What Spelling Changes
Orthography Workshop

Location: Max Planck Institute, Wundtlaan 1, Nijmegen

Thursday, November 6, 1997

10.00 - 10.30   Coffee

10.30 - 10.45   Introduction

10.45 - 11.45   Ignatius G. Mattingly, Haskins Laboratories, New Haven
"The Chinese writing system is not a syllabary."

11.45 - 12.30   Christina Noack, Helmut Spiekermann, Tobias Thelen, Institute for Semantic Information Processing, University of Osnabrück
"Computational tools for evaluating and teaching orthographic rules."

12.30 - 13.15   Matthias Butt, Institut für Germanistik, Universität Potsdam
"The role of word spacing and the conception of the 'word'."

13.15 - 14.15   Lunch

14.15 - 15.30   Anneke Nunn, Dutch Dpt., University of Nijmegen
"Dutch orthography: one type of spelling rules or two?"

15.30 - 16.15   Harald Baayen, Rob Schreuder and Anneke Neijt, MPI, IWTS and Dutch Dpt., University of Nijmegen)
"Linking graphemes in Dutch compounds - one letter more or less."

16.15 - 16.30   Tea

16.30 - 17.15   Peter Eisenberg, German Dpt., Potsdam
"How alphabetic writings reflect phonemic and syllabic structure."

17.15 - 18.00   Discussion: "Linguistic factors in alphabetic writing"

19.00   Dinner in town

Friday, November 7, 1997

09.00 - 09.45   Frans Daems, Universiteit Antwerpen, UFSIA
"What spelling mistakes can tell us about the writing process."

09.45 - 10.30   Gerard Kempen, Andress Kooij & Theo van Leeuwen, Dept. of Psychology, Leiden University
"Do skilled readers exploit inflectional spelling cues that do not mirror pronunciation? An eye movement study of morpho-syntactic parsing in Dutch."

10.30 - 10.45   Coffee

10.45 - 11.30   Hartmut Günther, University of Cologne
"On the role of orthography for writing systems."

11.30 - 12.15   Discussion: "What spelling changes"

12.15 - 13.15   Lunch

13.15 - 14.00   Beatrice Primus,Institut für Deutsche Philologie der Ludwig-Maximilians-Universität, München
"Suprasegmental phonology and orthography: the (his)story of the mute <h>."

14.00 - 14.45   Martin Neef, Universität zu Köln, Institut für deutsche Sprache und Literatur
"Regularity in phonology vs. spelling pronunciation."

14.45 - 15.00   Tea

15.00 - 15.45   Christa Röber-Siekmeyer, PH Freiburg
"Syllables in the perception of children at the beginning of writing and reading and its consideration for a concept for a writing and reading learning programme."

15.45 - 16.30   Anna M.T. Bosman, University of Nijmegen, Dept. of Special Education
"Metsch, Metch, or Match: The flexible game between orthography, phonology, and semantics."

16.30   Farewell drinks

The Chinese Writing System is not a Syllabary

Ignatius G. Mattingly
Haskins Laboratories & University of Connecticut

In an earlier paper (Mattingly, 1992), I have argued that an essential feature of a writing system is that it be "productive," that is, it must provide the user with a spelling system for representing and recognizing new words and words whose conventional spellings he does not know. Although an orthography may have other incidental apparatus, its productive spelling system is the core of what the writer/reader must know. Moreover, I claimed that such spelling systems were always based on phonological units: phonemes (consonantal and alphabetic systems), moras (Japanese), or syllables (Mayan and the various cuneiform systems), and that while logograms, representing morphemes, may have an ancillary role, as in Japanese, Egyptian and Sumerian, there are no pure logographies.

But there was a glaring exception to this latter generalization: Chinese writing. Its characters represent the monosyllabic morphemes that account for almost all of the Chinese morphemic inventory; the many polymorphemic Chinese words are written as sequences of characters. A character may be either a simple logogram, not analyzable into smaller orthographic elements, or a compound character. By far the largest class of compounds, accounting for over 80% of the characters in the *Xinhua Zidian* character dictionary (1971), consists of phonetic compounds (Zhou, 1978). Such a character has two components, the phonetic and the semantic. The phonetic is a form that occurs also as freestanding character whose pronunciation is, or once was, similar to that of the compound. Estimates of the number of actually occurring phonetics range from about 900 to about 3900, depending on the dictionaries and corpora used (DeFrancis, 1984). The semantic, a kind of classifier, is drawn from an inventory of 200-odd combining forms derived, for the most part, from simple logograms.

The orthodox interpretation of these facts is that Chinese writing is a logography (e. g., Chao, 1968). The productive spelling system, phonetic compounding, is based on the units of Chinese morphology. But DeFrancis (1989) argues that Chinese writing is not a logography, but a syllabary whose true units are the phonetic components; the compound characters themselves, like written words in English, are merely frames. He suggests that Chinese orthography is essentially a vast matrix with the semantics on one axis, the phonetics on the other. Each phonetic compound corresponds to a cell in the matrix.

I found this proposal compelling at the time and relied on it in my earlier paper. If it is correct, then Chinese is not an exception to my

generalization, for its productive spelling system relies, like those of several other writing systems, on a phonological unit, the syllable. But certain facts suggest that the syllabary account of Chinese writing may be mistaken. As already noted, the inventory of phonetics has not been precisely established, but it is certainly extremely large compared to known syllabaries. By the most conservative estimate, DeFrancis' matrix contains 900 x 200 = 180,000 cells, yet there are only 6542 phonetic compounds in the *Xinhua Zidian* (Zhou, 1978). The majority of phonetics do not have consistent phonological values. There are several phonetics corresponding to some phonological syllables and none to many others. These facts do not absolutely rule out the syllabary account, but they should certainly arouse suspicion.

The most telling fact, however, is the recursive structure of the phonetics: A phonetic compound may serve as the phonetic component of a more complex, second-order compound; this compound may in turn become the phonetic of a third-order compound, and so on (Zhou, 1978; Boltz, 1994). The process appears to be limited only by the maximum number of strokes -- 30 or so -- practical to include in one character; Zhou and Boltz give examples of fourth- and fifth-order phonetic compounds. Recursion in phonetic compounding is by no means a marginal phenomenon. Scores of second-order compounds can be readily found by looking through Karlgren's (1923) character dictionary, which is organized by phonetics.

What recursion means is that in principle, the number of possible phonetics (and hence the number of possible Chinese characters), is not merely indefinite but infinite. But surely this is one property that no syllabary can be allowed to have. It is of the essence of a syllabary that it have a finite number of symbols. Notice also that recursion means that the matrix metaphor is inappropriate: It is a strange matrix in which elements in the cells reappear as elements of the ordinates. Instead of a vast matrix, we have a simple recursive rule: $S + C_n > C_{n+1}$, where C stands for character and S for semantic.

It appears that while there is a finite set of semantic elements, there is no comparable finite set of phonetic elements. Any existing freestanding Chinese character is a possible phonetic. To form a new phonetic compound, select as the phonetic a character with a phonological value similar to that of the morpheme to be represented and join to it some appropriate semantic. The set of existing characters obviously includes all existing phonetic compounds, and it is this circumstance which accounts for the observed recursion. Thus, consideration of recursion reinforces the orthodox account of phonetic compounding.

The criticism of the syllabary account thus far has been based on orthographic facts. But before reaching any final conclusion, let us consider

some psycholingustic evidence. The experiment described below tested the psychological reality of the supposed syllabary.

Three sets of bogus phonetic compounds were prepared for use in a character verification task. The same semantic components were used in all three sets; they selected from those combining forms that are substantially different in appearance from the simple characters they derive from. In each character in the first set, the position of the phonetic component was occupied by the another such semantic combining form. Such formations are not possible in Chinese writing, and we called them "impossible characters." In each character in the second set, the phonetic position was occupied by an actual phonetic, but not one that actually occurs with the associated semantic in a genuine Chinese character. Since we and others have used such formations in many other experiments, we called them "conventional pseudocharacters." In each character in the third set, the phonetic position was occupied by a simple logogram that never appears as a phonetic in any genuine character. We referred to these as "unconventional pseudocharacters." We also prepared a set of genuine phonetic compounds as foils, half of them high frequency and half of them low frequency. We expected the impossible characters, which contain no phonetic components, to be rejected more rapidly than the conventional pseudocharacters. If the syllabary account is correct, the unconventional pseudocharacters should also be rejected rapidly, for they, too, would be "impossible." But if the syllabary account is wrong, then the unconventional pseudocharacters should be rejected no more rapidly than the conventional ones.

The subjects, Chinese students studying at the University of Connecticut and their spouses, were divided arbitrarily into three groups of equal size. Each group saw the genuine compounds and one of the three sets of bogus compounds. Genuine and bogus compounds were presented in random order to each subject on a computer monitor. The subject's task was to press the "Yes" key if he believed a character was genuine, otherwise the "No" key. Errors and reaction times were measured.

As we expected, the impossible characters were rejected quickly, on average after 614 msec, comparable to the 641 msec required to accept a genuine high-frequency character. The impossible characters could be summarily rejected because they contained no components that were possible phonetics. The conventional pseudocharacters took 769 msec to reject, signficantly longer than the impossible characters, and comparable to the 755 msec required to accept a low-frequency character. Since, on both the orthodox and the syllabary account, these are possible characters, some nontrivial lexical processing must have been required before they could be rejected. The unconventional pseudocharacters took 750 msec to reject, not signficantly different from the conventional ones, but again significantly longer than the impossible characters, and implying some lexical processing. Apparently the

unconventional pseudocharacters are also possible characters, containing possible phonetics. It can be concluded that a syllabary has no demonstrable role in character recognition and that the orthodox account of phonetic compounding is correct.

It appears, then, that our generalization must be revised. Spelling systems do not always depend on phonological units. What can be said is that tbey always depend on linguistic units that have specific phonological values. This revision allows that morphemes as well as syllables, moras, and phonemes can be exploited, yet retains the essentially phonological character of productive spelling systems.

What needs to be explained is why, in that case. there are no other strictly morphemic writing systems like that of Chinese. The answer is that in the case of most languages, the morphemes are phonologically complex and yet do not account for anything like all the phonotactic possibilities, so that homophony is a marginal phenomenon. If /blɪbʊk/ were suddenly to become an English morpheme, a morphemic writing system that had a logogram for every previously existing English morpheme would be still be hard put to spell this new item. But in Chinese, because morphemes are monosyllabic, syllable structure highly restricted, and homophony therefore ubiquitous, it is not difficult to find for a novel morpheme a homophone whose character can be borrowed.

It must be emphasized that the conclusion that Chinese orthography is a morphemic system in no way implies that Chinese writing is not phonologically-based, or that the phonetic component plays no role in the recognition of a character. On the contrary, it is the phonological similarity between the phonological values of two morphemes that is the basis of a phonetic compound, and our experimental results imply that readers analyze these compounds rather than treating them as monolithic symbols. If the characters were perceptual monoliths, then no difference in reaction time would have been observed among the three classes of bogus characters. The only question is how much of the rich recursive structure of higher-order phonetic compounds is psychologically real.

References

Boltz, W. G. (1994). *The origin and development of the Chinese writing system*. New Haven: American Oriental Society.

Chao, Y. R. (1968). *Language and symbolic systems*. Cambridge (England): University Press.

DeFrancis, J. (1984). *The Chinese language/Fact and fantasy*. Honolulu: U. Hawaii Press.

DeFrancis, J. (1989). *Visible speech/The diverse oneness of writing systems*. Honolulu: U. Hawaii Press.

Karlgren, B. (1923). *Analytic dictionary of Chinese and Sino-Japanese.* Paris: Librairie Orientaliste Paul Geuthner. [Dover reprint, 1974].

Mattingly, I. G. (1992). Linguistic awareness and orthographic form. In R. Frost & L. Katz (Eds.), *Orthography, Phonology, Morphology, and Meaning* (pp. 11-26). Amsterdam: North-Holland.

Xinhua zidian [New China character dictionary] (1971). Beijing: Commercial Publishing House.

Zhou, Y.-G. (1978). Xiandai Hanzizhong shengpangde biaoyin gongneng wenti [On the question of the phonetic representation function of phonetic radicals in modern Chinese]. *Zhongguo Yuwen, 146,* 172-177.

COMPUTATIONAL TOOLS FOR EVALUATING AND TEACHING ORTHOGRAPHIC RULES

Christina Noack, Helmut Spiekermann, Tobias Thelen
(Institute for Semantic Information Processing, University of
Osnabrueck)

Abstract

We are going to show some computational tools which were developed
('Ortho 2.1' and 'MoPs') or used for orthographic purposes (machine
learning techniques) in course of the DFG-project 'Computerbased
Modelling of Orthographic Processes' (project management: Prof.Dr.
Utz Maas, PD Dr. Helmar Gust) at the Institut for Semantic Information
Processing, University of Osnabrueck. These tools enable the user to
deal with orthographic questions, as to evaluate the effectiveness of
certain theories, to generate rules out of more or less specified
phonetic data and to teach children in primary school to use
orthographic rules.

1. 'Ortho 2.1'

'Ortho 2.1' is a Prolog-based programme for UNIX, using TCL/Tk as a
grafical user interface. It was developed to test different
orthographic theories on a sufficient extensive corpus of wordforms.

The corpus (altogether 500.000 wordforms) consists of several single
files on the base of the Duden (a list of words similar
to [2]) and the CELEX-database [1]. We use several information for
each wordform, such as phonetic transcription (referring to
dictionaries of pronunciation as Duden [3] or Siebs [9]),
morpho-syntactic information (wordclass, information on inflection
etc.) and data on word family. Information on syllables, metrical
structure, morphem-boundaries may as well be taken into account.
(1) gives an example (some wordforms of the paradigm <kind> 'child')
for the coding of the used data.

```
(1)   k"Int {NN-nS} Kind kind
      k"Ind+@s {NN-gS} Kind kindes
      k"Ind+@r {NN-nP} Kind kinder
```

As a reference for alternative theories the rules on the base of the
theory of Utz Maas [4] were implemented. We use 'g_log' (a Prolog
programming language dialect) to edit the orthographic rules. Below an
example (The 'schaerfungs_regel' controls the doubling of consonants in
the coda of a stressed syllable on condition of the existence of a
wordform in the paradigm with an empty coda):

```
(2)   schaerfungs_regel:
          {prominente_silbe:
          [(*1 *2 *3 [{a4ll:+} | *4]) | *5]}
       falls_wortvariante
          {prominente_silbe:
          [(*6 *7 *8 []) | *9]} .
```

To test different theories it is necessary to change the rules and possibly the used data as well. 'Ortho 2.1' enables the user to neglect certain information if they are, concerning a certain theory, not necessary.

In course of the recent orthographic reform-discussion we tested alternative rulesets to translate [s] in the coda of a stressed syllable into the graphemes <s>, <ss> or <sz>. The changes of rules and data, which were necessary to suit the programme to the given problem, took few hours. 110.000 wordforms (similar to [2]) had to be converted, rules to be edited. Three different theories were verified:

- test 1: the already implemented ruleset on the base of the theory of Utz Maas [4].

- test 2: a ruleset referring to the orthographic reform, changing every <sz> following a short vowel into <ss>.

- test 3: a ruleset that translates every [s] following a short vowel in <ss>.

The results of the test are shown below in table 1:

test	error rate
test 1	1,38 %
test 2	1,25 %
test 3	0.99 %

(table 1: results of test on [s]-graphemes)

The same way it is easily possible to evaluate other orthographic theories.

2. Machine learning techniques

Assumptions about the necessity of various linguistic information in order to find an appropriate representation of orthographic rules can be motivated theoretically but also proven by empirical investigations.

Machine learning techniques are able to find regularities in patterns without the need of specifing the theoretical background. If a learning algorithm performs well on a given training set, it can be derived that the given information is sufficient to solve the problem. On the other hand, if satisfying results cannot be achieved, the data representation has to be changed or extended.

We carry on experiments with three different machine learning approaches for which first results will be briefly presented.

2.1 Table Algorithm

Nearly all computational learning algorithms pose the restriction of fixed-length input patterns. As words are not always of the same

length, the technique of 'windowing' the patterns is widely used.
Not the whole word is considered, but only a snippet from it. This
window consists of a focus and left and right context. The
'Table Algorithm' [5] examines windows from a large corpus of words
and estimates the ambiguity of these windows. Results as shown in
table 2 can be used to dtermine an optimal window size for further
investigations, such as Artificial Neural Networks.

Window size	# patterns	ambiguity
0-1-0	95	81.05 %
1-1-1	2.620	13.02 %
2-1-2	9.298	1.52 %
3-1-3	19.629	0.34 %
4-1-4	34.894	0.07 %
9-1-9	80.010	0.02 %

(table 2: results of the Table Algorithm
         trained with 11.207 word forms
         from the CELEX database)

2.2 Artificial Neural Networks

Artificial Neural Networks, or at least the feed-forward models we
use, adjust local weights depending on the error an input pattern
produces given the current weights. Iterated presentation of the
training patterns leads to a small overall error. If the training
set was well chosen, the net is able to generalize from the trained
patterns to new untrained ones. So a trained artificial neural network
can find the spelling of words that it has never seen. Finding
appropriate training sets is a hard and time consuming process so
that final results cannot be given yet.

We want to find answers to the following questions from Artificial
Neural Nets:

- What influence has the omission and inclusion of certain information
  (e.g. stress, syllable boundaries, morphological information ...) on
  the performance of trained nets?

- Can minimal corpora for specific problems be built, so that a
  net can be successfully trained with it? Do word lists like the
  basic word corpus for primary schools in Niedersachsen contain
  sufficient examples for the main orthographic problems?

- Do hybrid models which combine knowledge-based modules and
  neural nets yield to better results than any of the two approaches
  alone?

2.3 Decision Tree Algorithms

Decision tree algorithms try to find criteria by statistically
appraising the information gain of branching the tree according to
a feature's value. So a tree of decision-knots is generated, which can
be thought of as a set of rules.

First investigations with the C4.5 algorithm [6] produced decision

trees for the transformation of [b] into <b> or <bb>. As expected
the results are not congruant to linguistic theory, as it
incorporates decisions based upon the sonorityvalue of phonemes and
single features instead of more general categories. The simplified
tree (cutting some rare cases) for a large training set is:

```
ll_stress :
   no  -> <b> (2074 cases)
   yes ->
      rl_sv : > 4 : <bb> (100 cases)
            <= 4 :
               rl_lab : no  -> <bb> (9 cases)
                        yes -> <b>  (2 cases)

 ll      = phoneme left to the focus
 rl      = phoneme right to the focus
 stress = is it stressed (yes/no)
 sv      = sonority value (0-12)
 lab     = value of the feature [+/- labial]
```

(table 3: simplified decision tree for transforming [b] to
          <b> or <bb>)

We hope to find orthographic sub-regularities by analysing
decision trees like the one presented, at the time of
this writing we're in the stage of finding optimal
representations.

3.   'MoPs'

3.1 Modelling of Orthographic Processes

In a regular one year student's project at the Institute for
Semantic Information Processing we developed an orthography
training system for primary schools. This programme called 'MoPs'
(Modellierung orthographischer Prozesse = Modelling of orthographic
processes) mainly deals with the phenomenon 'Schaerfung', i.e. the
doubling of consonants after short vowels in closed syllables or
in words derived from such a form. The results of this project are
presented in [8].

3.2 Of houses and garages

In order to be able to apply this rule, the children have to know
some basic concepts:

- finding the stressed vowel

- determining whether this vowel is long or short

- deciding if the prominent syllable is open or closed

We use some didactically motivated aids in order to enable children
to accomplish these tasks:

- The stressed vowel can be found in opposition to the
reduced syllable.

- As experience shows, children at this age mostly aren't able to
distinguish between long and short vowels, but between vowel
qualities.

- In order to make the theoretic syllable model easier to understand,
Christa Roeber-Siekmeyer and Utz Maas inventend
the 'house model' [7]. Prominent syllables are represented by a 'house',
reduced syllables by a 'garage'. The 'house' has three 'windows',each
of them is inhabited by a constituent, i.e. onset, nucleus and coda.
The 'garage' only has two windows, for the onset and the rhyme of the
reduced syllable. Long vowels in the prominent
syllable take more room, they inhabit both the second and the third
'window', short vowels shall not take two windows, so they have to be
squeezed. In a closed syllable the consonant(s) in the coda squeeze the
vowel and inhabit the third 'window'. In an open prominent syllable
there is no instantiated coda, so 'something else' has to squeeze the
vowel. In this case the first consonant in the garage takes this
role, the garage crashes into the house and the stressed vowel is
squeezed. To mark the double role of the onset of the reduced
syllable, the consonant leaves a 'twin' in the house's third window
to prevent the vowel from taking two windows again.

3.3 Error analysis

Since it was a computational linguistic project, MoPs included some
advanced techniques in dealing with errors. We developed an 'error
analysis' component that is able to detect and explain multiple
errors in children's spellings. This is important to give adequate
feedback if a word has not been correctly spelled, but the relevant
task (e.g. 'Schaerfung') has been well done and to adjust the order
of presented exercises.

As an example, the word <felsen> 'rock' was misspelled <fllsn> and the
error analysis finds three mistakes:

1. left out stressed vowel [E]

2. applied 'Schaerfung' although no reason was given by the syllable
structure and there is no word in the word family the rule
holds for

3. left out reduced syllable grapheme <e>

Now the programme can decide what to do to cover these errors. It is
able to dynamically choose and generate exercises using words
similar to the one in which an error occured. In the current
implementation, only error types 2. and 3. are covered, for 1.
there will be an explanation given like: 'You didn't spell the
word correctly. I'll show you the correct spelling.'

On error 2. MoPs will let the child choose the right house for the
word. The status of the
'letters' changes on inhabiting a window. Standing for a simplified
notation for phonemes they become graphemes under the influence of

didactically adapted orthographic processes such as squeezing.

On error 3. the programme will present an exercise from the beginning: Every reduced syllable must contain an <e>, even if it cannot be heard as in ['fEl.sn].

3.4 Ongoing research

The development of MoPs is continued in order to test it in two primary schools in Osnabrueck and Freiburg in September and October 1997. These tests are part of a research project of Christa Roeber-Siekmeyer (PH Freiburg).

We hope to be able to show that this rule-based didactic approach in addition to an advanced computational excercising environment enables the children to understand the phenomenon 'Schaerfung' so that they can apply it to unknown words.

4. Conclusion

The presented computational tools are an interdisciplinary approach to orthographic research, from which benefit both linguistic theory and computer applications.

In longer terms this can be valuable for designing workbenches for testing broader orthographic theories, spelling correctors and educational tools.

5. References

[1] CELEX-database: Centre for Lexical Information, University of Nijmegen.
[2] Duden - Die Rechtschreibung (1986). Mannheim (19th edition).
[3] Duden - Das Aussprachewoerterbuch (1990). Mannheim. (3rd edition)
[4] Maas, Utz (1992): Grundzuege der deutschen Orthographie. Tuebingen.
[5] Maas, Utz; Helmar Gust; Michael Riehl; Helmut Spiekermann (1997): Arbeitsbericht 1 des Projektes Computerbasierte Modellierung orthographischer Prozesse. Ms. Osnabrueck.
[6] Quinlan, Ross (1993): C4.5: Programs for machine learning. San Mateo.
[7] Roeber-Siekmeyer, Christa (1993): Die Schriftsprache entdecken. Weinheim.
[8] Saure, Michael; Tobias Thelen; Jochen Trommer (1997): MoPs - Abschlussbericht und Ausblick. Ms. Osnabrueck.
[9] Siebs, Theodor (1969): Deutsche Aussprache. Berlin.

The role of word spacing and the conception of the 'word'

Matthias Butt, Universitaet Potsdam

Graphematic analysis as it seems can draw on a number of devices that many a phonologist would

Early alphabetic writing systems (most notably Latin) indicate that structuring devices such a

Closer analysis, however, does not support this wishful thinking. To begin with, there are man

The latter is particularly disturbing as it shatters the notion of the word, which seemed to b

Criteria for 'wordness' of some given expression are typically derived from sub-systems as div

On each level there seems to be a number of necessary conditions for 'wordness' but no suffici
the outlines of the 'word' showing on each of these levels nevertheless, do not match between

I shall discuss the notion of the 'phonological word' following Eisenberg/Butt 1996 arriving a

I will then proceed to investigate some of the borderline cases for German word spacing and th

The common idea that there must be words as linguistic units seems to be based (at least partl

References:

Eisenberg, P./Butt, M. (1996): "Phonological word structures. Categorial and functional concep

Dutch orthography: One type of spelling rules or two?

Anneke Nunn and Anneke Neijt
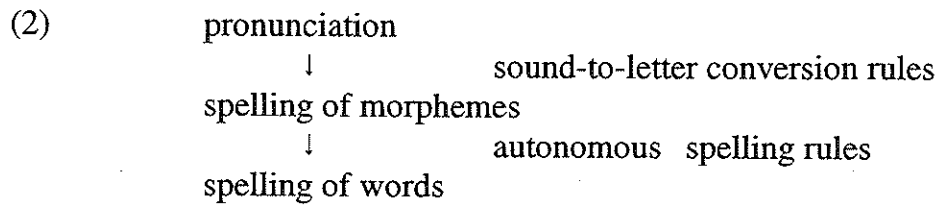Dutch Department, University of Nijmegen

Spelling is a code for the pronunciation. This formulation suggests that the spelling system consists of a set of rules which prescribe which sound is encoded by which letter or by which letter combination (possibly supplemented by a list of exceptions):

(1)   pronunciation
      ↓   sound-to-letter conversion rules
    spelling
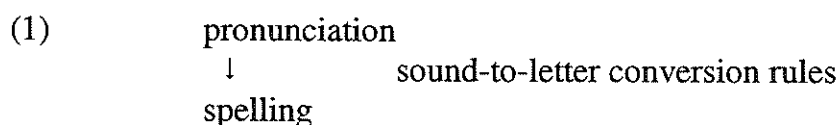
However, the description of Dutch spelling with sound-to-letter conversion rules misses some generalisations. In the first place, while some spelling phenomena may be explained by the corresponding sounds, other phenomena seem arbitrary when seen as a code for the pronunciation. For instance, the difference between <i> and <ie> in *bid* and *bied* represents a length contrast, but the fact that some long vowels can be written as two or one vowel letters (*raam-hamer, zeem-zever, vuur-ulevel, roos-oker*), while other vowels can be written in one way only (*roem-roemer, riem-gieter, reuk-heuvel*) is not expected on the basis of the corresponding non-alternating sounds. Rather the variation is predictable on the basis of spelling: it concerns pairs of geminates, not other digraphs.

   Secondly, the spelling of related words is often constant which may mean that spelling is derived from the sound representation of morphemes. For instance, in loan words /i/ is written as <ie> in final syllables and as <i> elsewhere: *liter* versus *actief*, but affixes are ignored: *actieve*, not **active*. However, some spelling rules do result in spelling variation, for instance the alternation of single vowel letters and geminates referred to above. If, on the one hand, we restrict the domain of application of all spelling rules to the morpheme, these facts remain unaccounted for. If, on the other hand, we allow all spelling rules to apply across morpheme boundaries, we lose the explanation for the constant spelling in other cases.

   To account for such seemingly contradictory properties of spelling rules we have adapted the model of the Dutch spelling system: next to morpheme-based sound-to-letter conversion rules we propose to use autonomous spelling rules which change letter sequences after morphemes have been combined:

(2)   pronunciation
                  ↓   sound-to-letter conversion rules
             spelling of morphemes
                  ↓   autonomous spelling rules
             spelling of words

This model is more complex, since it postulates an intermediate spelling level. At the same time it is more descriptively adequate and more restrictive, since it forbids sound-based rules to operate across morpheme boundaries, or letter-based rules to operate exclusively in the morpheme domain.

      The model also functions as an implementation of the two main principles of Dutch spelling: the so-called phonological principle (spelling represents the pronunciation) and the morphological principle (the spelling of morphemes is constant), and defines the relation between these competing principles.

Linking graphemes in Dutch compounds — one letter more or less.

Harald Baayen, Robert Schreuder, and Anneke Neijt, KUN and MPI, Nijmegen

The question addressed in this paper is the functional role of the orthographic realization of the linking schwa in Dutch nominal compounds. From a diachronic perspective, the linking schwa is a historical relic of a now obsolete morphological system. Synchronically, however, it is homographic and homophonic with the high-frequency inflectional affixes -e and -en. Are plural semantics activated in the mental lexicon when the linking schwa is written as the plural suffix -en?

We first carried out an experiment to show that perceptual identification during the earliest stages of reading is not affected by whether the linking schwa is realized as -en or -e. While spelling changes affecting the vowel of the first constituent of compounds severely affect their string familiarity and lead to longer identification latencies, no such effect could be observed for spelling changes affecting the linking schwa.

In a second experiment, we used the number decision task to show that changing the orthographic realization of the linking schwa from -e to -en induces the activation of plural semantics. Writing the linking schwa in the orthographic form of the plural suffix leads to an interference effect caused by the automatic parsing of the plural suffix and the activation of its meaning.

Our third experiment focused on compounds for which the linking schwa is realized as -en both in the old and in the new spelling system. Number decision latencies did not reveal a significant difference for the two spelling variants. Our hypothesis is that for these compounds, which traditionally have been interpreted and taught to have a plural interpretation for the first constituent, the direct route leads to the activation of the full semantics of these compounds including the plurality reading, hence causing equal interference for both spelling variants.

Our last experiment, plurality rating, supports this hypothesis. The effect of the plural suffix -en on the plurality rating of the first constituent is larger for the words that traditionally were written with -e as orthographic realization of the schwa. These words, traditionally interpreted as having a singular first constituent, reveal the largest effect of pluralization when the -en plural suffix is present in their orthographic form. This experiment shows that in Dutch the first constituents of nominal compounds can have plural semantics as part of their central semantic representations.

We conclude that the linking schwa is not a meaningless phoneme for those words where it is orthographically realized as -en — it is the plural suffix itself. Since the new spelling requires the ubiquitous use of -en as orthographic realization of the linking schwa, and given our experimental results, we expect that in the years to come the plural interpretation of the left-hand constituent will eventually become commonplace for compounds with a linking schwa. In this way, the process of the functional reinterpretation of the schwa as a plural suffix instead of as a (meaningless) relic of the obsolete morphological system of medieval Dutch will be completed. In roughly 15 years, when participants have become available for testing who have only known the new spelling, we will be able to test this prediction experimentally.

How alphabetic writings reflect phonemic and syllabic structure

Peter Eisenberg

The graphemic system as part of the grammar of a language with alphabetic writing can in principal be reconstructed in two different ways. First it can be understood as an autonomous combinatorial system operating on letters or graphemes as elemantary units and ending up with graphemic words.

The alternative is to reconstruct it via correspondences to a given phonology and morphology of the language in question. The main problem here is the separation of the involved levels of description.

In my talk I will first make a proposition how a separation of this kind can be achieved with respect to the orthography of German. On the segmental level the correspondence is established as usual by a set of context free rewrite rules. This can most naturally be done by means of a phoneme system in the sense of classical structuralism. The phoneme as a set of distinctive features is an adequate concept for what can be called the alphabetic part of our orthography. In this way every word can be written, but of course only a minor part of these writings is correct.

To arrive at more correct writings we have to carry out two further steps. First the purely alphabetic writings have to be restructured by transformations based on the syllabic structure of the word. The result is called a phonological writing. The phonological writing then undergoes morphological transformations, yielding the final result. I will describe some characteristic properties of the German system which can show how the components mentioned feed each other.

The orthography of German is normally said to represent an intermediate level between a phonemic (shallow) and a morphological (deep) writing system. In my view this means that the system is fairly balanced with respect to the segmental, syllabic, and morphological component. It even is hermetic in a way. As a matter of fact there have be no siginificant changes during the last 250 years.

A point of major interest seems to be that a considerable part of the rules of correspondence work on the bases of necessary structural conditions only. Very often this is seen as a weakness of the system or even as indicating some kind of unsystematicity. On the other hand it can be argued that the system gaines some flexibility. So it is well known that in German for different parts of speech there are different types of rules at work. This might be explained by the specific interaction between the syllabic and the morphological component.

We will illustrate the point by comparing the way in which syllable cut properties are represented in the inflectional forms of nouns and verbs depending on the characteristics of the respective inflection markers.

Kind	Kind+er	leg+(e)	leg+en
Kind+es	Kind+er	leg+st	leg+t
Kind+(e)	Kind+ern	leg+t	leg+en
Kind	Kind+er		

The main difference between the markers of the both categories concernes their syllabicity. All markers of nouns are syllabic whereas the most heavy ones of verbs are not. The direct consequence of this fact are heavy codas in verbal forms and light or empty codas in nominal forms. The system reacts by consequently representing smooth cut in nouns and abrupt cut in verbs whenever possible. By doing so it overwrites the morphological structuring by syllabic information.

What spelling mistakes can tell us about the writing process
Abstract

Fr. Daems, University of Antwerp

A better understanding of the basic process of writing (turning phonemes into graphemes) might be of interest for designing more effective methods for the teaching of writing. This is not only relevant for children with reading or writing problems (e.g. dyslectics) but also for students in regular education who have no specific learning problems. Furthermore a better understanding is of the utmost importance for societies where spelling standardisation or a major spelling reform, as has recently been the case for Dutch and German, is in order.

In this respect the question which route model the speller uses has some importance: a single route model, a double or a multiple route model? In recent years proponents of a single route model (e.g. Van Orden, Pennington & Stone 1990; Bosman 1994, Kempen 1994) have put forward challenging ideas in favour of a single route model in which phonologic mediation plays a major role. If phonologic mediation is of primordial importance, the question has still to be answered whether this is the only form of mediation and what relation there might be between phonology and other possible intervening factors.

Much empirical research on reading and writing processes is methodologically exemplary in that it conducts highly controlled experiments. At the same time this also implies a form of weakness in that the experimental conditions hardly reflect reading or writing as it actually occurs in real life situations. In the same way one may wonder to what extent experiments with learning computers reflect the mental activities of flesh and blood learners.

In our research in the University of Antwerp we tried to overcome some of these weaknesses in a couple of ways.
(1) We collected a number (some 70) of spelling mistakes in Dutch made by adult expert writers. We found these mistakes in newspaper articles, novels, letters, university syllabuses etc. We opted for the examination of spelling mistakes because they may help us to uncover something of the writers' spelling strategies. In selecting mistakes we focused on mistakes where the writer may have had to make a choice between two alternatives.
Some examples:
- dt / d (ik wordt)
- d/t (hij betaald)
- d/t (laadje)
- elijk/ellijk (onmiddelijk)
- tte/te (hij kuchtte)
- ikken/iken (monnikken)
- ij/ei (uitgerijkt)
- ieuw/iew (intervieuw)

The mistakes may be described as mistakes against phonological, morphological or etymological rules in Dutch orthography. In each case the mistake may also be described as a not appropriate alternative homophone (e.g. 'wordt' for 'word') or even pseudohomophone (e.g. 'kuchtte' for 'kuchte'). We then examined the frequencies of occurrence of both alternatives. In doing so we worked at word level, morpheme level and at the level of clusters of phonemes or graphemes. We also controlled word (subcategories).

In a large number of cases spelling mistakes seem to be consistent with frequency of occurrence. However, this statement has to be refined. Frequency of occurrence often seems to have to refer to the level of phoneme/grapheme clusters instead of the level of single words or morphemes (which is a counterargument to the double route model). In this last instance, this means that it would be more appropriate to reinterpret mistakes as 'kuchtte' as a case of use of a homophone ('*uchtte' instead of '*uchte') rather than as the use of a pseudohomophone ('kuchtte' for 'kuchte').

In other cases the frequencies of both alternatives are about the same (e.g. 'gebeurt' / 'gebeurd', 'peil' / 'pijl'), which might indicate that writers used other strategies, e.g. of a semantic or syntactico-semantic nature.

(2) We set up an experiment with a number of adult expert writers. They had to fill in missing words that were dictated. After each stimulus they were asked to verbalise their way of choosing a particular alternative. As stimuli we used a selection from the collection of mistakes. In this way we tried to create a setting that is closer to real life writing than a laboratory experiment. The technique of postponed thinking aloud that we used appeared however to have some drawbacks as well. Expert writers are easily inclined to legitimate their choice in terms of school knowledge rather than to reveal the strategies they have used. Another serious drawback is the fact that the information given by the informants has to be interpreted by the researcher; in a number of cases more than one interpretation is possible.

In our presentation we intend to report on our methodology, our material, and our findings. We will also indicate the relevance of our findings for the answer to the question which route model the writer uses. To say the least, it is clear to us that the occurrence of a number of spelling mistakes in Dutch cannot be explained in a model that is restricted to phonological mediation. Writers seem to use other strategies at the same time. Moreover, the traditional controversy in educational psychology between phoneme spellers versus word spellers seems to be misleading.

1

Do skilled readers exploit inflectional spelling cues that do not mirror pronunciation? An eye movement study of morpho-syntactic parsing in Dutch

Gerard Kempen, Andress Kooij & Theo van Leeuwen
Department of Psychology
Leiden University

The orthographies of Dutch and French, unlike those of English and German, frequently distinguish between inflectional suffixes that have identical pronunciations. Examples are AIMER, AIMEZ, AIM_FF, AIM_FE, AIM_FS, AIM_FES in French, and BESTEDEN, BESTEDE, BESTEEDDE, BESTEEDDEN in Dutch. This feature is a well-known cause of serious spelling errors and mistakes in beginning and experienced writers because it renders word form selection contingent, not only upon sound and meaning, but also on syntax. It seems likely that this dependency on syntactic structure is not restricted to writing but has repercussions on reading as well. This invites the inference that morpho-syntactic analyzers in skilled readers have learned to pick up inflectional cues that only exist in the visual (orthographic) domain. The present study explores the validity of this hypothesis in the context of verb form spelling in Dutch.

(1) Die baron die vorig jaar nog een vermogen had vergokt nu zijn laatste centen.
   That baron who last year still a fortune had gambles now his last pennies
   "That baron who owned a fortune until last year is now gambling away his last pennies."
(2) Die baron die vorig jaar nog een vermogen had verliest nu zijn laatste centen.
                                             ... loses ...
(3) Die baron die vorig jaar nog een vermogen had verspeelt nu zijn laatste centen.
                                             ... gambles ...
(4) Die baron die vorig jaar nog een vermogen had verkwist nu zijn laatste centen.
                                             ... squanders ...
(5) Die baron die vorig jaar nog een vermogen had verwedt nu zijn laatste centen.
                                             ... stakes ...

Consider examples (1) through (5). Sentence (1) elicits a strong garden-path reaction due to the ambiguity of both verbs: HAD is categorially ambiguous between main verb and auxiliary; VERGOKT is inflectionally ambiguous between past participle and finite verb. (The -T suffix added to the stem VERGOK marks either the third-person singular present-tense form or the past participle.)
Most readers prefer to take HAD as auxiliary and VERGOKT as past participle, for several reasons: HAD has a much higher frequency as an auxiliary than as a main verb; VERGOKT as past participle fits in perfectly with this interpretation, which furthermore satisfies the powerful parsing principle known as Right Association (also called Late Closure or Recency; cf. Kempen, 1996). Sentence (2), however, has no -- or a very weak -- garden-path character, presumably because VERLIEST is interpretable as a finite verb only.
It differs from the past participle VERLOREN in both spelling and

pronunciation. Sentence (3) illustrates an intermediate case: VERSPEELT is phonologically identical to, but orthographically distinct from the past participle VERSPEELD. (The -D suffix is pronounced /t/, due to final devoicing.)

Sentences (4) and (5), with main verbs VERKWIST and VERWEDT are similar to (1) and (3), respectively, but contract different morphological relationships.
VERKWIST results from VERKWIST-T as a consequence of degemination of word-final consonants. This makes it unclear whether the final T belongs to the stem or constitutes a suffix (unlike the T in VERGOKT, which must be the suffix). In VERWEDT, the final T plays an unambiguous suffixal role -- like in VERSPEELT. The homophonic past participle VERWED results from VERWED-D by degemination, rendering the status of the final D unclear. As a consequence, the relationship between VERWEDT and VERWED differs from that between VERSPEELT and VERSPEELD: the members of the latter pair both have an explicit suffix; in the former pair, only one member is suffixed explicitly.

Using sentence materials as exemplified by (1)-(5), we have explored the question posed in the title of this paper. If readers and spellers have learned to exploit the orthographic difference between homophonic verb endings, sentences like (3) and (5) (with VERSPEELT/VERSPEELD or VERWEDT/VERWED) are predicted to cause milder garden-path effects than sentences like (1) and (4) (with VERGOKT or VERKWIST) -- if the readers are garden-pathed at all. No garden-pathing is predicted for sentences of type (2).

METHOD

For each of the sentences types exemplified by (1)-(5), we prepared three additional variants. For instance, the set that includes sentence (1) is the following:
Il F C- Die baron die vorig jaar nog een vermogen had vergokt nu zijn laatste centen.
Il F C+ Die baron die vorig jaar nog een vermogen had, vergokt nu zijn laatste centen.
Il P C- Die baron die vorig jaar nog een vermogen had vergokt spendeert nu zijn laatste centen.
Il P C+ Die baron die vorig jaar nog een vermogen had vergokt, spendeert nu zijn laatste centen.
The symbols preceding these examples are explained in Table I. The C+ variants were introduced in order to obtain an estimate of the garden-path effect. We reasoned that a comma clearly marks the transition from the relative clause to the main clause, thereby removing the ambiguity (if any) created by a verb form. (N.B. According to the orthographic rules of Dutch, the comma at the end of a relative clause is optional.) The P-variants enabled us to verify that the past participle interpretation is indeed preferred. (The P-versions contain a third verb that is unambiguously finite; in the example, this is the verb SPENDEREN, to spend.)

Table I. Experimental conditions of the experiment and their abbreviations. The symbols Il and Hl denote verbs which undergo degemination in either the finite verb (F) or the past participle (P) forms, or both.

Comma	Verb Type	Finite Verb (F)	Past Participle (P)

	Identical	I1	had verkwist	had verkwist
		I2	had vergokt	had vergokt
Absent (C-)	Homophonous	H1	had verwedt	had verwed
		H2	had verspeelt	had verspeeld
	Different	D	had verliest	had verloren

	Identical	I1	had, verkwist	had verkwist,
		I2	had, vergokt	had vergokt,
Present (C+)	Homophonous	H1	had, verwedt	had verwed,
		H2	had, verspeelt	had verspeeld,
	Different	D	had, verliest	had verloren,

We prepared 8 sentence quartets for each of the types I1, I2, H1 and H2, and 16 quartets for type D. Each of the participants (20 students of Leiden University who had been screened for their mastery of verb spelling rules in Dutch) read one member of each these 48 quartets. The sentences were presented in quasi-random order, intermingled with 32 filler sentences of varying syntactic structure. At fixed intervals, the participant had to answer a yes/no question about one of the recently presented sentence.

RESULTS

The eye movements during reading these sentences were registered by a Generation 5.5 Dual-Purkinje-Image eye-tracker. The data relevant for present purposes are the reading times (RTs) for the 'ambiguous' (AMB) and the 'disambiguating' (DIS) regions in the experimental sentences. These regions were defined as follows:

```
                                                AMB           DIS
                                          -------------    --------
    Die baron die vorig jaar nog een vermogen / had, vergokt / nu zijn /
    laatste centen.
                                                AMB              DIS
                                          - - - - - - - - - - - - -
```

Die baron die vorig jaar nog een vermogen / had vergokt, / spendeert nu
/
    zijn laatste centen.

Table II. Estimates of the garden-path effect in the F- and P-variants of the five sentence types. The numbers are difference scores (milliseconds) computed by subtracting C+ RTs from C- RTs.

Region	Verb type		Total Gaze		First Gaze	
			F	P	F	P
AMB	I1	VERKWIST/VERKWIST	123	36	33	11
	I2	VERGOKT/VERGOKT	168	16	41	23
	H1	VERWEDT/VERWED	115	47	29	4
	H2	VERSPEELT/VERSPEELD	224	35	61	1
	D	VERLIEST/VERLOREN	67	12	24	13
DIS	I1	VERGOKT/VERGOKT	128	59	42	17
	I2	VERKWIST/VERKWIST	108	20	64	14
	H1	VERWEDT/VERWED	86	92	-32	62
	H2	VERSPEELT/VERSPEELD	86	50	5	21
	D	VERLIEST/VERLOREN	21	18	-7	16

For each of the five sentence types, and for the F- as well as the P-versions, we obtained an estimate of the garden-path effect by subtracting the RTs in the 'easy' C+ condition from the 'difficult' C-condition. Table II presents the resulting difference scores for both regions, separately for 'First Gaze' and 'Total Gaze'. The First Gaze RT for a region starts at the first fixation within that region and stops when a position outside that region is fixated.
That is, regressions into that region are not taken into account. The Total Gaze RT does include regressions and measures the total time spent in the region. (For details, see Konieczny et al., 1995.)

Leaving details of the statistical analyses aside (but see Kooij, 1997), we point out three main results. To begin with, the readers are hardly garden-pathed by the P-variants of the I1- and I2-sentences, whereas the F-versions of these sentence types cause a great deal of trouble. This pattern is already discernible in the First Gaze scores. On the other hand, D-type sentences hardly cause a garden-path effect. Both observations confirm our a priori expectations. Secondly, type-H2 sentences in general behave very much like their type-I1 and type-I2 counterparts. This phenomenon entails a negative answer to the title question for cases like VERSPEELT/VERSPEELD: the visible but inaudible distinction between these verb forms is not exploited in morpho-syntactic analysis. Within the ambiguous region, the F-versions of this sentence type are even responsible for the largest garden-path effect of all (224 ms). Thirdly, type-H1 sentences cause a relatively mild garden-path effect in the AMBiguous region; in the DISambiguating region it has already disappeared. That is, H1 verb forms like VERWEDT and VERWED are intermediate between fully identical F- and P-forms (VERGOKT/VERGOKT) on one hand, and those which differ both in sound and image (VERLIEST/VERLOREN) on the other.

DISCUSSION

The most salient finding of this study is the split between two types of homophonic but non-homographic inflectional cues. A verb form like VERWEDT is easily recognized as a finite verb, implying a positive answer to the title question. On the other hand, readers are troubled by forms such as VERSPEELT, which entails a negative answer. This split appears reliable: we have observed it in two pilot studies with a self-paced reading task (Evenblij, 1995; Kooij, 1996). However, it was not observed by Van Heuven (1978, 1991; see also Tismeer, 1984), who arrived at an overall negative answer to the title question: visible but inaudible spelling cues do not guide the parsing process, neither in type-H1 nor in type-H2 verb forms. On the other hand, Brysbaert (1996) found that readers quickly recognize verb forms like WIEDDEN (of WIEDEN, to weed) and ROESTTEN (of ROESTEN, to rust) as past-tense forms, despite the homophony with the present-tense forms (and with the infinitives).
A possible explanation for the discrepancy between Van Heuven's data on one hand and Brysbaert's and ours on the other may have to do with task differences. In Van Heuven's experiments, the subjects had to read the sentences aloud. Moreover, the sentences were presented in capital letters without any punctuation. This may have rendered audible cues much more salient than in normal silent reading, causing the parsing process to rely on them rather than on the -- somewhat degraded -- visible cues. (Brysbaert used a self-paced silent reading task.)

We conclude by suggesting an explanation for the H1 versus H2 split. It

capitalizes on the fact that spelling patterns such as -IEDD-, -STT-, and word-final -DT only occur in polymorphemic words. For instance -STT- indicates past- tense formation (ROESTTEN) or composition (FEESTTENT, party tent). Such spelling patterns perhaps trigger morpho-syntactic analyzers more directly than spelling patterns that occur in mono- as well as in polymorphemic words. (The latter is true of the word-final patterns in type-H2 forms.) We intend to follow up this suggestion in future eye-tracking studies.

REFERENCES

Brysbaert, M. (1996). Sentence reading: Do we make use of non-audible cues? Manuscript, Catholic University of Louvain.

Evenblij, J. (1995). The utilization of d/t verb suffixes during reading and parsing Dutch sentences. M.A. Thesis, Department of Psychology, Leiden University.

Heuven, V. van (1978). Spelling en lezen: hoe tragisch zijn de werkwoordsvormen? Assen: Van Gorcum.

Heuven, V. van (1991). Invloeden van spelling op het lezen. In: Bennis, H., Neijt, A. & Santen, A. van (Red.), De groene spelling. Amsterdam: Bakker.

Kempen, G. (1996). Computational models of syntactic processing in human language comprehension. In: Dijkstra, T & De Smedt, K. (Eds.), Computational psycholinguistics: symbolic and subsymbolic models of language processing. London: Taylor & Francis.

Konieczny, L., Hemforth, B., Scheepers, C. & Strube, G. (1995). PP-attachment in German: Results from eye movement studies. In: Findlay, J.M., Walker, R. & Kentridge, R.W. (Eds.), Eye movement research: Mechanisms, processes and applications. Amsterdam: Elsevier.

Kooij, A. (1996). Het gebruik van de werkwoordelijke d/t uitgangen tijdens lezen. Internal Report, Department of Psychology, Leiden University.

Kooij, A. (1997). Helpt de werkwoordspelling de lezer bij het herkennen van zinsstructuur? Een oogbewegingsstudie. M.A. Thesis, Department of Psychology, Leiden University.

Tismeer, L. (1984). Effecten van verklankbaarheid van geschreven verschillen tussen werkwoordsuitgangen bij hardop- en stillezen. M.A. Thesis, Linguistics Department, Leiden University.

On the role of orthography for writing systems

Hartmut Günther, University of Cologne

1. Writing systems and orthographies

Following Eisenberg (1983; 1996), I assume that the writing system is part of the language system. An orthography is a normative description of the writing system. This implies that a writing system may exist without an orthography as indeed was the rule in the past. Contrary to common wisdom, present-day writing systems like Spanish, German, French or English are not the result of a designing process, but their major structural features developed by the use of writing and printing (as an invisible-hand-process, Keller 1992). Grammarians from the 16th up to the 19th century were more occupied with trying to understand the writing systems than with ideas of how to change them. However, since grammars were as rule designed to be used in the teaching of writing, the wording of their descriptions is normative. This gives a first hint on why an orthography is needed at all for a language (orthophony, though it exists, does not play a major role in public discussions).

2. The need for normative orthographies

Different from spoken language, written language is usually learned and taught in institutions. This is necessary since children's spoken language acquisition is self-driven and based somehow on universal mechanisms, but the acquisition of written language is not. In order to teach the acquisition of writing, teachers have to rely on an adequate description of the writing system. In modern times, it seems appropriate if just one description of the writing system is officially accepted, in order for all children of a language community to be instructed on the basis of the orthography, i.e. the same description of the writing system in order to achive two goals: First, in school, words and texts written by children are evaluated according to the same codification in all schools of the speech community (eg. German *Hahn* 'cock' has to be spelled like this all over the country regardless of the fact that *haan* would render the same pronounciation quite nicely as it indeed does in Dutch). Second, by this very fact, all adults (tend to) write the same way which facilitates written communication.

3. Concepts of orthographic reforms

Under this perspective, a reform of an orthography is primarily not a change of structural features of the writing system, but mainly (a) a better description of an existing writing system than the description(s) beforehand in use and (b) an adjustment of the description of the writing system because of (written) language changes. Contrary to such a perspective, reformers of orthography in our century considered orthographies to be devices constructed deliberately by man, which hence can be changed at will. They tended to deny the existing of such a thing like a writing system; rather, they considered writing to be some device rendering the "real", i.e. spoken, language more or less precisely by means of visible marks, which gets worse all the time people use it; from this follows the position (c) that every orthography has to be changed from time to time in order to reachieve that ideal. It may be noted that no such ideal has every been formulated in relation to orthophony. In my talk, I will discuss these positions using some examples of present day German ortography and its proposed reform (for a detailed discussion, see Günther 1997a).

4.1 Example (1): Adequate reforming - The ss/ß distinction

In German there are two phones [z] and [s]; in writing, we have (at least) two letters, eg. <s> and <ß>. [z] is always written <s>; it occurs only in syllable onsets and between vowels. [s] is written either <s> as in *bis* 'until', <ss> as in *lassen* 'to let', or <ß> as in *heiß* 'hot'. The distribu-

tion of the use of each graphemic rendering of [s] can be learned; nevertheless, it is the source of many mistakes in children's (and adults) writings. The major source of errors is the variation of stem writing, i.e. we write *Riß* 'rip' but *Risse* 'rips'. The latter form, moreover, displays the general way of indicating short vowels in German (alternatively, or better, "Silbengelenke", Eisenberg 1995). The present spelling reform (printed, for instance, in Duden 1997) will cancel this irregularity: <ß> will be restricted to be the written representation of [s] after long vowels or diphthongs. This, actually, was in fact Austrian spelling up to 1901.

4.2 Example (2): Inadequate reforming - Word division

The development of spaces or blanks can be accounted for as one move in the development of writing systems in order to facilitate reading (Raible 1991). As Maas (1992) has convincingly argued, spaces are indicators for grammatical structure: Syntactic units are put between spaces. To put it the other way round: Lacking spaces indicate "no syntax here". This implies, that the rules were spaces are to be used cannot be based on lexical lists; rather, they have to be formulated in terms of syntactic structure (Günther 1997b). The proposed reform of German completely neglects this aspects; instead, it is based on word class assignment via lexical entries. This arbitrarily created system is not learnable; data from first experiences at school will be reported (Zierer 1997).

4.3 Example (3): Unclear description - lengthening <h>

Because of phonotactic constraints, the graphemic marking of vowel length is in principle redundant. Nevertheless, in some cases, long vowels before /m,n,l,r/ are sometimes additionally marked by the letter <h>, eg. *Sahne* [za:n@] 'creme', *nehmen* [ne:m@n] 'take' since the letter seuqences *sane, nemen* would be pronounced the same way. Roemheld (1955) observed a statistical tendency that so called "lengthening h" (Dehnungs-H) tends to be distributed such that its occurence is more likely if the (graphemic) syllabic onset is short - a regularity which is never mentioned in schoolbooks. An experiment with pseudowords like nat, nan, schnan revealed that adult subjects are well aware of these regularities despite the fact that they were not able to give even an hint on the system - the produced nearly no Dehnungs-h with pseudowords like nat, some more with examples like schnan, and very many with stimuli like nan (Günther & Gantioler 1996). This definitely somewhat unclear bit of German orthography can hence also be learned - even without being properly taught; this bit of knowledge about the German writing system has to be added to its description, ie. orthography.

4.4 Conclusions

The examples will be discussed in terms of the above mentioned three positions concerning orthographic reforming. It will be argued, that

- Sound scientific description has to precede changing
- Changing has to be based on systematic features of the system, not on (non linguistic) general ideas on easyness, elegance or the like
- It is necessary to present a learnable text of the orthography

The present proposal of orthographic reform in German meets none of these criteria. However, it is nevertheless a step forward if compared with the present description of German orthography by the official Duden.

5. References

Duden. 1991. Die deutsche Rechtschreibung. 20.th edition. Mannheim: Bibliographisches Institut.

Duden. 1997. Die deutsche Rechtschreibung. 21.th edition. Mannheim: Bibliographisches Institut.

Günther, Hartmut. 1997a. Alles Getrennte findet sich wieder - Zur Beurteilung der Neuregelung der deutschen Rechtschreibung. In: H-W. Eroms & H.H. Munske (ed.), Die Rechtschreibreform -Pro und Kontra. Berlin: Erich Schmidt.

Günther, Hartmut. 1997b. Zur grammatischen Basis der Getrennt-/Zusammenschreibung im Deutschen. In: C. Dürscheid et. al. (ed.), Sprache im Fokus - Festschrift für Heinz Vater. Tübingen: Niemeyer, 9-21.

Günther, Hartmut & Gantioler, Ilse. 1996. Was Rechtschreiber können und nicht wissen - eine experimentelle Studie zum sog. Dehnungs-h. Paper, presented at the spring meeting of the "Studiengruppe Geschriebene Sprache", Werner Reimers Stiftung, Bad Homburg.

Eisenberg, Peter. 1983. Orthographie und Schriftsystem In: K.-B. Günther & H. Günther (ed.), Schrift - Schreiben - Schriftlichkeit. Tübingen: Niemeyer, 41-68.

Eisenberg, Peter. 1995. Der Buchstabe und die Schriftstruktur des Wortes. In: Duden-Grammatik - Der Duden in 12 Bänden Bd. 4. Mannheim: Bibliographisches Institut.

Eisenberg, Peter. 1996. Sprachsystem und Schriftsystem In: Günther, H., Ludwig, O. et al. (ed.). 1996. Schrift und Schriftlichkeit - Ein interdisziplinäres Handbuch internationaler Forschung Vol. 2. Berlin: de Gruyter, 1368-1380.

Keller, Rudi. 1990. Sprachwandel. Von der unsichtbaren Hand in der Sprache Tübingen: Francke.

Maas, Utz. 1992. Grundzüge der deutschen Orthographie. Tübingen: Niemeyer.

Roemheld, Friedrich. 1955. Die Längenbezeichnung in der deutschen Rechtschreibung. Der Deutschunterricht, 71-82.

Raible, Wolfgang. 1991. Zur Entwicklung von Alphabetschrift-Systemen. Is fecit cui prodest Sitzungsberichte der Heidelberger Akademie der Wissenschaften, phil.-hist. Klasse Bericht 1/1991, 1-42.

Zierer, Verena. 1997. Die neue Rechtschreibung im Unterricht der 6. Klasse. Examensarbeit Lehramt Sekundarstufe 1. Deutschseminar, Erziehungswissenschaftliche Fakultät der Universität zu Köln.

Beatrice Primus, Stuttgart/München

Suprasegmental phonology and orthography: the (his)story of the mute <h>

My talk will examine the graphematic representation of long vowels in German ('Dehnungszeichen'). It will pay special attention to the mute <h>, which is analysed more thoroughly from a synchronic and diachronic perspective.

One of the aims of my talk is to show the advantages of a non-functional approach to the graphematic system of German. In this kind of approach (cf. Eisenberg 1989, 1995), the distribution of graphemes is analysed on the graphematic level alone, without using phonological terms. The phonological functions of the graphematic signs under discussion will be shown to follow from their distributional properties. The main advantage of this approach is that it can explain why a particular graphematic sign may have several phonological functions.

Another aim of my talk is to show that phonological and graphematic representations involve several tiers, including the segmental and suprasegmental tier. Both the phonological and graphematic suprasegmental tier encode the structural representation of syllables and words.
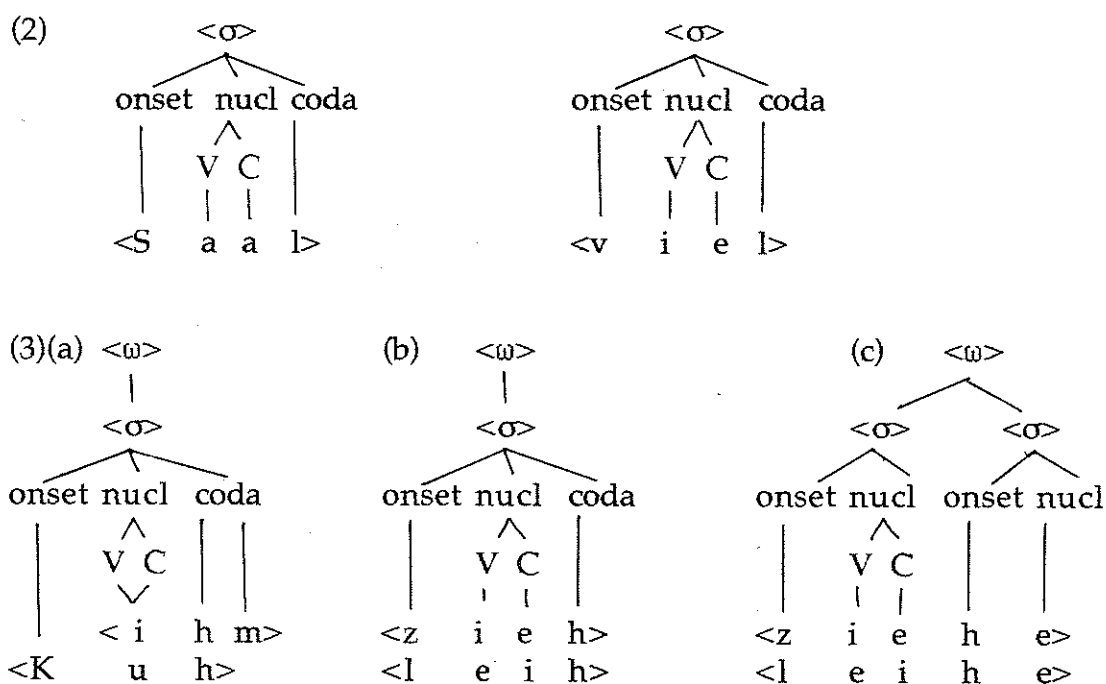
The first advantage we obtain from the separation of the segmental and suprasegmental tier manifests itself on the segmental level. The nine graphemes representing vowels in German are shown in (1) below. These are the vowel graphemes which are used in the graphematically native vocabulary of Modern German (cf. Eisenberg 1995). As to the native phonological vowel inventory of Modern German, it consists of only eight vowels which can be distinguished on the segmental level by their inherent properties such as roundness, horizontal and vertical tongue position (cf. (1) below). Five of these phonemes enter a one-to-one relationsship with five graphemes, as shown in (1):

(1)   /a/   /o/   /u/   /Y/   /œ/   /i/   /eː/   /ɛ/   /ɛː/
        | | | | | ╱╲   └─   ╱╲   ─┘
       <a>   <o>   <u>   <ü>   <ö>   <i>   <ie>   <e>   <ä>

These one-to-one correspondences presuppose a rule which prohibits the phonological realisation of <a>, <o> and <e> if they are immediately preceded by the same grapheme in the same syllable (i. e. tautosyllabic <aa>, <oo> and <ee> is realized as a single phoneme). The result shown in (1) is surprising in view of the fact that the logically strongest version of the phonological orthographic principle (one phoneme corresponds biuniquely to one grapheme) was not supposed to hold strictly for any grapheme-phoneme-pair in German.

The analysis on the suprasegmental level will follow Wiese (1996) and Becker (1996) and will tranfer the syllable representations proposed there to the level of the graphematic syllable. On this account, the nucleus of a syllable has two obligatory positions. A long vowel occupies both positions and a short vowel only one position, in which case a consonant is in the second nuclear position.

My assumption is that the German vocalic 'Dehnungszeichen' (i. e. the second component in <ie>, <aa>, <oo> and <ee>) are restricted to the second nuclear position of the graphematic syllable. The mute <h> is restricted to an immediately postnuclear position (coda or onset of the following syllable) and the immediately preceding nuclear positions have to be filled by one or two vowel graphemes. This means that the mute <h> can be preceded by a long vowel occupying both nuclear positions or by a diphthong. Cf. the graphematic representations in (2) and (3):

(2)

```
          <σ>                          <σ>
        /  ∧  \                      /  ∧  \
  onset  nucl  coda          onset  nucl  coda
    |     ∧     |              |     ∧     |
    |    V C    |              |    V C    |
    |    | |    |              |    | |    |
   <S    a a   l>             <v    i e   l>
```

(3)(a)

```
       <ω>                  (b)     <ω>                  (c)       <ω>
        |                            |                          /    \
       <σ>                          <σ>                      <σ>      <σ>
     /  ∧  \                      /  ∧  \                   / ∧      / \
 onset nucl  coda            onset nucl coda          onset nucl  onset nucl
   |    ∧   |  |               |    ∧   |               |    ∧     |     |
   |   V C  |  |               |   V C  |               |   V C    |     |
   |    \/  |  |               |    | |  |               |    | |   |     |
   |   < i  h m>              <z    i e  h>            <z    i e    h    e>
  <K      u  h>              <l    e i   h>            <l    e i    h    e>
```

On the basis of the distributional properties of the mute <h> and of the grapheme for /h/, the German 'Hauchlaut', it is possible to reconstruct the history of the mute <h> and the fact that the only consonant graphemes that may follow it are sonorant graphemes.

As to the phonological functions of the 'Dehnungszeichen', it will be shown that they follow from their distributional properties. The function suggested by their name 'Dehnungszeichen' follows from the fact that a vowel monophthong preceding a 'Dehnungszeichen' has to be long on the phonological level. This is straightforward in (3a) where the respective vowel occupies two nuclear positions on both the graphematic and the phonological level. In (2) and (3b) the vowel occupies two nuclear positions only on the phonological level. This results from the fact that the vowel grapheme in the second nuclear position is phonologically mute.

The mute <h> has been assumed to have also a syllabification function, as shown in (3c). Following Ossner (1996), this function is captured in terms of the universally optimal syllable CV. It will be shown to follow from the distributional restrictions of the mute <h>. The last part of the talk will present further functions of the 'Dehnungszeichen' in German which have been neglected in the literature. One of these functions refers to syllable weight and the optimal phonological word in German.

Becker, Th. (1996): Zur Repräsentation der Vokallänge. In: Zeitschrift für Sprachwissenschaft 15, 3-21.

Eisenberg, P. (1989): Die Schreibsilbe im Deutschen. In: Eisenberg & Günther (Hgg.), 57-84.

Eisenberg, P. (1995): Der Buchstabe und die Schriftstruktur des Wortes. In: DUDEN - Grammatik, 5. Aufl., Mannheim, 56-84.

Ossner, J. (1996): Silbifizierung und Orthographie des Deutschen. In: Linguistische Berichte 165, 369-400.

Wiese, R. (1996): The phonology of German. Oxford.

Martin Neef   *26.09.1997*

Abstract for the Workshop 'What spelling changes'

Regularity in phonology vs. spelling pronunciation

In German as in other languages, regularities can be found that are surface-true for a large amount of data except for a limited number of items. These irregularities to otherwise nice generalizations can lead to a conception of grammar as a set of constraints that are violable in principle as is carried out in Optimality Theory. They can, on the other hand, also lead to an insistence on the surface-true character of generalizations. In this case, each irregularity has to be explained individually with recourse to other aspects of language as e.g. language change. I want to pursue the latter declarative strategy and show that in some interesting cases the orthography can be made responsible for counter-examples to generally surface-true well-formedness-conditions. This sheds a light on the interaction of orthography and the levels of grammar proper as e.g. phonology and morphology.

I want to demonstrate this line of argumentation in two different areas of German phonology. The first concerns the distribution of the laryngal sound [h]. The distribution of this sound is strongly restricted (parallel to the other laryngal in German, the·glottal stop): it can only appear in the syllable onset, and it cannot cluster with other consonants in this domain. Moreover, I want to defend the hypothesis that it can only appear at the beginning of a phonological word. This prosodic domain is defined as containing exactly one morphological stem. Problematic for this hypothesis are some suffixes like in <Schönheit> 'beauty' and <krampfhaft> 'frantic' and some simple words like <Ahorn> 'maple' and <Alkohol> 'alcohole' where the [h] can not be analyzed as being located at the beginning of a phonological word. Interestingly, the letter <h> is not necessarily pronounced in all of these cases. I want to claim that the letter <h> in some of these cases has primarily an orthographic function; its pronunciation origins in the orthography. In this sense, we are confronted with an instance of spelling pronunciation. A clearer case of this phenomenon is the pronunciation of <Ruhe> 'silence' as [ʀuːhə]. In the data I want to discuss, however, phonological regularity defines what has to be considered as spelling pronunciation.

The other relevant field of data concerns the grapheme <i>. In German phonology, there is a regularity that constrains the succession of syllables of different types. I call this regularity which is based on observations by Bornschein/ Butt (1987: 141) the *Syllable Peak Adjacency Condition* (SPAC) (cf. Neef 1997: 17-21):

(1)   *Syllable Peak Adjacency Condition*
       The syllable peak of a minor syllable must not be right-adjacent to the syllable
       peak of an unstressed syllable. Domain: Phonological word.

This condition is able to explain some central regularities in German morphology as concerning the distribution of the *s*-plural, the restricted possibility of conversion into verbs and some irregularities in adjective inflection. However, there are nouns containing the letter <i> in an unstressed position like <Ferien> 'holidays' or <Studie> 'study' contradicting the otherwise well-motivated SPAC. In these examples, however, the letter <i> is not necessarily pronounced as a full vowel, but it can also be realized as the consonant [j]. I want to claim that the consonantal pronunciation is standard whereas the vocalic pronunciation is orthography-driven. Therefore, a rule will be presented that constrains the distribution of the letter <j> in orthography and explains why we have to write <i> even though we typically pronounce <j>.

These two case studies argue for a conception of grammar that allows for an interaction between the orthographic level of representation and the grammatical levels proper like phonology and morphology. In particular, the orthographic representation of a word can have influence on its phonological interpretation even if this interpretation contradicts general conditions of phonological well-formedness.

References

Bornschein, Matthias/ Butt, Matthias, 1987. Zum Status des *s*-Plurals im gegenwärtigen Deutsch. In: Abraham, Werner/ Arhammar, Ritva (eds.), 1987. *Linguistik in Deutschland. Akten des 21. Linguistischen Kolloquiums*. Tübingen: Niemeyer, 135-154.

Neef, Martin, 1997. *Conversion into verbs: A declarative analysis of the German infinitive*. Düsseldorf, Wuppertal: Universität (= *Theorie des Lexikons* 95).

Christa Röber-Siekmeyer, PH Freiburg

Abstract

Syllables in the perception of children at the beginning of writing and reading and its consideration for a concept for a writing and reading learning programme

The aim of my contribution will be to show that children, when they start to subdivide spoken texts, perceive syllables before words and sounds, and in addition, how they perceive siyllables. My report is based upon trials with children before schooling and children in their first and second year of education in northern aud southern Germany. On the one hand it deals with interpretations of the writing of texts in comparison with the transcription of their spoken texts, then with interpretations of the writing of specially dictated words. The analysis that I shall give is orientated to the phonetical/phonological syllable model of Utz Maas (1997), which is confirmed by the results of these examinations with children.

We used our results to develop a framework for teaching reading and writing, which is based on the corresponding phonological model,that helps children to become aware of their language according to the written text. Letters are not introduced as representations of isolated sounds like equal pieces of a chain, as traditionally has been the case. Instead it makes distinctions between stressed and unstressed syllables and between the four types of stressed syllables in German. With the help of a picture (house with garage) that can be used in several games, and children learn that there is a close connection between speaking and writing and that writing has special regular characteristics to mark the structure of the spoken language.

During a Computer Linguistic project at the University of Osnabrück, in which I participated as an adviser on teaching methods, a computer programme was developed for use with children in their second year at school which is based on this change in the understanding of the relationship between the spoken and the written language. It concentrates on the spelling of double consonant letters after short vowels in stressed open syllables. At the moment it is being tested in a class for a second time after being considerably changed after the first test. Parts of the programme that will be shown at the end of my contribution give an example of the phoetic/phonological based, didactically unusual presentation of writing to young children.

Metsch, Metch, or Match:
The Flexible Game between Orthography, Phonology, and Semantics

Anna M. T. Bosman
Department of Special Education
University of Nijmegen

My view on psycholinguistics is based on two assumptions, which are fundamentally inconsistent with information-processing theory. The first one is that those aspects (or variables) necessary to explain word perception and word spelling, i.e., orthography, phonology, and semantics, are fully interdependent. The consequences of a dynamical approach for the explanation of psycholinguistic effects are, amongst others, a) that a model built on the interdependence assumption requires that information in the system flows from x to y and z, and back, i.e., recurrent feedback will determine the system; b) that observed effects in laboratory tasks can never be traced back to one single aspect (cf., representation, process, or operation); manipulating one variable immediately affects the others. The second assumption is that all behavior, including reading and spelling, is always strategically controlled. I have given up on the strategic versus automatic distinction.

The most important theoretical and practical consequence is that in visual word perception or spelling one never asks the question whether an experimental effect is caused by orthography, phonology, or semantics. It will always be the result of the interplay between all three.

The topic of the workshop is 'What spelling changes'. I believe that psycholinguistics have something to say about it. To that end, I will discuss the results of two experiments both with Dutch-speaking adults and children demonstrating the flexibility of the Dutch reader. The Dutch reader adapts fairly easy to a mild form of spelling reform, like the most recent Dutch spelling reform, and most likely also to a more severe one. A model that is able to describe the effects revealed by the experiments is Van Orden's Phonologic Coherence Model. In this recurrent network, three families of fully interdependent subsymbols (nodes) are assumed, letter nodes, phoneme nodes, and semantic nodes. The presentation of a printed word activates letter nodes which, in turn, activate phoneme and semantic nodes. Following initial activation, recurrent feedback dynamics begin between all these node families. Behaviourally meaningful structure emerges in positive feedback loops between the three sets of nodes. The order in which feedback loops cohere is determined by the history of bi-directional correlations between words' printed forms and their linguistic functions.
Overall, the relations between letters and phonemes in alphabetic languages support the most powerful bi-directional correlations. The same letters and phonemes occur together in very many words. Phoneme-semantic relations and letter-semantic relations are less strongly correlated.
Phonemes and semantic features, and letters and semantic features covary much less systematically. However, phoneme-semantic relations support stronger correlations than letter-semantic relations. This is true because, essentially, we speak before and more often than we read. Thus, at this macro-level of description, node families differ in overall strength and consistency of relations with other node families.

I my paper I will show how this model explains a) why spelling is more difficult than reading, b) why phonology is such a powerful constraint in spelling and reading, c) why a reader can easily adapt to a spelling reform.