogy approach learn to spell the various conjugation classes of six prototypes of six different classes of verbs (encompassing almost all Dutch verbs). When encountered with a new verb, they first have to classify the verb and then deduce the spelling of a particular conjugation by analogy of the prototype. Students who are taught by means of the algorithmic approach do not learn the spelling of a set of prototypical verbs, but they are presented with a flow chart of yes-no decisions that require answers to grammatical questions. The algorithm is such that a proper read-out always leads to the correct spelling. The main difference between the analogy approach and the algorithmic

mic approach is, that the former requires little and the latter requires relatively profound grammatical knowledge (see Assink, 1987a, for details).

In an empirical study with the same sample of primary-education students (5th and 6th graders) as in the present study, it appeared that students who were instructed according to the algorithmic approach outperformed those who were taught according to the analogy approach. A similar result has been reported by Zuidema (1988). Instruction was given during a period of at least 7 months, twice a week, and each session lasted 45 minutes. At the end of the school year, two months after instruction had stopped, the effects appeared to be stable for the good and intermediate spellers, but not for poor spellers, their spelling performance dropped significantly. Thus, the most effective instructional method, which required more than half a year relatively intensive practice, did not cause stable verb-spelling performance in all students. More importantly, the algorithmic approach did not cause a perfect command of verb spelling, not even in the good spellers. The mean percentage correct on the posttest of the good spellers was 77%, and of the intermediate and poor spellers it was 61%. The first tentative conclusion I draw from this result is: Dutch verb spelling *is* difficult to master!

Good spellers with a far from perfect verb-spelling skill need to improve their skill in secondary education. However, often little attention is devoted to systematic instruction of the rules underlying Dutch verb spelling in secondary education. Matters are even worse for the poor spellers, who will most likely continue their secondary education at a relatively low level, providing even less opportunity for improving verb-spelling performance. Moreover, students in this study, who attended high-level secondary-education schools appeared to have only limited metacognitive knowledge about the fact that Dutch verb spelling is fundamentally rule-based. Although the mean percentage correct of university students in this study was 89%, this does not impress considering that a group of 6th graders had a mean score of 77% after one year of practice. The second tentative conclusion I draw from this is: Dutch verb spelling *remains* difficult!

To return to the question that was raised in the introduction: What makes Dutch verb spelling so difficult? I believe it is not necessarily, because the rules are too complicated. After all, 5th and 6th graders in primary education achieve a reasonable level after half year of instruction. It is much more likely, that after some time, students forget that verb spelling requires conscious application of rules. The fact that 38% of students in primary education and as little as 16% of the students in secondary education said that they applied the rule while doing

the test, the only way to be sure of the proper spelling, provides evidence for this assumption. Further, if we assume that one or two errors are random mistakes, then 40% of the university students knew and may indeed have applied the rules correctly. However, error scores of university students, and those of students from primary and secondary education were rather systematic: They were determined by context and frequency. I assume that when the issue is a little more complex, conscious application of the rule is all the more required. The fact that a conflicting context causes the largest number of errors suggests that verb-spelling rules were not applied fully consciously. If working memory is overloaded, spelling performance of even experienced spellers deteriorates significantly. Largy, Fayol, and Lemaire (1996) showed similar effects on spelling performance of French university students, who also had to perform a rule-based spelling task (i.e., verb-noun inflections).

Thus, my final conclusion is that Dutch verb spelling is indeed difficult, but by no means impossible to master. It remains difficult for even the most experienced speller, because it requires conscious application of rules and continuous monitoring of the spelling process. Continuous monitoring of a process during an activity that sometimes requires this explicitly as in rule-based spelling, but sometimes not, as in writing the spelling of words with unique spellings, is an effortful task for anybody.

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