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Spelling errors of 24 cohorts of children across primary school 2012-2015: a BasiScript corpus study

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Abstract

In this paper we present a study of some spelling error types that Dutch primary school children made in the dictations and in the free or themed texts they contributed to the BasiScript corpus, i.e. a corpus comprising child written output produced between 2012 and 2015. The present article first briefly describes the corpus. Then it presents an analysis of the spelling errors that occurred in a selected set of words in the dictations regarding diphthongs (in grades 2 and 3) and verb forms (in grades 4 and 5) – which are notoriously difficult to spell for these age groups. In our analysis we investigate whether the frequencies of the words in the BasiLex corpus (a corpus of child written input) predict the spelling errors and whether there is a correlation between number of incorrect spellings of the words in the dictations and in the free texts and themed texts of the respective grades.

1. Introduction

Recently, two richly annotated Dutch corpora concerning child language have been published. The first is BasiLex, an 11.5-million-word corpus of written texts that are offered to children in the primary school ages (Tellings et al. 2014). The other is BasiScript, a nine-million-word corpus of dictations and texts that are written by primary school children (Tellings et al. 2018). So BasiLex is an input corpus (texts that children read) whereas BasiScript is an output corpus (texts that children write). These two corpora with materials collected across largely the same time frame provide a basis for numerous studies into primary school children's language development as well as for studies in other areas of linguistics.

The present article describes a study into spelling errors in the BasiScript corpus, in fact the first study done with BasiScript. The ability to spell correctly is important, not just because society expects people to deliver correctly spelled texts. The well-founded and much researched Lexical Quality Hypothesis of Perfetti and colleagues (Perfetti and Hart 2002) states that mental representations of words in the brain consist of phonological, orthographic, and semantic information. These three types of information are interconnected and influence each other, and they determine the quality of the mental representations. For instance, words such as *key* and *quay* which are phonologically rather similar can be distinguished from each other more easily when the orthographic representations and the semantic representations of the words in the mental lexicon are good.

For grades 2[1], 3, 5 and 6 we looked at how children spelled a small number of selected words in the dictations, across six data collection rounds between autumn 2012 and spring 2015. The selected words contain notorious spelling issues for the respective grades, more specifically homophone diphthongs for grades 2 and 3 and homophone verb spellings for grades 5 and 6. We looked at how many and what types of spelling errors the children made regarding these homophones; whether BasiLex frequencies (so the frequencies of occurrence of these homophones in texts offered to children) predicted these errors; and whether there was a correlation between number of incorrect spellings of the words in the dictations and in texts written by children of the respective grades (in so far the children used these words in their texts) in BasiScript.

The structure of the paper is as follows. In Section 2 we first give a brief description of the BasiScript corpus. Since the corpus is new, we think it is important to give the reader an impression of how the data were collected, what type of texts the children wrote, how the data were processed and tagged, and why this corpus (as well as the BasiLex corpus) is unique. Then, in Section 3, we introduce the study and in Sections 4 and 5 we describe our method and the results obtained. Section 6 concludes this paper.

2. The BasiScript corpus

Below we briefly describe BasiScript, more detailed information can be found elsewhere (Tellings et al. 2018).

2.1 Data collection

BasiScript comprises nine million words written by children in grades 2 to 6 of Dutch primary school. The data was collected in six data collection rounds. Much of the data is longitudinal: many of the children participated for a period of three years (between autumn 2012 and spring 2015) during which they wrote texts each autumn and each spring. Data were collected either by the teachers or by students as part of their Bachelor or Master Thesis in the field of Educational Sciences. Students also assisted in finding schools. Most texts were written by children with no diagnosed severe visual, aural, or cognitive impairment. However, we also received some texts from special schools for children with such impairments and from regular schools in which these children are educated with ambulatory support. In addition, we received some texts from the Expertise Centrum Nederlands (a center for research of Dutch language teaching, `www.expertisecentrumnederlands.nl`), written in 2010; from a PhD project carried out at Radboud University, texts written in 2011; and from the University of Amsterdam, texts written in 2014 and 2015. All in all, 165 schools participated. Table 1 gives the number of texts written by children in each category. The number of tokens per grade are: 770,042 (grade 2), 1,301,114 (grade 3), 1,828,981 (grade 4), 2,283,755 (grade 5), 2,386,975 (grade 6), 11,668 (year 1 and 2 of high school) and 8.289 (grade not known). The dictations the children wrote are not included in these numbers (see Section 4).

Type of education	**Ntexts**	**Source**	**Ntexts**
Regular schools	89,927	Within the project	90,123
Visual impairment	449	From Expertise Center Dutch	165
Auditive or special language impairment	5,626	From PhD project Nijmegen	343
Learning problems	1,349	From UvA	6,720
TOTAL	97,351	TOTAL	97,351

Table 1: Numbers of texts in the BasiScript corpus per category of children and source

1. In the Dutch school system grades start in Kindergarten. So grade 1 in most Anglo-Saxon countries is grade 3 in the Netherlands, Anglo-Saxon grade 2 is Dutch grade 4, et cetera. We use the more common Anglo-Saxon grade numbers here.

Table 2 gives the distribution of the participating schools over the Dutch provinces, and the sizes of the provinces in terms of their population. Provinces, of course, are not dialect boundaries but exact dialect boundaries are hard to demarcate. With this table we intend to give the reader an idea of how the different parts of the Netherlands are represented in the BasiScript corpus. As Table 2 shows, not all parts of the country are represented equally. In the two largest provinces, Zuid-Holland and Noord-Holland, there are many universities and other research institutes that compete for schools to participate in research. Moreover, most schools were recruited by students of Radboud University, which is in the province of Gelderland. Hence the large number of schools in Gelderland and the adjacent provinces of Overijssel and Noord-Brabant, even though we encouraged the students to look for schools outside these areas. Because of the difficulty of finding schools, we only have grade numbers and gender information of the children, so not home language and other relevant information. Schools turned out to be much more willing to cooperate the less we asked from them.

Province	**Number of inhabitants** [1]	**Original project**	**Other sources**[2]	**Total**
Groningen GR	583,109	5	0	**5**
Friesland FR	647,287	1	2	**3**
Drente DR	492,205	1	3	**4**
Overijssel OV	1,151,573	16	3	**19**
Gelderland GL	2,060,141	31	8	**39**
Flevoland FL	411,669	0	2	**2**
Noord-Holland NH	2,833,263	5	7	**12**
Zuid-Holland ZH	3,680,652	8	12	**20**
Utrecht UT	1,295,618	4	7	**11**
Zeeland ZL	382,335	2	1	**3**
Noord-Brabant NB	2,528,844	21	6	**27**
Limburg LB	1,117,314	7	1	**8**
	17,184,010	101	52	**153**

Note: Not in the table: 12 regular schools, location unknown, of which ambulatory guided visually or hearing impaired children participated, one or two children per school.

[1] Situation at 1-1-2018, `http://www.metatopos.eu/provincies_eu.php`.

[2] Expertise Center Dutch, PhD project at Radboud University, the University of Amsterdam.

Table 2: Numbers of texts in the BasiScript corpus per category of children and source

2.2 Text types and task administration

The children wrote different types of texts: Free texts, i.e. texts for which at most a subject was given; Themed texts, for which the children were given a specific instruction; and Dictations (more information in Section 3). We asked children within the project to write, in each data collection round, two Free texts, two Themed texts (with two different assignments) and one Dictation (originally, only in the first data collection round, two Dictations). Within one school year children got the same two assignments for the Themed texts in the two data collection rounds and also the same dictation but the assignments and the dictations differed for the different grades. So, for instance, in the autumn ánd in the spring a child in grade 5 would write one Themed text on the possible disadvantages of spending (too) much time with the computer and one on the ethics of circuses. The child would also do the same dictation in both seasons. However, not all schools participated in every data collection round with all classes and all children doing all tasks, for various reasons. The texts we received from outside the project were categorized by us as Free texts or Themed texts, depending on how much instruction the children had received according to the respective project

leaders. These texts were never dictations. Also the children with impairments did not write any dictations.

Most of the texts by far were handwritten and then digitized by our staff, whereas a small number of texts was produced digitally on a web application. After the first data collection round we no longer offered the opportunity to type in texts digitally since quite a number of children tended to show bad writing behavior. For instance, they filled the screen with foul language or *hahahahaha*, et cetera. This probably occurred because the teachers didn't watch what the children did. Moreover, the typed-in texts were stored immediately when the child finished, the teachers didn't collect them like they did with the handwritten texts. So the children apparently felt free to do this. Schools that already used the web application could keep using it but we did not encourage this.

All handwritten texts were scanned and the images were stored in a compressed lossless format (i.e., .png). From these images, typists keyed in the data using a web application we developed. We asked typists to stay as closely as possible to the original text. This included maintaining the line breaks and the variations/errors in spelling and use of punctuation. Tags were added to mark text crossed out by the child, unreadable text, and text left out by the typist because it could identify the child (e.g. surnames, telephone numbers). Thereupon an annotation layer was constructed that rendered all words in the texts in their orthographically correct form. This was done by students of Dutch or related subjects. Each child and each text received a unique ID containing school number, gender indication, grade number, first name, and first grapheme of family name (with additional digits or letters if this did not lead to a unique ID). The grade number made the ID for the same child different for the different school years in which he or she participated (if so). In other words, the ID of the child only changed when the child went to a higher grade and was the same for all his/her contributions written within one grade. In the corpus texts can be viewed based on ID of the child, data round, and text type. In the corpus all the original IDs have been changed so as to reach optimal anonymization. For instance, a participating boy named Roy L in grade 6 of school 53 could now have an ID containing the name Frederick B in grade 6 of school 104[2]. At the images of the texts the ID and other identifying information has been taped-up whereas in the transcriptions information that could lead to identification of the child has been left out. Researchers and commercial parties have access to the digitized versions of the texts; only researchers can have access to the images of the original texts and they sign an agreement of confidentiality.

2.3 Text processing and tagging

All texts have been delivered in the open source FoLiA format. This is an XML format that has also been used for BasiLex and for SONAR, the largest Dutch corpus. The same format is currently being used in various projects in which Dutch and Flemish language are being processed (Gompel and Reynaert 2013).

Frog V0.13 was used to do the POS tagging and lemmatization. Frog is an open source natural language processing suite for the Dutch language. Frog does the tokenization, tagging, and lemmatization, and it morphologically segments word tokens in Dutch text files. It also assigns a dependency graph to each sentence, it identifies the base phrase chunks in the sentence, and it attempts to find and label all named entities (Bosch et al. 2007). For all the words in the lexicon the length, frequency and distribution were determined next to their family size (i.e., the number of words that have the target word as a stem, e.g. *school*, *schoolboy*) and family frequency (i.e. the summed frequency of the members of a stem family), and their orthographic neighborhood size and neighborhood frequency (i.e., the number of words that differ only one grapheme from the target word, e.g. *mat*, *map*, and the summed frequency of these). These word properties were collected because they have shown to be psycholinguistic variables that influence word processing (Balota et al. 2006). In addition, 1,170 highly-frequent and polysemous content words (803,601 tokens)

2. Information concerning the approximate location of the schools is available for researchers.

were annotated for word meaning. The tools used for this task have been developed within the DutchSemCor project (see `http://www2.let.vu.nl/oz/cltl/dutchsemcor/`).

2.4 BasiLex and BasiScript: unique corpora

The BasiLex corpus has unique properties compared to other Dutch written corpora; as far as we know there are few language corpora, and not of this magnitude, that contain written language directed at primary school children. The BasiScript corpus is unique for a similar reason: there are no Dutch corpora of this size and breadth containing written texts produced by primary school children; smaller corpora exist, but generally not in the public domain and mostly developed for and within specific studies. There are other features that make BasiScript special. First, a considerable number of children have participated more than once – up to three years, twice a year – and through their IDs they can be followed throughout the corpus. The fact that, within one school year, they wrote the same dictations and texts with the same assignments in both data rounds, enables users of the corpus to chart their development on specific tasks[3]. Second, because next to the spelling-corrected texts both the original keyed-in texts and the scans of the handwritten texts are available, computational linguistic tools can be developed for detecting spelling and interpunction errors, using the BasiScript corpus as training or gold standard evaluation data; also, handwriting recognition tools may be trained and evaluated using this data. Third, the corpus may be useful for training corpus-specific statistical language models or word embeddings, representing the language and distributional semantics of young writers in a school context.

3. Spelling errors: an introduction to our study

Although the spelling of Dutch is more transparent than the spelling of English, it has some peculiarities that require explicit instruction. In the present study we focus on some of these spelling issues that Dutch children encounter and that are notoriously difficult for children in particular grades (Bosman et al. 2013). For grades 2 and 3 we looked into the spelling of diphthongs, while for grades 5 and 6 we investigated the spelling of verbs.

Some diphthongs in Dutch have two different spellings, such as [ɑu] which is spelled either as *au* or as *ou*, and [ɛi] which is spelled either as *ei* or as *ij*[4]. One has to learn such spellings by heart or derive them morphologically (*ijskoud* has to do with *ijs*, ice, and not with *eis*, demand). Moreover, the spellings of some diphthongs are easily confused such as *ei* for [ɛi] with *ie* for [i] because of the similar graphemes, while other diphthongs are semi-homophone (i.e. [œy], *ui* and [ø:], *eu*). We investigated the errors made in these diphthongs in the grades where there is special focus on learning them (i.e., grade 2 and 3). Furthermore, regarding Dutch verbs we looked at the spelling of the singular present tense; the simple past tense; adjectively used participles for verbs with stems ending in *d* or *t*; and the spelling of past participles for verbs starting with *ge*, *be* or *ver*. These are learned especially in grades 5 and 6.

In Dutch, the second and third person singular present tense are formed by adding *t* after the stem (e.g. *pakt* for the verb *pakken* (EN: to take)). Beginning readers have difficulty with spelling these forms for verbs the stems of which end in *d*. For example, singular present tense forms of the verb *zenden* (EN: to send) are the homophones *zend*, *zendt*, *zendt* (1st, 2nd and 3rd person respectively). Another rule in Dutch concerns subject-verb inversions. When the personal pronoun *je* (EN: you, singular) follows the verb, the *t* is dropped. So the inverse form of *jij speelt* (EN: you play) is *speel jij* (EN: do you play). Again, this results in homophones when the stem ends with *d*, such as in *jij zendt* and *zend jij* (EN: you send, do you send). Another issue is the spelling of past participles of verbs starting with *ge*, *be*, or *ver* in the infinitive. Most Dutch verbs get the prefix

3. When the present study was performed, this was technically not possible yet.
4. Speakers of some dialects know the difference because the graphemes *ei* and *ij* have different pronunciations in their dialect, e.g. the Sallands dialect (Nijen Twilhaar 2003).

ge and the suffix *d* or *t* in the past participle, e.g. *spelen*, ***ge**speel**d*** (EN: to play, played), *tappen*, ***ge**tap**t*** (EN: to tap, tapped) but verbs starting with *ge*, *be*, or *ver* in the infinitive only get a suffix *d* or *t*. For example, *gebeuren, (het) gebeurt, (het is) gebeurd* (EN: to happen, (it) happens, (it has) happened), the latter two verb forms are homophones. This is even more difficult when the past participle has a homonym; see for example the homophones *(hij) beleeft, (hij heeft) beleefd, (hij is) beleefd* (EN: (he) experiences, (he has) experienced, (he is) polite). Finally, there is the doubling of *t* or *d* in participles. In the simple past tense the *t/d* is doubled (e.g. *hij slach**tt**e de kippen* (EN: he slaughtered the chickens). However, when the past participle is used as an adjective, there is single *t/d* because only *e* is added; for example, *de geslach**t**e kippen* (EN: the slaughtered chickens). Similarly, *zij verbran**dd**e het hout* (EN: she burned the wood) versus *het verbran**d**e hout* (EN: the burned wood).

In Dutch primary schools there is no government-prescribed curriculum. However, a limited number of language and spelling methods is being used, which teach the Dutch spelling more or less in the same order. The Cito-LVS, a much-used set of tests primary schools use to monitor the progress of their students, contains spelling tests based on the order in which these methods teach the spelling rules and spelling usage (`http://www.cito.nl`). The spelling of diphthongs is assessed from grade 2 onwards (i.e. also in the higher grades) and verb spelling is assessed in grades 5 and 6 (but not in the lower grades). Teaching these spellings usually starts in grades 1 and 4, respectively.

An important factor in learning to spell is frequency. The higher the frequency of particular spellings or particular words, the more likely it is that children (Lété et al. 2008) and adults (Bonin et al. 2016) will use or know that spelling. Most of these studies use frequency counts from adult language corpora. In a comparison of frequencies in BasiLex with frequencies in a subcorpus of SONAR (an adult written language corpus) it was found that these frequencies can differ considerably for particular words (Tellings et al. 2014). Amongst others, school words, words for family members, and verbs that refer to activities were more frequent in Basilex whereas words referring to politics, economy, governing and verbs referring to speech acts were more frequent in SONAR. We now have the possibility to use frequency counts based on a child written language input corpus: BasiLex. In our study we addressed the following research questions:

- First, how do Dutch children perform in the BasiScript dictations on the spelling of some words that, for their grade level, contain notorious spelling problems?
- Second, is BasiLex frequency, measured in different ways, a predictor of these spelling achievements?
- Third, were often misspelled words in the BasiScript dictations also misspelled more often when used in the BasiScript texts?

For the first research question we looked both at the number of children that spelled a word correctly and at the frequencies of particular spelling errors. We expected children in grades 2 and 3 to mainly make errors involving diphthongs either by mistaking them for other diphthongs that are (semi) homophones (e.g. *ei* for *ij* and vice versa), or by selecting the right diphthong but spelling it incorrectly (e.g. *ie* for *ei*). We expected children in grades 5 and 6 to make errors against verb spelling by mixing up *d*, *t*, and *dt*, and by exchanging double for single *d* or *t* and vice versa.

With regard to the second research question, we looked at the effects of overall BasiLex frequency of lemmas, and at the effects of summed grade frequency of lemmas. In BasiLex it is possible to look up not only the overall frequency and the grade frequency of a lemma or a word for a specific grade or for all grades together but also the summed frequency over different grades. We expected the summed grade frequency to be a better predictor than the overall frequency, since grade frequency is supposed to more accurately describe the number of times a child of a particular grade has seen the word.

Finally, for the third research question we expected words that were more often misspelled in the dictations to be misspelled more often in the texts as well. There is hardly any research

that compares spelling in dictations with spelling in self-composed texts. Spelling ability is mostly assessed via dictations or via copying of texts. However, Italian children's spelling ability on a dictation task and on a free composition writing task were found to correlate with correlations of .63 (Grade 2, N=85), .59 (Grade 3, N=80), .71 (Grade 4, N=84) and .56 (Grade 5, N=76) (Bigozzi et al. 2017). They also found correlations for the type of errors although these were somewhat lower. For homophone errors on the two tasks they found correlations of .49, .38, .33, .47 and .42 for the respective grades (i.e. grades 2 to 5) and for non-homophone errors .57, .55, .54, .68, and .37, all significant at the .01 level.

4. Method

The BasiScript dictations for grades 2 and 3 contained 25 words, those for grades 5 and 6 contained 35 words. The target words were selected based on the overview of spelling categories in the Cito-LVS for the different grades. The target words were presented in context such that the child could derive what word (in case of homonyms) or what word form (in case of different spellings of homophonic verb forms) was meant. For instance, in *Hij ligt in het gras, schrijf op "ligt"* (EN: He is lying in the grass, write down "lying") the child should know that the homophone *licht* (EN: light) was not meant. And in *Zij verzendt het pakje, schrijf op "verzendt"* (EN: She sends the package, write down "sends") the child should derive that here a third person singular present tense is meant. From the dictations we selected the 32 words that were eligible because they either contained a diphthong with two homophone spellings or they were a verb form to which one of the above discussed verb spelling issues was applicable: seven words for grade 2, six for grade 3, nine for grade 5, and ten for grade 6. All selected grade 2 and grade 3 words contained a diphthong with homophone spellings (*ou/au* or *ei/ij*) or semi-homophone spellings (*eu/ui*). All grade 5 and grade 6 words contained *d*, or *t*, or *dt* spelling in either a verb or a deverbal adjective.

Since there were six data collection rounds, we have six cohorts in which the spellings of these words were recorded. Table 3 gives the number of participating children and schools per period. In all, we looked at the data of 2,330 children from grade 2; 2,409 from grade 3; 2,388 from grade 5, and 2,354 from grade 6.

	autumn '12	**spring '13**	**autumn '13**	**spring '14**	**autumn '14**	**spring '15**
gr. 2	265 (8)	368 (10)	477 (16)	615 (22)	309 (11)	296 (10)
gr. 3	250 (8)	355 (12)	510 (19)	610 (23)	342 (12)	342 (11)
gr. 5	251 (8)	328 (11)	562 (18)	641 (23)	322 (12)	284 (10)
gr. 6	260 (8)	393 (11)	514 (17)	584 (20)	331 (12)	272 (10)
TOTAL	1,026	1,444	2,063	2,450	1,304	1,194

Table 3: Participating children (schools) per data round. The same children and schools can participate in more than one data round (see main text).

The children did not come from the same schools in each round. From those schools who did dictations, six schools participated in all six data rounds; four in five data rounds; one in four data rounds; two in three data rounds; seven in two data rounds; and seven in one data round. This makes a direct comparison between data rounds impossible unless one limits the data set to six schools. Furthermore, as explained above children that took part twice in the same school year (autumn and spring) got the same dictation twice whereas children who took part once in a school year got it once. This set-up implies that reliable statistical analyses can be made regarding spring results only when the data set is limited to those children who participated twice in a school year. We did not want to reduce our data set for this first study into BasiScript and adjusted the choice of statistical analyses to the limitations mentioned above (see Section 5).

Dutch word forms	EN translation	grade	overall freq	summed freq	% not found
huis	house	2	4.1	3.3	1.1
keus	choice		2.3	1.0	4.3
nou	now		4.1	3.5	5.0
rijst	rice		2.6	1.6	3.5
slijpen	sharpen		1.9	0.8	6.3
steil	steep		2.4	1.3	6.4
vrouw	woman		3.7	2.8	6.5
beitel	chisel	3	1.6	1.0	6.2
knijpen	pinch		2.8	2.4	4.7
luifel	awning		0.8	0.0	6.4
toeschouwers	spectators		2.3	1.5	15.7
trouw	loyal, true		2.4	1.9	2.7
vrijdag	Friday		2.8	2.2	3.4
bespiedden	spied	5	1.4	1.3	3.6
gevluchte	fled (adject. used)		2.9	2.8	8.1
slijpt	(he/she)sharpens		1.9	1.8	5.2
verpleegd	nursed (partic.)		1.0	1.0	6.4
verschroeid	scorched (partic.)		1.3	0.8	6.7
versierd	decorated (partic.)		2.7	2.6	3.8
verwoeste	destroyed (adject. used)		2.5	2.3	4.9
verzendt	(he/she) sends		1.8	1.7	2.5
zuchtte	(he/she) sighed		3.1	3.0	4.1
aanvaardde	(he/she- accepted	6	1.7	1.7	4.9
meldde	(he/she) reported		2.6	2.5	1.7
minachtte	(he/she) despised		1.2	1.0	5.6
slachtten	(they) slaughtered		1.9	1.9	2.5
strijdt	(he/she) battles		2.2	2.2	0.8
verloofd	(being) engaged		1.5	1.4	4.8
veroverd	(having) conquered		2.7	2.7	4.8
verroeste	rusted (adject. used)		1.1	1.0	5.8
verwaarloost	(he/she) neglects		1.9	1.9	6.8
verward	(being) confused		2.2	2.1	6.3

NB Overall frequency=frequency in entire BasiLex corpus; summed frequency=frequency for the grade in which the word was given in the dictation plus the grades before that one (e.g. for house this would be the summed frequency of grade 1 and grade 2).

Table 4: Dictation words, grade, BasiLex log frequencies, and percentage of children for which spelling of the word could not be retrieved (all data rounds taken together)

We determined the number of correct spellings and the number of particular incorrect spellings partly automatically and partly by hand (by looking up and counting spellings in an Excel file). Both methods required keying in as many different incorrect spellings we could think of. In this way, for each word we could look up roughly 95% of the spellings, with some outliers to either side. The remaining 5% are unreadable words, missing words, or very eccentric spellings. We also looked up the overall lemma frequencies and the summed lemma frequencies for the grades in BasiLex and computed the log frequencies. Table 4 gives the word, grade, BasiLex log frequency, and percentage of children for which we could not retrieve their spelling of the word. The relatively high percentage

of spellings not found for *toeschouwers* most probably reflects the difficulty of spelling this word – it allows for many different incorrect spellings and probably often is left out by the children.

5. Results

In this section we first, in a rather lengthy Section 5.1, discuss the results regarding Research question 1, with some excursions to Research question 2 yet only descriptively. Then, in Section 5.2, we report the statistical analyses meant to answer Research question 2. In Section 5.3 we will answer Research question 3.

5.1 Research question 1

5.1.1 Correct spellings and different types of spelling errors

In order to investigate how Dutch children perform on the spelling of words that are notoriously difficult (first research question), we computed the percentage of children that gave correct spellings for each word and the percentage of children that made the spelling errors we hypothesized. Table 5 gives these figures for grades 2 (white), 3 (grey), 5 (white), and 6 (grey) consecutively. The totals do not add up to 100% since, as we discussed above, not all spellings could be retrieved. In each frame first the percentage of entirely correct spellings is given. Next (if existent) the percentage of children is given that did spell the word correctly as far as the particular spelling difficulty was concerned but that made one or more other spelling errors. For instance in *steil*, this could be *zteil*, in *verroeste* this could be *veroeste*. The notations with the 'greater than' sign (>) first give the correct spelling and then what the child made of it. So, for instance, 0.6% of the children turned the *ou* from *nou* into *au* and then into *ua*[5] whereas 15.8% of the children turned the *ou* into *au* and spelled it as *au*. In all these cases, the children might or might not have made other spelling errors in the word as well, for instance, to remain with the given example, spelling *nuaw*. To give an example for the verbs: *gevluchte* was spelled entirely correct by 64.0% of the children; 10.0% did write *t* as they should have but made another spelling error (e.g. *gefluchte*); 16.5% wrote *tt* (e.g. *gevluchtte* or *gefluchtte* or *gevlugtte*, etc.) and 0.4% wrote *d* instead of *t* (e.g. *gevluchde* or *gevlugde*, et cetera).

In our discussion of Table 5, in the next sections, we will compare incorrect spellings regarding the particular spelling problem with correct spellings of the words as far as the particular spelling problem is concerned (so taking spellings that were wrong only at other points as "correct", e.g. adding up 43.2% and 19.0% for *verroeste*). It is important to mention here that many of the errors in cases where the children did spell the diphthong or the verb ending correctly, were homophonic, for instance spelling *luifel* as *luivel*, *toeschouwers* as *toesgouwers*, *gevluchte* as *gefluchte*, *veroverd* as *feroverd*, et cetera.

5.1.2 Results for grades 2 and 3

Table 5 shows that three of the seven words spelled by grade 2 children have percentages correct for the diphthong of 80 or higher; three words score about 75%, and one (*steil*) has only 19% correct. This word is not the one with the lowest BasiLex frequency (see Table 4) but it is the only one with *ei*. BasiLex gives as summed (grade 1 and 2) frequency for words with *ij* 106,028 (log frequency 5.02) and for words with *ei* 18,254 (log frequency 4.26). So *ij* is much more frequent than *ei*. Most probably children spell here what they encounter most. *Stijl* is also a Dutch word but with a lower summed frequency than *steil* (BasiLex frequency of 9 against 20 for grades 1 and 2 together).

For grade 3, from the six words there is one with a percentage correct for the diphthong around 95; three are in the 80% to 90% range; one is in the 60% to 70% range (*toeschouwers*, with many

5. We didn't expect children to write *ji* instead of *ij* since the handwritten *ij* is written as one letter. And indeed we did not find a single child that wrote *ij* as *ji*.

huis	96.6	steil	18.9	rijst	73.1	slijpen	79.8	vrouw	71.6
ui>iu	2.0	ei	0.0	ij	0.4	ij	2.1	ou	6.1
ui>eu	0.2	ei>ij	50.2	ij>ei	21.8	ij>ei	9.0	ou>au	12.2
total	98.7	ei>ie	0.6	ij>ei>ie	1.2	ij>ei>ie	0.6	ou>uo	0.6
keus	81.5	total	69.7	total	96.5	total	91.5	ou>au>ua	0.6
eu	1.4	nou	62.2	toeschouwers	51.7	trouw	82.4	total	91.0
eu>ue	5.5	ou	13.4	ou	14.5	ou	2.2	beitel	17.3
eu>ui	3.8	ou>uo	2.3	ou>uo	0.8	ou>uo	0.7	ei	1.8
eu>ui>iu	0.3	ou>au	15.8	ou>au	12.1	ou>au	11.5	ei>ij	74.4
total	92.5	ou>au>ua	0.6	ou>au>ua	0.1	ou>au>ua	0.0	ei>ie	0.1
luifel	37.9	total	94.3	total	79.1	total	96.8	total	93.5
ui	51.5	knijpen	83.1	vrijdag	94.9	gevluchte	64.0	slijpt	91.7
ui>iu	0.5	ij	5.0	ij	0.6	t	10.0	t	2.5
ui>eu	2.2	ij>ei	10.7	ij>ei	0.7	t>tt	16.5	t>d	0.3
ui>eu>ue	0.2	ij>ei>ie	0.7	ij>ei>ie	0.3	t>d	0.4	t>dt	0.0
total	92.3	total	99.4	total	96.5	total	90.6	total	94.5
verpleegd	28.3	verschroeid	30.8	versierd	64.4	verzendt	28.7	verwoeste	74.0
d	0.2	d	4.9	d	2.5	dt	0.4	t	3.6
d>t	63.4	d>t	55.7	d>t	24.3	dt>d	58.5	t>tt	13.8
d>dt	1.8	d>dt	1.6	d>dt	4.6	dt>t	9.9	t>d	3.6
total	93.7	total	93.0	total	95.9	total	97.6	total	95.0
bespiedden	18.5	zuchtte	33.3	aanvaardde	21.7	meldde	60.7	verroeste	43.2
dd	3.0	tt	1.6	dd	0.3	dd	1.3	t	19.0
dd>d	74.8	tt>t	62.0	dd>d	73.1	dd>d	36.2	t>tt	29.8
total	96.3	total	97.0	total	95.1	total	98.2	t>d	1.6
verward	67.6	verloofd	75.9	strijdt	67.3	slachtten	49.2	t>dd	0.1
d	0.2	d	0.3	dt	0.9	tt	4.4	t>dt	0.0
d>t	16.4	d>t	14.9	dt>d	30.0	tt>t	43.4	total	93.7
d>dt	9.5	d>dt	3.8	dt>t	0.9	tt>d	0.3		
total	93.6	total	94.9	total	99.1	total	97.3		
verwaarloost	54.1	veroverd	66.9	minachtte	30.6				
t	5.3	d	11.4	tt	0.5				
t>d	32.6	d>t	13.6	tt>t	62.2				
t>dt	5.5	d>dt	3.4	tt>d	0.0				
total	97.4	total	95.2	total	93.3				

Note: The first line in a frame gives the percentage of entirely correct spellings. The second line gives correctly spelled words as regards the spelling difficulty indicated by the grapheme(s) yet incorrectly spelled otherwise. In a>b, a gives the correct spelling, b gives the incorrect spelling that the child gave instead. In a>b>c, c gives the incorrect spelling the child gave of the incorrect b spelling. For further explanation see the text above.

Table 5: Percentages of children that gave particular spellings, summed up over all data rounds.

unreadable, missing, or very eccentric spellings); and again the only word with *ei* has the lowest score of about 19% correct. Although *beitel* had the lowest-but-one BasiLex frequency of occurrence (see Table 4), most probably here also the cause is the more frequent *ij* spelling compared to *ei*. Summed (grade 1, 2 and 3) BasiLex word frequencies are 210,347 (log frequency 5.32) for words with *ij* and 38,955 (log frequency 4.59) for words with *ei*. *Bijtel* is not a Dutch lemma although it is a highly rare word form of the also quite rare verb *bijtellen* (EN: count up, zero frequency in BasiLex for the word form and lemma).

5.1.3 Results for grades 5 and 6

In grade 5 the easiest verb *slijpt* (stem not ending with *d* or *t*) is spelled correctly for the verb ending by almost 95% of the children. A similar present tense but now for a word with a stem that does end with *d* (*verzenden*) results in a percentage correct of 29.0%. The past tenses and the participles, that all might elicit homophone errors, have percentages correct between 21.0% and 66.9% so rather divergent but all of them not very high. Finally, there are the deverbal (past participle) adjectives *gevluchte* and *verwoeste* which are spelled correctly fairly often with 74.0% and 77.5%. These better results might be due to the fact that the *t* in these words can be heard so most children will choose between *t* or *tt* for these words and not consider *d* or *dd*, as Table 5 confirms. In grade 6 most percentages are in the 50% to 70% range with two participles (*verloofd* and *veroverd*) scoring around 75% and two past tenses (*minachtte* and *aanvaardde*) scoring 30.6% and 21.7%, respectively. Whereas the scores for grade 5 more or less reflect the item difficulty, this is less the case for grade 6.

Formally, if the spelling rules for verbs are known, most Dutch verb forms can be spelled following these rules provided that the infinitive is known from which the inflected form is derived. There is no need for any further knowledge about the particular verb involved. Nevertheless, the literature shows that frequency does play a part also for words for which the spelling can be derived from rules (Sandra et al. 2004). Therefore, we also looked at the BasiLex summed frequencies of verb forms ending with *t*, *d*, or *dt*. Similar to grade 2 and grade 3 children making more *ei* >*ij* errors because *ij* is more frequent, the grade 5 and grade 6 children might make particular verb spelling errors more often because these spellings are more frequent. It has been found that Dutch adults in their errors of verb spellings typically chose the more frequent (in written Dutch) homophone spelling (Sandra et al. 2004). For grades 1 to 5 the summed frequencies of verb forms ending with *t*, *d*, and *dt* were 447,054 (log frequency 5.65); 100,076 (log frequency 5.00); and 28,185 (log frequency 4.45) respectively. For grade 1 to 6 these were 503,502 (log frequency 5.70); 117,037 log frequency 5.06); and 33,404 (log frequency 4.52). So, verb forms ending with *t* are considerably more frequent, even more so when those with *dt* are added.

Looking at Table 5 we see a mixed pattern. *Verpleegd* and *verschroeid* (grade 5) have many more spellings with *t* than correct spellings with *d* so these results are in line with the expectations based on the frequencies. In contrast, *versierd* (grade 5) and the grade 6 words *verward*, *verloofd* and *veroverd* have more (correct) spellings with *d* although they still have a considerable number of spellings with *t*, ranging from 17.0% to 28.9%. The verb forms with *t* are not particularly spelled better than the verb forms with *d*. Of course, we have a limited number of cases here. Looking at the spelling of all verb forms ending with *t*, *d*, or *dt* in the Free texts and Themed texts of BasiScript could add to these results.

5.1.4 Differences between cohorts

Whereas in the foregoing sections we looked rather detailed at the spellings of individual words, here we take a broader perspective and compare cohorts. Table 6 gives the percentages correctly spelled words for each data round per grade.

grade (N words)	**aut12**	**spr13**	**aut13**	**spr14**	**aut14**	**spr15**
gr2 (N=7)	65.8	71.4	64.3	70.9	70.6	72.2
gr3 (N=7)	58.2	64.8	60.1	65.2	60.3	63.5
gr5 (N=10)	40.8	47.7	40.5	46.4	42.7	49.4
gr6 (N=10)	52.9	55.4	50.3	57.1	49.2	57.5

Table 6: Percentages correct per data round (total N words=32)

We wish to point again to the fact that part of the children did the same dictation test in the autumn and spring of the same school year. Perhaps children who spelled the word correctly the first time were more likely to also spell it correctly the second time because they had a qualitatively high mental representation of the orthography of the word already. Moreover, the correct writing down of the word the first time might add to the frequency with which the word was seen by the child and, more importantly, enhance the quality of the mental representation of the word since the child not simply read the word but wrote it down herself. Similarly, writing down the word incorrectly the first time might add to the frequency of incorrect spellings and record incorrect spelling of the word in the mental lexicon. The few studies investigating the effect of seeing incorrect spellings give mixed results. Two studies with college students showed that reading incorrect spellings negatively affected spelling accuracy of the read words later on (Jacoby and Hollingshead 1990, Dixon and Kaminska 2007), whereas in another study, with 10-year olds not such effects were found (Dixon and Kaminska 2007).

Table 6 shows that in almost all cases scores are higher in spring than in autumn of the same school year. It would be methodologically difficult to split apart, as a cause of this improvement, general word learning during the school year from the effects of the fact that part of the children had performed the same dictation half a year before (since sometimes entire schools did the same dictation twice, or rather once, and then the variation in results could be caused either by school differences or by differences in how often the dictation was done in a school year). Moreover, all six data rounds had partly the same and partly different participants. Nevertheless, it is remarkable that the autumn-spring differences mostly lie around 5% to 6%, whereas the autumn-autumn and spring-spring differences mostly lie around 1% to 2%. So the different cohorts do not really show different results. In other words, Dutch children's spelling ability seems to have not clearly improved nor deteriorated over the years 2012 to 2015. The only exception is grade 2 in autumn '14, there we see an increase of some 5% as compared to autumn '13 and autumn '12. We cannot explain this result. More detailed analysis of the data are necessary, in which the results of the children who did the same dictation twice are separated from the other results and in which, more importantly, the degree to which data collection rounds resembled each other as regards the participating schools is investigated.

5.2 Research question 2

We analyzed the correlations between the autumn performances (in which all children did the dictation for the first time) and both the overall logged frequencies and the summed logged grade frequencies of the lemmas of the spelled words in BasiLex, see Table 7. We took the three autumn performances together, so that the difference in participant groups in the three autumn measurements did not play a role. We also analyzed the correlations for the spring performances taken together, but we present these with caution for the reasons discussed above.

	Total score 3 springs	**Summed lemma log freq**	**Total lemma log freq**
Total score 3 autumns	.966**	.361 n.s.	.507**
Total score 3 springs		.461*	.553**
Summed lemma log freq			.886**

* Significant at the .05 level.
** Significant at the .01 level.

Table 7: Correlations autumn scores and spring scores (correctly spelled words) with BasiLex frequencies for 32 words

Table 7 shows a very high correlation between the autumn rounds and the spring rounds. This suggests, again with caution, that some words remain difficult also after half a year of schooling.

Contrary to our expectations, correlations are higher and have a better significance level for the total lemma log frequency of the words in BasiLex than for the summed log frequency over the grades. This might be explained, first, by the fact that the number of words on which the summed grade frequencies are based is by definition lower than the number of words on which the total frequencies are based, which gives the former less power. Moreover, word counts over all grades taken together will have a higher ecological validity (i.e. they represent reality better) than word counts computed over only a few grades – with fewer grades there is a higher chance occurrence risk.

It is also surprising that correlations are somewhat higher in the spring than in the autumn, where we would have expected them to be lower because of the presence of more noise. The total number of participants in the spring rounds was higher than in the autumn rounds (N=5,088 as against N=4,393, see Table 3); this might have caused more robust effects. Furthermore, it is understandable that input frequency plays a smaller role at the beginning of the school year, after a long vacation period in which most children have received much smaller amounts of written input than they have received towards the end of the school year.

We thereupon did a regression analysis on the autumn results with the total lemma log frequency only, because of the high correlation (.886, Table 7) between the two frequency measures (collinearity). We used the total lemma log frequency because it had the highest correlation with the spelling results, with the highest significance level. The ANOVA yielded a significant model, F(1.30)=10.383, p-value=.003, with an R^2 of .257, implying that 25.7% of the variance in the spelling results was explained by the total lemma log frequency in BasiLex.

5.3 Research question 3

For all 32 dictation word forms we looked up their occurrence in the BasiScript Free texts and Themed texts of the respective grades, see Table 8. In Grade 2, all dictation words are used in the texts although some very infrequently, and they are spelled correctly most of the time. The types of error mostly involve the homophonic nature of the word and some reversals or other errors. Only for huis (EN: house) the number of reversals is higher than the number of homophonic errors. In Grade 3, four of the six dictation words are used, only two of them with a reasonable frequency and the far majority of them are spelled correctly. In Grade 5, only three out of nine dictation word forms are being used. From the three verbs only versierd (EN: decorated) is quite frequent and well over one third of them are spelled incorrectly, in all cases these were d/t errors. In Grade 6, eight out of ten dictation words are being used, yet all of them quite infrequently, and few errors are made. Table 8 also gives the percentages correct of the six words that occur reasonably frequently in the texts, for the texts and for the dictations. The small number of cases makes statistical analyses nearly impossible, although a marginally significant correlation of ,793, p=:06 was found. However, the similarities are striking, with the exception of nou which was spelled incorrectly much more often in the texts than in the dictations. An explanation might be that children tend to use nou (EN: now) as a stopgap in their texts and therefore spell it rather carelessly whereas in the dictations they treat it as they treat the other dictation words.

					error type			
grade	**word form**	**freq.**	**corr. spelled**	**incorr. spelled**	**homophone**	**reversal**	**d/t**	**other**
2	steil	6	3	3	3			
	slijpen	6	6	0				
	rijst	7	5	2	2			
	keus	8	6	2				2
	vrouw	39	27	12	10	1		1
	nou	314	263	51	35	7		9
	huis	982	935	47	18	26		3
3	luifel	0						
	toeschouwers	0						
	beitel	1	0	1	1			
	knijpen	4	4	0				
	trouw	39	32	7	4	1		2
	vrijdag	123	118	5				5
5	bespiedden	0						
	gevluchte	0						
	slijpt	0						
	verpleegd	0						
	verschroeid	0						
	verzendt	0						
	verwoeste	2	2	0				
	zuchtte	11	2	9			9	
	versierd	35	22	13			13	
6	aanvaardde	0						
	verroeste	0						
	minachtte	1	1	0				
	slachtten	1	1	0				
	verwaarloost	2	2	0				
	verloofd	2	2	0				
	strijdt	4	2	2			2	
	meldde	6	5	1			1	
	veroverd	6	6	0				
	verward	6	4	2			2	

grade	**word form**	**perc corr dictation**	**perc corr text**
2	huis	96.6	95.2
2	nou	62.2	83.8
2	vrouw	71.6	69.2
3	trouw	82.4	82.0
3	vrijdag	94.9	95.9
5	versierd	64.4	62.9

Note. Homophone: ei/ij etc. errors; reversal: ou/uo etc. errors; other: in all cases the word was spelled correctly as regards homophone or d/t but some other spelling error was made

Table 8: Occurrence of dictation words in the BasiScript (Free and Themed) texts per grade with number and type of errors, N=32, and percentage correct in dictations and in texts for six word forms.

6. Conclusion

The present study shows that the spelling issues we discussed in Section 3 pose problems for children in the respective grades. Table 5 shows that the spelling errors they make in many cases are diphthong errors or verb ending errors. However, the degree to which this is the case varies rather heavily per word. For grades 2, 3 and 5 the best spelled words had a percentage correct of around 92% to 97% and the worst spelled words had a percentage correct of around 18%. For grade 6 the distance between the percentage of the best spelled word and the worst spelled word was smaller (76% and 22%, respectively). It is also clear that the verb spellings are much more a problem for grades 5 and 6 than the diphthong spellings are for grades 2 and 3. Where, except for the outliers, the percentages correct are around 40% to 80% for the lower grades, for the higher grades they are mostly around 30% to 60%. Here it should be noted again that, on principle, verbs can be spelled correctly if one knows the rules. This also holds for rather infrequent or unknown verbs. In contrast, the homophone words for grades 2 and 3 require knowledge of the word itself or at least the relevant morpheme in the word.

Another conclusion is that although a statistical comparison between grades 5 and 6 is not possible given the different target words, there is no indication that grade 6, the last year of primary school, performs better than grade 5. Apparently, the rules for Dutch verb spellings that are at stake here are difficult to apply in all cases even for children at the end of primary school. Tentative explanations for the error types and their numbers can be found in the frequencies of the different spellings of certain diphthongs (i.e., *ij* more frequent than *ei*) and to a lesser degree in the frequencies of certain verb endings (*t* more often than *d*) in the reading materials that are offered to children (i.e., as measured in BasiLex). In their misspellings, children seem to choose spellings that they encounter more often in their reading materials. We did find fairly strong correlations between BasiLex frequencies and spelling performance. We also found that the differences between the cohorts seem to be small, so the spelling performance in school years 2012/2013, 2013/2014, and 2014/2015 did not differ very much.

A comparison between performance on the BasiScript dictation words and on the same words as used in the BasiScript texts turned out to be possible only to a limited extent, since most of the investigated dictation words were not or very sparingly used by the children in their texts. Nevertheless, the percentages correct for the dictation words and for the same words as spelled in the texts were highly similar, and a relatively high although only marginally significant correlation was found for the dataset with only six target words. This points to consistency of spelling performance in different tasks and was also found in another study. However, in that study the comparison between dictations and compositions was not on a one to one basis but on the overall spelling performance per task, which makes it easier to have enough power for statistical analyses (Bigozzi et al. 2017).

The present study was a first, limited and exploratory study into the brand-new BasiScript corpus. Much more is possible. Especially studies in which BasiLex (children's written input) is related to BasiScript (children's written output) can yield important insights into Dutch children's written language development. Such insights can help developers of assessment tests and school methods to produce better products, and they can help teachers to develop better education for children.

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