

## What's in a suffix? The past tense in Dutch children with reading problems

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**Abstract:** children with developmental dyslexia demonstrate profound problems with the acquisition of literacy skills. Phonological difficulties have been hypothesized to underlie those problems, but morphosyntactic weaknesses have also been demonstrated. In this study we examined the morphophonological process of inflecting regular verbs for the past tense in which both phonological factors (final sound of the verb stem) and morphology (the selection of the suffix) are involved. The results showed that children with reading problems were sensitive to the context requirement of a past tense (i.e., morphology), but that they showed different morphophonological error patterns relative to their normally reading peers.

### 1. Introduction

Developmental dyslexia is characterized by a severe problem with developing fluent reading despite normal cognitive and emotional development (Snowling, 2000). There is general consensus in the literature that children with developmental dyslexia show poor phonological processing (Vellutino et al., 2004). In addition to phonological deficits, recent investigations have indicated subtle problems with inflectional morphology, such as subject-verb agreement (Rispens, Roeleven, & Koster, 2004; Rispens, Been, & Zwarts, 2006) and the past tense (Joanisse et al., 2000; Robertson, Joanisse, Desroches, & Terry, 2012). Research on the combination of these two elements, morpho-phonology, is limited in children with dyslexia (see Marshall, Ramus, & van der Lely, 2010; Robertson et al., 2012), although it can be assumed that difficulties will arise in this area. The present study focuses on the interaction between phonology and morphology in children with reading problems by studying the production of the regular past tense.

The Dutch regular past tense is a morphophonological phenomenon as the selection of the suffix *'-te'* or *'-de'* is guided by an interaction between morphology and phonology (see Rispens & de Bree, 2014). Verb stems ending in an underlyingly voiceless obstruent take *-te*, all other verbs take *-de* (Ernestus & Baayen, 2001). For example, the infinitive *bakken* (to bake), with the stem ending in a voiceless obstruent (*bak*), becomes *bak-te*

(baked) in the past tense, whereas *noemen* (to name) with a stem-final sonorant becomes *noem-de* (named). For the acquisition of the Dutch regular past tense, sensitivity to the interaction between morphology and phonology is thus necessary.

Previous experimental evidence has shown that lexical frequency influences children's past tense marking of regular verbs (e.g. Oetting & Horohov, 1997; Matthews & Theakston, 2006). In other words, a higher frequency of the inflected form facilitates its retrieval. This finding has also been attested for Dutch: Ernestus and Baayen (2001) found evidence for lexical frequency effects in the productions of past tense forms of Dutch adults. Similarly, Rispens and de Bree (2014) found that lexical frequency influenced past tense production in 7-year-olds.

In addition to lexical frequency, type frequency has also been shown to play a role in development of the production of past tense. Type frequency refers to the number of instances that lexical items occur in a certain pattern (Bybee, 2007). For regular past tense production, this refers to the frequency of past tenses expressed by the allomorph *-te* versus *-de*. Type frequency is assumed to affect morphological productivity, as highly frequent suffixes tend to be applied to newly learned items rather than low frequent suffixes (Bybee, 2008). Highly frequent past tense markers (types) are thus expected to be most productive. In Dutch, the combination of voiceless consonants + *-te* is phonotactically more frequent than voiced consonants + *-de* (Rispens & de Bree, 2014). Rispens and de Bree (2014) found that past tense production was influenced by type frequency based on the frequency of the verb stem + allomorph (*-te* > *-de*). Both monolingual TD Dutch 5- and 7-year-olds showed an effect of allomorph type on past tense production. The 5-year-olds showed an effect of type frequency (*-te* > *-de*) when they inflected lexical and novel verbs for the past tense; the 7-year-olds only showed this effect of type frequency for the inflections of novel verbs. Furthermore, for the 7-year-olds, but not the 5-year-olds, the past tense production of lexical regular verbs was influenced by lexical frequency, with verbs high in frequency being inflected more accurately. The absence of a lexical frequency effect in the younger group suggests that vocabulary size influences the occurrence of lexical frequency effects in verb productions.

Next to frequency effects, phonological preferences can also impact on inflection (see Song, Sundara, & Demuth, 2009; Marshall & van der Lely, 2007). In Dutch, there is evidence that early development of voiced segments/phonemes is different from that of voiceless ones. Dutch children around the age of three have been found to show a clear preference for voiceless over voiced segments (Kager, van der Feest, Fikkert, Kerkhoff & Zamuner, 2007) and acquire voiceless phonemes before voiced ones (e.g. Beers, 1995). Dutch shows final devoicing, and has the tendency of voiceless word-internal clusters

(Zonneveld, 1983). The advantage and preference for *-te* allomorphs in Dutch in the study by Rispens and de Bree (2014) can also be accounted for by this phonological preference.

It can be hypothesized that the phonological deficits that occur in developmental dyslexia affect the development of past tense morphology, due to the structural relationship between the final phoneme of the verb stem and the allomorph it takes. Robertson et al. (2012) examined the production of the past tense in English speaking children with developmental dyslexia who speak English. Similar to the Dutch past tense, the English past tense is morphophonological in nature, as the selection of allomorphs /t/; /d/; and /ɪd/ depends on the phonological properties of the final phoneme of the verb stem (compare *baked*; *kissed*, and *waited*). The children with developmental dyslexia inflected regular verbs correctly significantly less often for the past tense compared to a chronologically age-matched control group. Production of the past tense of novel words was not significantly different. Furthermore, performance on both regular and novel verbs was similar for the children with developmental dyslexia and reading-age-matched control children. These findings suggest a developmental lag compared to the age-matched children (Robertson et al., 2012).

The literature on morphophonology and literacy in Dutch does not pinpoint clear morphophonological difficulties for poor readers. One study has been reported with respect to literacy and past tense inflection in Dutch. Kerkhoff, de Bree, Hoeben and Vreugdenhil (in press) assessed allomorph selection (*-te* or *-de*) for the Dutch past tense specifically for verbs that can differ in voicing value in the infinitive and stem, such as *leven-leefde* 'lived', compared with *blaffen-blafte* 'barked'. There were no differences between normal and poor readers on past tense production in a spoken condition. However, whereas correct past tense inflection of words and novel words increased when orthographic support was provided (e.g. presenting both auditory and written *leven*) for the group of normally reading children, this benefit was not attested for a group of poorly reading children. These findings do not point towards severe morphophonological difficulties in poor readers. Note, however, that no reading-age-matched group was included. Additionally, a study by de Bree and Kerkhoff (2010) did not find morphophonological difficulties in children with a familial risk of dyslexia (i.e., with a dyslexic parent). The morphophonological area under investigation was voicing alternation of the plural. Critical items were nouns that differed in underlying voicing of the last consonant: compare *hand-handen* 'hands' and *krant-kranten* 'newspapers'. The comparison of voicing alternation in the plural of five-year-old children with and without a familial risk of dyslexia showed that both groups showed a preference for non-alternation (i.e., *-ten* plurals rather than *-den* plurals). Interestingly, the children at risk for dyslexia showed

more difficulty in inflecting novel words for the plural, indicative of phonological processing difficulties.

Returning to the current research, it is thus an open question whether or to what extent past tense difficulties will be attested in children with reading difficulties. We therefore examined past tense productions of Dutch speaking children with reading problems 1) to gain insight into morphophonological processing in children with reading problems, 2) to investigate the effects of lexical frequency and type frequency in children with developmental dyslexia relative to typically developing children and 3) to add cross-linguistic data on morphophonological abilities in children with reading problems.

## 2. Methods

### *Participants*

Two groups of children participated in this study. Thirty-eight children with reading problems (RP) ( $n=38$ ; 16 girls) between 7;1–10;8 years of age participated. They all attended regular elementary schools. The children were referred by speech and language therapists or by special education specialists working at the primary schools. To ascertain the reading problems, two reading tests were administered: the real word task (RWT; Brus & Voeten, 1973) and a pseudo-word task (PWT; van den Bos, Spelberg, Scheepstra, & de Vries, 1994). In the RWT the child is required to read out a list of existing words as quickly and accurately as possible within one minute. The PWT follows the same principle, but uses non-words and takes two minutes. Timed reading tasks were chosen as in the Netherlands speed is judged to be a better indicator of reading development than accuracy alone due to the relative transparency of the orthography (De Jong & van der Leij, 2003). Both tasks are commonly used as part of the diagnosis procedure of developmental dyslexia. The children were classified as having RP when they scored more than 1 *SD* below the mean of the combined scores of the RWT and the PWT (a maximum score of 6). All children who participated in this study within the group of RP met this criteria. Children who had a history of speech output problems, such as dyspraxia, or showed evidence of such problems at the moment of testing were excluded. All children had normal hearing and normal or corrected-to-normal, vision. Note that the participants in this group were not all officially diagnosed with developmental dyslexia; some children were still in the process of being officially diagnosed.

The second group consist of control children without RP who were matched on chronological age with the group of children with RP ( $n=41$ , 26 girls) between 7;8–11;6 participated. The same exclusionary criteria were applied to the control group. All children

had a mean score on the combined score of the PWT and RWT of at least 7, indicating at least average reading ability. An independent t test demonstrated the two experimental groups did not differ with respect to their age,  $t(77) = .99, p = .32$ .

### *Tasks*

Past tense production was investigated through elicitation of past tense forms of existing verbs and novel verbs, see Rispens and de Bree (2014).

*Task 1: Past tense production of existing verbs.* Twelve regular verbs were selected based on high and low token frequency counts of the CELEX (Baayen, Piepenbrock, & van Rijn, 1993) database. The verbs were furthermore classified according to the type of past allomorph with which the verbs are inflected. Half of the verb stems ended in an underlying voiceless obstruent (four times /k/ and twice /s/), the other half in a voiced consonant (twice /l/, twice /r/ and twice /w/). These stems were chosen as they rendered unambiguous *-te* or *-de* expectations. All verbs in the infinitival form had a CVCVC structure.

*Task 2: Past tense production of novel verbs.* Fifteen novel verbs were presented. Seven of the verbs ended in an underlying voiceless obstruent (4 times 'p' and 3 times 'k') and eight in a voiced consonant (4 times 'm', twice 'n' and twice 'r'). Only verb stems ending in consonants that demand unambiguously a *-te* or *-de* suffix were chosen. The verbs were controlled for phonotactic frequency by using the database of Adriaans (2006).

### *Procedure*

The children were shown a picture in a PowerPoint presentation on a screen of a laptop computer that depicted an action (see also Rispens & de Bree, 2014). Children heard a prerecorded female voice pronounce the target. Pictures were presented to the children, one at a time, and they were accompanied by a little story during which the picture remained on the screen. This three line story first described what was going on in the picture and then stated that characters performed this action often or every day. The children were then asked to finish the final sentence in which they were prompted to give a past tense form.

The responses of the children were recorded and transcribed on-line and scored afterwards. An item would be scored as correct if the choice of the past-tense suffix was correct. Violations of agreement between the verb and the subject were not taken into account. The order of the presentation of the two tasks was pseudo-randomized: half of

the children were first presented with task 2 (novel verbs) followed by task 1 (lexical verbs), the other half the other way around.

### 3. Results

#### *Regular lexical verbs*

Table 1 shows the correct past tense productions of the two groups. The results indicate that the children with RP have an average accuracy performance of 90% of past tense productions correct. The control children produced on average 85% correct past tenses. A repeated measures ANOVA with lexical frequency (high/low) and type frequency (*-te* /*-de*) as the within-subjects variables and group (RP-control) as the between-subject variable was carried out. No significant main effects or interactions were found (lexical frequency:  $p = .91$ ; type frequency:  $p = .1$ ; group:  $p = .38$ ; all interactions  $p > .33$ ).

Table 1: Mean proportion scores correct ( standard deviation between parentheses) of the past tense productions of the lexical and novel verbs

	<b>Lexical verbs</b>			
<b>Group</b>	HF <i>-te</i>	LF <i>-te</i>	HF <i>-de</i>	LF <i>-de</i>
RP	.87 (.30)	.89 (.27)	.92 (.20)	.93 (.21)
Control	.84 (.28)	.84 (.27)	.89 (.24)	.86 (.29)
	<b>Novel verbs</b>			
	<i>-te</i>		<i>-de</i>	
RP	.75 (.29)		.78 (.27)	
Control	.84 (.29)		.69 (.41)	

#### *Novel verbs*

The accuracy scores on the past tense production of the novel verbs are displayed in Table 1. A repeated measures ANOVA with type frequency (*-te* /*-de*) as the within-subjects variable and group (RP-control) as the between-subject variable was carried out. The results showed that there was no main effect of type frequency ( $p = .14$ ), nor a main effect of group ( $p = .93$ ), but that there was a significant interaction between type frequency  $\times$  group,  $F(1,73) = 4.36$ ,  $p = .04$ . To investigate the interaction of type frequency  $\times$  group, post hoc analyses were carried out. A paired samples t-test showed that the children with RP did not differ significantly in producing the past tense of novel verbs with *-te* and *-de*,  $t(37) = .44$ ,  $p = .66$ . The control children, in contrast, showed a significant

advantage for producing past tenses of novel verbs demanding the *-te* suffix,  $t(36) = 2.45$ ,  $p = .019$ .

Both groups produced around 25% errors on the novel verb task. To investigate the error patterns of the children, we used a qualitative error analysis. Five categories were created based on the actual occurrence of errors (see Table 2, and Rispens & de Bree, 2014). For our research question, we were particularly interested in the ‘wrong suffix’ error category as this relates to sensitivity to morphophonology. Responses that could not be classified as one of our defined error types were assigned to the category ‘other’. This means that all responses were assigned to a category as it never occurred that a participant responded with silence. Results are presented in Table 2.

The error analysis shows that the poor readers made somewhat more suffix errors than the normal readers. Closer inspection indicates a difference between the *te* and *de* verbs for the control children but not for the children with RP. Children with RP produce a wrong suffix (e.g. *vupde* instead of *vupte* (11.65%) and *daante* instead of *daande* (12.5%)) in the novel verbs, whereas the control children mostly produce a wrong suffix in verbs demanding *-de* (*daante* instead of *daande* 17,2% of errors versus 2,5% errors such as *vupde* instead of *vupte*).

This error pattern thus matches the significant effect of type frequency in the control children: novel verbs demanding a *-te* suffix have an advantage over verbs demanding a *-de* suffix, and this preference is also shown in the type of errors produced (*-de* > *-te* occurs more frequently than *-te* > *-de*). The RP children did not demonstrate the same facilitation for verbs taking a *-te* suffix, and their errors did not indicate a preference for either suffix.

Table 2. *Error patterns and their occurrences in percentages (all errors + accurate responses = 100%) in the realizations of the two groups. Standard deviations in brackets.*

Error categories	Example of novel verb	Normal readers	Poor readers
<i>-en</i> (infinitive)	<i>vuppen</i>	5% (16%)	4% (10%)
Zero marking	<i>vup</i>	0,2% (0,1%)	0% (0%)
<i>-t</i> suffix (present tense)	<i>vupt</i>	2,4% (7,5%)	1,2% (3,4%)
Incorrect suffix	<i>vupde</i> (instead of <i>vupte</i> )	9,8% (15,5%)	12,1% (14,8%)
Other: Various types of errors	Examples: a). verb ‘go’ + verb: ( <i>ging vuppen</i> ) b). change within the verb stem (e.g. <i>vumde</i> ) c). infinitive + ‘-de’ ( <i>vuppende</i> )	6,9% (18.25%)	6,7% (14,3%)

#### 4. Discussion and conclusions

The present study aimed to investigate the past tense in children with RP to gain insight into morphophonological processing, to investigate the effects of lexical frequency and type frequency in children with RP, and to add cross-linguistic data to studies of morphophonological abilities in children with RP.

To start with the overall research aim –examining the past tense in children with RP–, the results of the present study indicated that the production of the past tense in children with RP is comparable with that of children without RP matched on the same age. In line with previous findings (e.g. de Bree & Kerkhoff, 2010; Joanisse et al., 2000; Kerkhoff et al., in press), this study does not show clear evidence of morphophonological difficulties in poor readers. For real verbs, the group of normal and poor readers do not differ in percentages correct inflection and influence of lexical frequency and type frequency. For novel verbs, an interaction between type frequency and group was attested. This interaction reflects that fact that only the normal readers showed a preference for the *-te* suffix. In contrast to other studies, no effects of lexical frequency were observed in either group. A potential explanation could be that these children were older than children that participated in previous experiments, and that the lexical effects are no longer visible at this later age.

The literature on Dutch past tense inflection reports different patterns related to *-te* and *-de* preferences. Whereas Rispens and de Bree (2014) found a *-te* preference for 5 and 7-year-old typically developing children, Kerkhoff et al. (in press) did not find a preference in either direction for 9-year-old normal and poor readers. In the present study, the group of poor reading children did not show a preference on novel verbs for either suffix, and the normal readers a *-te* preference, thus adding to the mixed findings. Whereas the normal readers seem to adhere to phonological patterns of voicelessness within clusters (Kager et al., 2007; Zonneveld, 1983) and a higher frequency of consonant + *-te* compared to consonant + *-de* (Rispens & de Bree, 2014), the group of poor readers does not, at least for novel verbs. Also, when the children with RP produced the wrong suffix, they did not show a preference for the *-te* suffix, whereas this was the case for the control children (presence of *daante* errors, but virtually absence of *vupde* errors)

A highly tentative suggestion is that the *-de* realizations in contexts where a /t/ is required, are caused by spelling instruction. Given that devoicing occurs in Dutch, children hear a /t/ but are often instructed to write a 'd', as in nouns *hand* 'hand', *mond* 'mouth', *bed* 'bed' and past participles, such as *gezegd* 'said' and *gehoord* 'heard'. For novel verbs, no representation is available. Through a strategy, based on orthography, the children might thus opt for a *-de* allomorph (see Kerkhoff, de Bree & Buesseler, in press, on voicing



in spoken and written plural noun production). Children with reading problems may use this strategy more than children without reading problems, as they often have had more and more explicit spelling strategies to help them overcome their often occurring spelling problems. Children without RP will therefore not use this strategy (change a /t/ into a /d/), but rather will use a phonological principle when they have to inflect novel verbs for the past tense: opt for the phonologically less marked *-te* in Dutch.

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