

Sources of spelling mistakes in the writing process

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1 INTRODUCTION

Research into reading and writing may help us to better understand the cognitive functioning of humans. In the last decades an enormous number of studies on the processes of reading and writing and on the acquisition of these skills has been published. Strikingly enough the bulk of it was devoted to reading and much less to writing. This is particularly true for the basic processes of using spelling in reading and writing, i.e. grapheme-phoneme and phoneme-grapheme conversions. An explanation for this may be sought in the fact that reading processes lend themselves more easily to manipulation in laboratory conditions and to techniques such as time measurement (e.g. latencies) or eye tracking. In our contribution we focus on the spelling process.

This contribution is based on research in progress on spelling in Dutch. It is well known that languages with an alphabetic spelling may vary in the degree to which their spelling reflects deep or surface phonology. Examples of the first are English and French, for the second Italian and Spanish. Dutch spelling is often considered to be somewhere in-between.

As the mental operations involved in the spelling process are hard to look into empirically, we think that spelling mistakes may be an excellent way to approach the mental operations. In an intuitive way we restrict the notion of spelling mistake to outputs that are plausible given the spelling system of a given language. Therefore we would categorise an output in English such as 'Their is a problem...' as a spelling mistake. We disregard mistakes such as 'Tehre is...' because such outputs may easily be ascribed to non-linguistic causes as e.g. (occasional) motor dysfunctions.

2 RESEARCH QUESTIONS

In recent years a spelling (writing) model has been advanced in which phonologic mediation plays a preponderant role (e.g. Van Orden et al. 1990; Bosman 1994; Kempen 1994). Spelling a word would mean first and foremost that its phonemes are coded into graphemes. This coding clearly cannot simply proceed from one phoneme to the next one. When one is to write the phoneme /o/ in Dutch in e.g. *zoon* or *zonen* (E. 'son', 'sons') he has to take into account the nature of the syllable.¹ Syllable-final position (open syllable) requests <o>, another position (closed syllable) requests <oo>. Bosman (1994: 94) shows that the phoneme /i:/ in English words can only be coded correctly when the writer takes into account the word as a whole as can be seen in: *be*, *entry*, *key*, *leaf*, *chief*, *beef*. According to Bosman (1994: 93-95) and other authors the spelling learning process involves establishing connections between certain phonological subsymbols and certain orthographic subsymbols. In a model of phonologic mediation the notion of frequency is of the utmost importance in all those cases where a given phoneme may be coded into more than one grapheme. The greater probability of one conversion over another is due to the frequency with which the speller has made these conversions. In other words, the strength of the connections is determined by the speller's writing practice.

Adherents of this model claim that there is always phonologic mediation and that a single route model, with only phonologic mediation, is sufficient to account for the spelling process. They reject the current dual route model² which includes both (1) an indirect, phonological route, and (2) a direct route from orthographic lexical representation in the

¹ Phonemic representations are indicated by slashes (/ /), graphemic representations by angle brackets (< >).

² An excellent survey of the arguments for a single route and a dual route model is given in Kleijnen (1997).

mental lexicon to an orthographic output. A direct route means that there is actually no phoneme-grapheme conversion; the writer copies a graphemic representation of an entire lexical unit ('word image' or 'orthographic image') taken from his mental lexicon into a graphemic output. Secondly the direct route is also postulated in cases where the writer is assumed to copy the graphemic representation of part of a lexical item (analogy) into a graphemic output; this would be the case when a writer is writing a pseudoword (e.g. Lewis Carroll's Jabberwocky: *slithy*, analogy with *slimy*) or a word that is novel for him (e.g. *raving*, analogy with *saving*).

Under the assumption of necessary phonological mediation we want to explore the question whether this is sufficient for covering the spelling process. Bosman (1994: 94) writes: "[...] only when the word as a whole contributes to the orthographic coding will the proper spelling be activated". In this contribution we want to explore the question whether 'the word as a whole' is the sole larger unit at stake in the coding of phonemes into graphemes. What is in other words the nature of these larger units involved in phoneme-grapheme conversion: syllables, morphemes, words, varying phoneme clusters, varying grapheme clusters. Does the phoneme-grapheme conversion operating on units larger than the single phoneme involve non-phonological decisions of a paradigmatic, grammatical (syntagmatic) or semantic nature?

3 PROCEDURE

We collected a corpus of some ninety spelling mistakes in Dutch, made by adult, experienced writers, in Flanders (Belgium) and in the Netherlands. They were university students, linguists, university professors, journalists etc., in other words writers whose mistakes cannot be explained by ignorance, lack of proficiency, lack of training and the like. The mistakes were found in quality newspapers, journals, novels, letters, university syllabuses, doctoral dissertations and the like.

In the first place these mistakes were examined by comparing them with the token frequencies found in the 38 million words corpus of the Instituut voor Nederlandse Lexicologie at Leyden (INL, Netherlands)³. We did not take into account type frequencies.⁴

Secondly, we set up some elicitation experiments with adult experienced writers. The selection of stimuli was based on our corpus of mistakes and on our frequency findings. As this second phase is still in progress we will in the remainder of this contribution discuss findings based on frequency data.

4 RESULTS

³ We want to express explicitly our gratitude to the Instituut voor Nederlandse Lexicologie at Leyden, and its director dr. P. van Sterkenburg, for their willingness to give us on-line access to the Institute's corpora. Without their assistance this study would not have been possible.

⁴ For clarity's sake we would like to point out that a token frequency represents the frequency of occurrence of a particular word form (or part of a word form) in its orthographic representation in the printed sources that the INL 38 million corpus was based on. For our purposes it is very useful that this corpus contains the forms as they were found in the printed sources, including spelling and other mistakes.

Type frequencies refer to the frequencies of the lexical entries that the tokens are considered to be connected with, and are therefore less useful for spelling research.

Spelling errors are particularly persistent in the case of homophones. According to traditional spelling instruction in Dutch a distinction is made between variable and non-variable (constant) words. The spelling differences between homophonous forms of the same word paradigm is traditionally seen as an instance of variability. This is typical for conjugation. Examples: (*ik*) *vind*, (*hij*) *vindt* ('I find', 'he finds'); (*hij*) *betaalt*, (*het is*) *betaald* ('he pays', 'it has been paid'). As at the surface there is no difference to be heard, variation in spelling is here said to reflect deep phonology; in surface phonology all obstruents are voiceless in syllable-final position. One may however suspect that the spelling variation in these cases is strongly artificial, as it was designed and consecrated in the 18th century in the name of rationalism⁵. In any case, when a speller has to convert the phonemes of /v~~vw~~/ he has to decide between <vind> and <vindt> on the basis of grammatical (syntactic) considerations.

In Dutch we also find homophonous word forms that belong to different word paradigms, in which case we may speak of constant word forms. An example is *peil*, *pijl* ('level', 'arrow'). The spellings <ei> and <ij> are different graphemes for the same diphthong. They are motivated by etymology, of which the normal speller is not aware. Therefore the decision for one grapheme rather than the other is based on semantic considerations, i.e. word meaning.

In the following we present some results of our examination of spelling mistakes in the case of homophones, and of associated frequencies we found in the INL corpus.

4.1 Verb forms

Dutch verb forms have in common that their spelling is in principle governed by rules that take into account grammatical function. Therefore one possible explanation for spelling mistakes in this domain is a defective application of these rules by the speller⁶.

But another explanation may be put forward as well. It might well be the case that the speller does not apply these rules at all, but that he rather makes a phoneme-grapheme conversion strongly directed by the relative high frequency of certain grapheme strings corresponding to entire words, morphemes, syllables or just certain phoneme strings. That is the avenue we want to explore in this paragraph. To this end we consider two cases: (1) verbs ending in <dt> or <d>; (2) verbs ending in <tte> or <te>.

4.1.1 Verbs ending in <dt> and <d>

In the case of verbs whose stem ends in deep phonology in /d/ there is a large number of homophonous verb forms in the present tense of finite verbs with two alternative endings depending on their syntactic function: <dt> in the second and third person singular of the finite verb (*je wordt*, *hij wordt*); <d> in the first person and in the second person with inversion of subject and finite verb (*ik word*, *word je*).

The striking fact is that for the verbs *vinden*, *binden*, *treden* and *worden*⁷ we found impressive numbers of mistakes where the writers produced <dt> instead of <d>. The verb

⁵ Medieval Dutch texts very often reflect surface phonology.

⁶ Politicians and other laymen, and even teachers, in Flanders and the Netherlands often believe that misspellings of verbs by students or the general public are due to laziness ("they know the rules but are too lazy to apply them"), or to a lack of norm conscience or to a defective intelligence. People are often stigmatized for verb misspellings. The one and only occasion I have ever known our government to apologize publicly was when a few years ago the Flemish government published an advertisement in the newspapers in which they made their excuses for a verb misspelling in a government advertisement one day earlier!

forms: *vind*, *bind*, *treed* and *word* were produced erroneously as *vindt*, *bindt*, *treedt* and *wordt*. We found a much smaller number of mistakes in the opposite direction.

In Table 1 we illustrate this with the frequency figures of correct spellings for *word* (right-hand column) and the mistake *wordt* in the 38 million corpus of the INL.⁸

Table 1

ik wordt	11 (8%)	ik word	127
wordt ik	7 (8%)	word ik	81
wordt je	44 (15,2%)	word je	240

In Table 2 we present frequency figures from the INL. Since these verb forms occur in compound and non-compound words we looked up the figures for both; this is indicated by the wild card *. We also used the wild card * to focus on forms that are smaller than the corresponding morpheme, forms that consist of a string of graphemes (vowels or consonants) which is part of the morpheme; in the same way we represent any string of consonants by the wild card C; in later tables the symbol V stands for vowel graphemes. Between square brackets we indicate either that the form was looked for without any restriction as to word class: [0]; or that the search was restricted to verb forms: [v].⁹ The left-hand column of Table 2 contains possible spellings which are correct in certain contexts and wrong in others.

Table 2

[0] *vindt	16614	*vind	4259
[v] *vindt	16614	*vind	4259
[0] *bindt	706	*bind	17
[v] *bindt	706	*bind	17
[0] *Cindt	17450	*Cind	22775
[v] *Cindt	17423	*Cind	5661
[0] *treedt	9324	*treed	159
[0] *reedt	9337	*reed	6428
[0] *eedt	9900	*eed	17593
[v] *treedt	9324	*treed	159
[v] *reedt	9336	*reed	4043
[v] *eedt	9897	*eed	13242
[0] *wordt	163279	*word	775

⁷ They correspond roughly with the English verbs *to find*, *to bind*, *to tread*. The Dutch verb *worden* is the passive auxiliary or else the verb corresponding to the English copulative verb *to become*.

⁸ It should be stressed that the original texts in the INL corpus (newspaper articles etc.) have passed some form of editing or correction before their publication. From this we may infer that the frequency of mistakes must in reality be much higher.

⁹ Due to the Dutch spelling system the vast majority of words ending in <dt> cannot be anything else than second or third person finite verbs in the present tense. This explains the small frequency differences between the figures for [v] words and [0] words.

[v] *wordt	163279	*word	773
[0] *Cordt	163294	*Cord	4566
[v] *Cordt	163280	*Cord	875

From Table 2 we may make some tentative inferences.

First of all the frequency figures suggest that if writers erroneously use the form in <dt> they may do so on the basis of the much higher frequencies of the full forms in the left-hand column. If we descend to a level lower than word level (the full form) in cases as *vindt*, *bindt* (<*Cindt> and *treedt* (<*reedt>, <*eedt>) we find frequencies with which the mistakes are no longer congruent.

Moreover the strongly diverging figures for [0] *Cind (22775) and [v] *Cind (5661) suggest that if the writer is influenced by frequency of use he seems to keep in mind some notion of verb character when he spells *vindt* instead of *vind*, and *bindt* instead of *bind*.

The extremely diverging figures for *wordt* and *word*, irrespective of the question if word category is taken in consideration, strongly suggest frequency as the cause of misspellings.

4.1.2 Verb forms ending in <tte> and <te>

A number of Dutch verb forms end, at least in surface phonology, in the phonemes /tɕ/. In spelling this ending can only be rendered as <tte> if it is a past tense singular form of a verb whose stem ends in /t/. On the other hand there are a number of sources for the ending <te> (with one <t>): past tense singular of verbs whose stem ends in a voiceless obstruent other than /t/; the inflected form of the past participle of all verbs whose stem ends in a voiceless obstruent, including /t/; and the inflected past participle of certain strong or anomalous verbs (e.g. *gezochte*, from *zoeken*, E. *search*).

There are a number of interesting mistakes to discuss. They involve mistakes such as *lachte*, *kuchte*, *onverwachte*, *bevoorrechtte*. The first two were meant as singular past tense of verbs whose stem ends in /x/ (the voiceless velar fricative). In that case however the only possible form in Dutch is a form with a single <t>; the forms *lachte* and *kuchte* are in fact impossible according to Dutch orthography, they are nevertheless often to be found as mistakes. The last two forms as they occurred in our corpus were meant as inflected, adjectival forms of stems ending in <cht>, and should therefore end in <chte>. The word *onverwachte* is not possible because there is no verb *onverwachten*, only an adjective *onverwacht*, which however is related to the verb *verwachten* ('to expect'), which has a legitimate past tense form *verwachte* (with <tte>) in its paradigm. Of these four word forms only the last one, *bevoorrechtte*, can occur as a past tense of the finite verb and thus in principle function as a direct competitor for the intended form *bevoorrechte*.¹⁰

In Table 3 some frequency figures from the INL corpus are presented. All of the full forms in the left-hand column are necessarily spelling mistakes save *bevoorrechtte*, which may occur as a legitimate spelling, but which in our corpus was nevertheless a spelling mistake.

¹⁰ We say 'in principle' because the legitimate past tense form *bevoorrechtte* has a 0 frequency in the 38 million words of the INL. For this reason it should be doubted whether this infrequent form may act as a competitor and cause the misspelling of the inflected past participle.

Table 3

[v] lachtte	0	lachte	39
[v] *lachtte	6	*lachte	110
[v] *achtte	763	*achte	116
[0] lachtte	1	lachte	80
[0] *lachtte	7	*lachte	165
[0] *achtte	764	*achte	6894
[0] kuchtte	0	kuchte	0
[0] onverwachtte	1	onverwachte	382
[0] *verwachtte	132	*verwachte	787
[0] bevoorrechtte	0	bevoorrechte	85
[0] *rechtte	3	*rechte	2996
[0] *echtte	72	*echte	8500
[v] *echtte	61	*echte	0
[v] *Vchtte	2100	*Vchte	163
[v] *Vchtten	631	*Vchten	25943
[0] *Vchtte	2101	*Vchte	24311
[0] *Vchtten	633	*Vchten	58924

If we assume that frequency of competitor word forms may be an explanation for certain spelling mistakes, then the frequency figures in Table 3 may lead us to some intriguing hypotheses. First of all it is as if writers have a tendency to spell the verb ending /xt/ as <chtte> regardless of the question whether the stem ends in /x/ or in /xt/.¹¹ In verbs the frequency of the ending <*Vchtte> (2100) is much higher than the frequency of <*Vchte> (163). The nature of the vowel, represented here as V, does not seem to matter. But according to the INL frequencies this superiority of <*Vchtte> over <*Vchte> is restricted to verb forms (indicated by [v] in Table 3); the overall frequencies of <*Vchtte> (2101) and <*Vchte> (24311) show a radically different tendency when we disregard word class. This seems to suggest that something like a vague verbal notion is present when spellers make the mentioned mistakes, even when they are not writing a finite verb but an inflected adjectivized participle or a deverbative adjective. If competitor frequency is at stake, then the competitor is not the full word, but only a grapheme pattern of the form <Vchtte>, in which the nature of the vowel is unimportant; the pattern is however associated with some notion of ‘verbness’.

In the second place the direction of the frequencies is radically different between forms ending in <e> and forms ending in <en>, where <n> either indicates a plural form or an infinitive. If frequency is an explanation for the erroneously spelt forms *lachtte*, *kuchtte*, *onverwachtte*, *bevoorrechtte*, then the frequency of the forms ending in <n> does not seem to be of influence since they offer a completely different picture from the forms ending in <e>.

Other mistakes with verb endings have to be interpreted somewhat differently. We refer to mistakes as *koste* instead of *kostte* (sg. past tense of *kosten*, E. ‘to cost’), and *peste* for

¹¹ This does not only hold for the four misspellings that are examined here, but for other verbs as well. We found other instances of misspellings following the same pattern, e.g. *gezochtte* (inflected past participle of *zoeken*, E. ‘to search’), *pochtte* (sg. past tense of *pochen*, E. ‘to boast’).

peste (sg. past tense of *pesten*, E. ‘to pester’). In contrast with the previous cases here the mistakes consisted in spelling <te> instead of <tte>, i.e. with one t instead of two. In Table 4 we present some frequency figures from the INL. The left-hand column contains the full forms that were produced as mistakes. The competitor *koste* however is legitimate as part of the prepositional expression *ten koste van* (E. ‘at the expense of’); the spelling *peste* is not possible at all.

Table 4

[v] koste	0	kostte	473
[v] *Coste	190	*Costte	477
[0] koste	735	kostte	473
[0] *Coste	1134	*Costte	480
[v] peste	0	peste	0
[v] *peste	0	*peste	3
[v] *Ceste	3	*Ceste	87
[0] peste	0	peste	0
[0] *peste	11	*peste	3
[0] *Ceste	5508	*Ceste	97

In contrast with the previous cases here the full forms *koste* and *peste* cannot be explained on the basis of their frequencies as verbs. If frequency is at the origin of the mistakes then we should rather take into consideration the frequencies of the grapheme cluster <*CVste> regardless of word class, and possibly regardless of the nature of the vowel grapheme¹².

4.2 Non-verb forms

We would also like to discuss some mistakes where no application of grammatical rules is involved. In this paragraph we discuss a couple of word endings.

A large number of Dutch words end in the phonemes /**cl**/ spelt either with one l (<elijk>) in e.g. *degelijk*, E. ‘thoroughly’, or with double l (<ellijk>) as in *onmiddellijk*, E. ‘immediate(ly)’. Especially this last word is famous for its misspellings with one l as *onmiddelijk*, or *onmiddelijke* for the inflected form. For learned people the word is transparent as a compound consisting of three morphemes: on+middel+lijk¹³. This composition necessitates the doubling of l. For probably the vast majority of writers the compound character is opaque; they see this word as inarticulated. Even though a lot of attention is paid to it in spelling instruction at school, including the use of mnemonics, people often make the mistake, as is clear from the frequency figures from the INL in Table 5. Even the Dutch inverted dictionary (Nieuwborg 1969) spelt it incorrectly.

A second case is the ending /**ck**/, as in *monniken* (E. ‘monks’), *haviken* (E. ‘hawks’), *perziken* (E. ‘peaches’). There is some doubt as to the exact nature of the phoneme preceding /k/: is it /**w**/ or is it /**c**/, possibly as an allophone for /**w**/. The plural forms of these

¹² In a number of other mistakes which we do not discuss in this contribution, we find the same situation.

¹³ Compare with German *unmittelbar* (un+mittel+bar) or English *immediately* (in+mediate+ly).

nouns consist of the singular form ending in <ik>, to which is added the plural ending <en>. Words like these are often spelt wrongly with double k.

In Table 5, which contains frequency figures based on the INL corpus, full word forms in the left-hand column represent misspellings, the correct spelling is given in the right-hand column.

Table 5

onmiddelijk	109	onmiddellijk	3404
onmiddelijk*	134	onmiddellijk*	4033
*Celijk	143606	*Cellijk	3695
Celijk	289060	*Cellijk*	4380
monniken	7	monniken	108
havikken	6	haviken	21
*Cikken	4180	*Ciken	261

When we compare the high token frequency figures of the strings <elijk> and of <ikken> with the much lower figures for <ellijk> and <iken>, we may conjecture that frequency is one of the main if not the main cause of the misspellings. As to the misspelling *onmiddelijk* the type frequency lends support to the conjecture as well. The inverted Dutch dictionary (Nieuwborg 1969) contains 7 entries¹⁴ ending in <ellijk> as grapheme representation for /~~ck~~/, against 966 entries ending in <elijk>.

If we assume that the higher frequency of competitor grapheme strings is a main cause of misspellings, then it is worthwhile to give some attention to the nature of these grapheme strings and of the corresponding phoneme strings. These strings do not correspond with well-known linguistic units larger than the phoneme such as morphemes or syllables. They clearly do not respect morpheme or syllable boundaries, and thus the grapheme strings that we represent as <elijk> and <ikken> do not coincide with specific Dutch morphemes or syllables, neither in speaking nor in spelling. This suggests that the units that writers handle in phoneme-grapheme conversion are just ‘chunks’ which are not determined by units which are dear to linguists such as morphemes or syllables although these chunks may occasionally as it were by chance overlap with morphemes or syllables.

The idea that the units writers handle in converting phonemes into graphemes are variable chunks, is possibly corroborated by misspellings such as the loanword *interview*, which is often spelt mistakenly, also in English texts by Dutch authors, as *intervieww*. This misspelling is particularly interesting because Dutch does not know the phoneme string /ju:/ with the corresponding grapheme string <iew>, but has the grapheme string <ieuw> (for the phoneme string /~~ɯ~~/ in e.g. *nieuw*, E. ‘new’), with a much higher frequency than the grapheme string <iew> of loanwords (see Table 6, based on the INL figures).

Table 6

intervieww	16	interview	755
ieuw	75876	*iew*	5946

¹⁴ Actually there should be 8 such entries, but as indicated before, Nieuwborg 1969 uses the misspelling *onmiddelijk*. The real number of lexical items might even be smaller, because three of them are compound forms of *adellijk* (E. ‘noble’). The seven entries are: *adellijk*, *oudadellijk*, *hoogadellijk*, *onadellijk*, *middellijk*, *ijdellijk* and *simpellijk*. This reduces the number of types ending in <ellijk> to 4. On the other hand the number of 966 entries in <ellijk> should also be reduced since a number of them are compounds.

5 CONCLUSION

In this contribution we examined misspellings for which token frequencies may be responsible. Under the assumption of phonologic mediation our examination of frequencies does not yield counterevidence to the idea that the unit of phoneme-grapheme conversion is larger than the single phoneme, but there are good reasons to assume that this larger unit often does not coincide with the word as a whole.

In the case of verb forms with alternatives such as *vindt* and *vind* (par. 4.1.1) our material suggests that full simple words (which may be part of a compound) are the units that are operated with¹⁵. At the same time we may conjecture that the speller attaches a notion of verbness to these words.

For the subset of verb endings in <tte> and <te> we considered, namely those containing the velar fricative /x/ (<ch>) the material suggests that the unit of operation is smaller than the single word, but here too the speller seems to use the notion of verbness. For another subset, including *koste* and *peste*, the unit of operation is also smaller than the single word, but the notion of verbness does not seem to be relevant.

In the non-verb forms we examined, the unit of operation does not seem to take into account morpheme or syllable boundaries. Here examination of the misspellings in relation to frequency suggests that writers operate on ‘chunks’ that are hard to define exactly; the only thing we can say is that these grapheme chunks have a relatively high frequency as compared with comparable chunks.

If frequency is an important cause of misspellings then it is frequency of units that are variable in their extent. This would mean that we should extend the meaning of the notion of homophone: it may denote various stretches of phoneme strings in the phoneme-grapheme conversion process. Moreover one may wonder if the notion of analogy in the direct route in the dual route model does not coincide largely with the phoneme-grapheme conversion over larger units in the single route model.

Finally we found some instances where sole phonologic mediation does not seem to suffice for explaining a number of spelling mistakes, e.g. certain cases where the notion of verb seems to be involved. Other misspellings¹⁶, which are not discussed in this contribution, clearly indicate that the speller makes semantic considerations. Since some of these mistakes are incongruent with frequency figures, we suggest that here too phonologic mediation is not sufficient.

To conclude, spelling mistakes remain fascinating, especially when they are made by literate people.

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¹⁵ We use here the term ‘simple word’ instead of ‘morpheme’ because we do not know whether a speller regards a 3rd person singular as *vindt* as consisting of 1 or 2 morphemes at the moment he is making the phoneme-grapheme conversion.

¹⁶ Examples are: *wijds* for *weids* (E. ‘sonorous’, ‘sumptuous’); *leidt* (‘E. leads’) for *lijdt* (E. ‘tolerates’); *peiler* for *pijler* (E. ‘pillar’).

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