

Effects of Phonology and Morphology in Children's Orthographic Systems: A Crosslinguistic Study of Hebrew and Dutch

STEVEN GILLIS AND DORIT RAVID

1 Introduction

In recent years linguists and psychologists have shown growing interest in the linguistic nature of orthographic systems (Aronoff, 1994), in their psycholinguistic representation in adults (Derwing, 1992) and in their development in learning to read and write (Bryant & Goswami, 1987; Treiman, 1993). In this paper we focus on the role of phonological and morphological information in children's developing orthographic perception in two languages with differing linguistic typologies: Hebrew, a Semitic language with a rich morphology, and Dutch, a Germanic language with sparse morphology. The goal of this paper is to find out how children with different typological backgrounds approach morpho-phonological and morphological cues when faced with spelling homophonous letters.

Despite the typological and orthographic differences between the two languages, they share the same phenomenon: homophonous graphemes. For different reasons, certain phonological distinctions in both Dutch and Hebrew are neutralized, yet these segments are mapped onto distinct graphemes. This opaque phonology-to-orthography mapping may constitute an obstacle to the acquisition of correct, or conventional, spelling. For example, the two Dutch words *arend* 'eagle' and *agent* 'officer' share a final [t] in speech due to final devoicing, however written Dutch retains the *t/d* dis-

inction in the spelling. Similarly, Hebrew *tarim* ‘you,SgMasc-will-lift’ and *ta’im* ‘tasty’ share an initial [t] due to historical neutralization processes, however written Hebrew makes a distinction between TRYM¹ (spelled with TAF) and T9YM (spelled with TET). Our question is thus: How do Dutch- and Hebrew-speaking children learn to spell homophonous graphemes? Specifically we are interested in the ways these learners employ morphological and morpho-phonological cues in order to spell phonologically neutralized segments.

2 Methodology

The research design of this study consisted of two spelling tests, one for Hebrew and one for Dutch. Each spelling test contained 32 target items with homophonous segments which are spelled differently, equally divided into four groups of conditions.

Condition I: Morphological and Morpho-phonological Cues

In both Hebrew and Dutch, Condition I of the spelling tests contains 8 homophonous target segments which are recoverable through both morphological and morpho-phonological cues. “Recoverability” indicates the existence of conversion procedures whereby the correct grapho-phonemic mapping is achieved.

In Dutch, Condition I consists of pairs of verbs in present tense and in past participle ending with surface [t] due to final devoicing, e.g., *betover* ‘bewitch, present tense’ / *betoverd* ‘bewitch, past participle’, surface form [b@tovert]). However the verbs are spelled with <t> and <d> respectively. There are two ways to recover the difference in the spelling: (1) through morphology, that is present tense spelled with <t>, past tense spelled with <d>; (2) through morphophonology, by converting past participle forms to adjective or to simple past, thus recovering surface [d].

In Hebrew, Condition I consists of pairs of words containing the same segment [v] as a function vs. root letter. For example, *ve-red* ‘and-get down’ ([ve] stands for function letter ‘and’ spelled W) / *vered* ‘rose’ ([ve] is a root letter spelled W). Every pair of words sounds the same due to phonological neutralization of historical /w/ and /b/ spirantized to surface [v]; however homophonous [v] may be spelled either by W or B. There are two ways to recover the difference in the spelling: (1) through morphology, that is function letter [v] is always spelled W, whereas root letter [v] may be spelled either B or W (items balanced in the test); (2) through morphophonology: W always represents a spirant, whereas B represents an alternat-

¹ Hebrew letters are represented here by capital Latin characters.

ing pair of stop and spirant, which can be detected by morphological conversions (e.g., convert *u-vahir* 'and-bright' into nonbound *bahir* 'bright').

Condition II: Morpho-phonological Cues

This condition contains 8 homophonous items with a morpho-phonological (but not morphological) conversion cue for each language.

In Dutch, Condition II consists of pairs of nouns ending with surface [t] due to final devoicing, e.g., *arend* 'eagle' / *agent* 'officer'. The final segment is part of the stem and therefore not morphologically recoverable, however it is morpho-phonologically recoverable by preventing final devoicing through pluralization: [a:r@nt] 'eagle' ---> [a:r@nd@] 'eagles' (spelled <arenden>) / [a&ent] 'officer' ---> [a&ent@] 'officers' (spelled <agenten>).

In Hebrew, Condition II consists of pairs of words in the same pattern, containing a surface [x] due to neutralization of guttural /h/ (DOT UNDER H PLEASE) and /k/ spirantized to surface [x]. This identical segment is a root letter in both cases and therefore not morphologically recoverable, however it is morpho-phonologically recoverable through the low vowel associated with [x] deriving from low guttural /h/ and spelled *H*. For example, *dérex* 'way' and *kérx* 'ice' share the same pattern *CéCeC* (in which Cs stand for root consonants) and the final root segment [x]. A clue for the correct spelling DRK / QRH is the low vowel *a* in *kérx* 'ice' (Ravid, 1995).

Condition III: Morphological Cues

This condition contains 8 homophonous items with a morphological (but not morpho-phonological) conversion cue for each language.

In Dutch, Condition III consists of pairs of verbs containing a surface [t] which may be spelled either as a single <t> or a geminate <tt>. There is no morpho-phonological conversion rule, however the members of each pair have distinct morphological functions: [t] spelled as <t> occurs in adjectives, e.g., *verplichte* 'made, adjective', whereas [t] spelled as <tt> occurs in simple past, e.g., *verplichtte* 'make, simple past'.

In Hebrew, Condition III consists of pairs of words containing a parallel surface [t] which may be spelled as either T or *T*. There is no morpho-phonological conversion rule to recover the neutralized phonological segments /t/ and /t/ (DOT UNDER SECOND T PLEASE) respectively, however the members of each pair have distinct morphological functions: [t] standing for a function letter is always spelled T, whereas [t] standing for a root letter may be spelled as either T or *T* (balanced in the test). For example, *kašot* 'hard' is spelled QŠWT since *-ot* is a feminine plural suffix; while *mašot* 'oar' spelled MŠWT with a final root letter *T*.

Condition IV: No Cues

The last condition consists of 8 homophonous segments with two possible spellings with no recoverability through either morphological or morphophonological cues.

In Dutch, the test items were pairs of words containing the diphthong [Ei], which can be spelled as either <ij> or <ei>, for historical reasons, e.g., *zwijnen* ‘pigs’ / *treinen* ‘trains’.

In Hebrew, the test items were pairs of words containing the vowel *i*, which may be either spelled by Y or else not represented at all in nonvocalized Hebrew spelling, e.g., *min* ‘from’ spelled MN / *min* ‘gender’ spelled MYN. The linguistic conditions under which these two spellings occur are either arbitrary or available only to specialists in historical Hebrew phonology.

The four conditions of the research design were thus systematically varied according to the following scheme:

Condition	Morphological Function	Morphophonological Recoverability
I	+	+
II	-	+
III	+	-
IV	-	-

Table 1: Overview of conditions in the experiment

The four study conditions can be represented on the following arbitrariness scale:

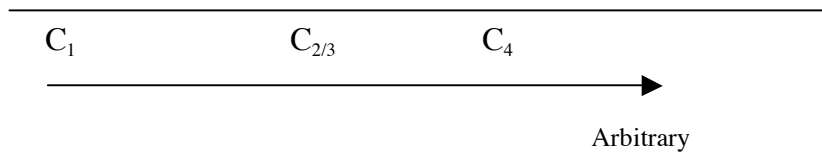


Figure 1: Experimental conditions on an arbitrariness scale

We predicted that children learning Dutch and Hebrew would respect the arbitrariness scale and show the same learning profile: the more motivated the relationship between phonology, morphology and orthography, the fewer errors and the steeper the learning curve. Thus Condition 1, which supplies the most cues, was predicted to be the easiest, Conditions 2/3, with

only one cue per condition, were predicted to be harder, and Condition 4, with no cues, was predicted to be the hardest of all.

3 Participants and Procedure

240 Israeli and 160 Dutch-speaking Belgian monolingual schoolchildren with a middle-high socio-economic background from grades 1-6 were administered the spelling tests. They were asked to spell the 32 target words which were given in a sentential context to ensure clear and nonambiguous understanding.

4 Results

Arbitrariness-success score. Table 2 shows the success scores of the Israeli and Belgian participants in the 4 conditions by age.

Grade	Hebrew				Dutch			
	I	II	III	IV	I	II	III	IV
1	73.1	54.4	69.1	46.8	49.7	53.0	53.6	59.8
2	81.8	61.8	76.3	52.9	50.2	81.9	50.5	85.5
3	92.9	79.4	86.3	66.0	50.9	87.5	50.0	88.5
4	92.6	80.9	81.3	73.9	50.2	95.0	53.8	91.4
5	96.8	91.3	91.0	87.8	50.8	95.0	55.0	94.6
6	98.5	92.8	90.8	89.9	54.4	98.8	63.1	95.6

Table 2: Percentage correct responses as a function of language (Hebrew/Dutch), grade (1-6) and experimental condition (I – IV).

For Hebrew, our predictions are confirmed. All conditions show a learning curve (see Figure 2). The curves for Conditions I (morphological and morpho-phonological cues) and III (morphological cue) start at around 70% and reach ceiling in 3rd grade. Conditions II (morpho-phonological cue) and especially IV (no cues) show a more gradual learning curve between grades 1 and 4. Thus the less arbitrary or more motivated conditions in Hebrew are learnt earlier than the more arbitrary or less motivated conditions. For Dutch, our predictions are not confirmed (see Figure 2). Conditions I and III are at chance level except for 6th grade, while Conditions II and IV rise steeply between grades 1 and 2, and then reach ceiling in 4th grade. Thus the more arbitrary or less motivated conditions in Dutch are learnt earlier than the less arbitrary or more motivated conditions.

Since our results were found to be so different for the two languages (see Gillis & Ravid, 1999, for statistical details and more fine-grained comparisons), we examined the specific effects of morphological and morpho-phonological cues on our participants' spelling performance in the two languages.

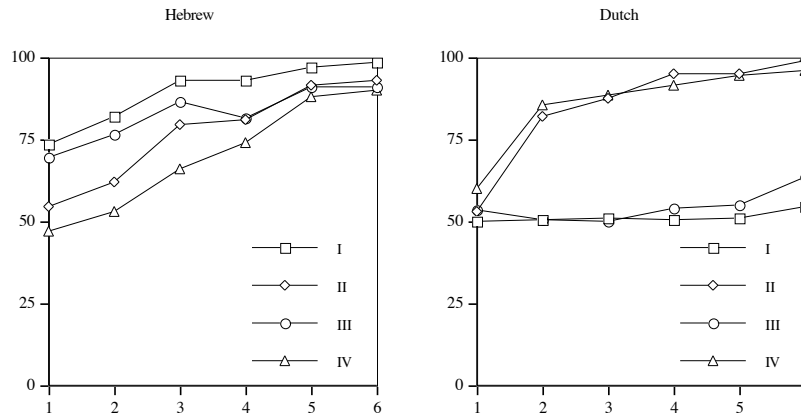


Figure 2: Percentage of correct responses as a function of grade (1-6)

Morphological recoverability. Recall that some of our homophonous target segments were recoverable through their morphological functions. For example, the fact that function letters have unique spellings while root letters may be spelled in two ways, in Hebrew; and the differential spelling of Dutch present tense and part participle t / d. We analyzed the morphologically recoverable vs. morphologically non-recoverable target items in both languages by age. In Hebrew, the morphologically recoverable items have a higher score than the non-recoverable ones, and the two learning curves coalesce in 5th grade. In Dutch, the morphologically recoverable condition shows no learning before 6th grade, while the non-recoverable items reach 80% and higher from 2nd grade. Thus morphological cues facilitate learning to spell in Hebrew-speaking children and hinder learning in Dutch-speaking children.

Morpho-phonological recoverability. Recall that some of our homophonous target segments were recoverable through their morpho-phonological functions. For example, Dutch pluralization prevents final devoicing and neutralization of t / d, and in Hebrew stop / spirant manipulation and vowel lowering indicate which surface segments are mapped onto which specific graphemes. We analyzed the morpho-phonologically recov-

erable vs. morpho-phonologically non-recoverable target items in both languages by age. In Hebrew, both recoverable and non-recoverable items started at around 60%, but the morpho-phonologically recoverable items had a consistently higher score than the non-recoverable ones until the two learning curves reached 90% and coalesced in 5th grade. In Dutch, the two types of target items started at around 50% and climbed slowly to about 75% in grade 6. The learning curves were identical and there was no difference between the scores on the recoverable and non-recoverable items. Morpho-phonological cues thus facilitate learning to spell in Hebrew-speaking children but have no effect on the development of Dutch-speaking children.

5 Discussion

This study examined the development of spelling in Hebrew- and Dutch-speaking gradeschoolers from grades 1-6. The study participants were administered a spelling test containing 32 target items with homophonous letters in 4 conditions systematically varied by number and type of morphological and morpho-phonological cues. Analysis of the results showed differential learning patterns in the two languages: Israeli children performed better given morphological and morpho-phonological cues, while Belgian children performed worse with morphological cues and were not guided by morpho-phonological cues.

Two related issues seem to be of interest in discussing these results. One is the fact that orthographic knowledge of alphabetical systems is linguistic in nature. Spelling has long been considered external to the domain of linguistic and psycholinguistic inquiry. It is only in the last two decades that linguists and psychologists have seriously considered writing systems as representational systems in their own right rather than mere reflections of speech (Aronoff, 1994; Derwing, 1992). Orthographic systems encode representations of linguistic notions such as "phoneme", "morpheme", "word", etc., and the knowledge that is needed to spell involves linguistic domains of phonology, morphology and syntax. In a sense, while discovering the principles of alphabetical systems in learning to read and write, children are essentially discovering - and in another sense, creating - a linguistic representation of speech: awareness of distinct "words", of the notion of a "sentence", and of the separate existence of phonemes arises as a product of learning about the features of a writing system. The process of learning to think about a writing system goes hand in hand with learning to think about spoken language.

More specifically, based on our cross-linguistic findings, we would like to put forward a typological hypothesis, the orthography / morphology hy-

pothesis: Language typology determines the sensitivity of children learning to spell to morphological cues. Israeli and Belgian children in our study treated morphological and morpho-phonological cues differently in their spelling development. Morphological cues were accessible and helpful to Hebrew speakers and far less accessible to Dutch speakers. A possible explanation derives from language typology. Hebrew is a morphologically rich language in which even core lexical items - everyday familiar items - are morphologically constructed. All verbs have a root-and-pattern structure and the overwhelming majority of nouns are at least bi-morphemic. Inflection is rich, obligatory and wide-spread. Hebrew-speaking children have to use morphological cues in language acquisition, and they do so from early on (Ravid, 1995). As a result, Hebrew spellers look for morphological cues from their initial encounter with its orthography. This tendency is enhanced with the acquisition of literacy: Hebrew is even more synthetic than its spoken version, due to optional high-register inflections and to spelling of some function words as part of the next written word (Levin et al., in press, submitted). There are indications that certain morphological classes are acquired in spelling by second grade (Ravid, 1999). Dutch is, in contrast, a morphologically sparse language.

References

- Aronoff, M. (1994). Spelling and culture. In W.C. Watt (ed.) *Writing systems and cognition*. Dordrecht: Kluwer.
- Bryant, P.E. & Goswami, U. (1987). Phonological awareness and learning to read. In J.R. Beech and A.M. Colley (eds.) *Cognitive approaches to reading*. London: John Wiley & Sons, 213-243.
- Derwing, B.L. (1992). Orthographic aspects of linguistic competence. In Downing, P., S.D. Lima & M. Noonan (eds.) *The linguistics of literacy*. Amsterdam / Philadelphia: John Benjamins, 193-210.
- Gillis, S. & Ravid, D. (1999) *Differential effects of phonology and Morphology in Children's Orthographic Systems: A crosslinguistic study of Hebrew and Dutch*. Ms.
- Ravid, D. (1995). *Language change in child and adult Hebrew: A psycholinguistic perspective*. New York: Oxford University Press.
- Ravid, D. (1999). The development of orthographic perception in Hebrew: A theoretical model and some empirical examination. In O.R. Schwarzwald, S. Blum-Kolka & E. Olshtayn (eds.) *Festschrift for Raphael Nir: Studies in communication, linguistics, and language teaching*. Jerusalem: Carmel. [in Hebrew]
- Treiman, R. (1993). *Beginning to spell: A study of first-grade children*. New-York: Oxford University Press.