Item Presentation in Primers - An Analysis Based on Acquisition Research

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Abstract

It is known that children have difficulties with correct spelling of orthographic regularities in German ('liebe', 'kennen'). By looking at instruction material in first grade, this work is a first step of an ongoing study to understand how children's spelling in German is affected by their method of instruction. A major influence on spelling and reading acquisition is the input children receive during the initial phase. It is therefore important to analyse the reading material and understand how these relate to research-based knowledge of acquisition. We show that there is a substantial difference between popular primers (first grade material to teach reading) on how they present material to first graders. It can also be seen that none of the modern primers seem to emphasize item presentation with regularities that help students learn to generalize to new words. These findings are important because the differences have a potential major effect on reading and orthography acquisition that remain mostly unknown and unstudied.

1 Introduction

There are a number of widely accepted theories in the community regarding the acquisition of orthographic and reading skills, though most agree that acquisition, especially in the crucial phase of reaching rapid word recognition is still not perfectly understood. Compounding the issue, is the difficulty in understanding how any findings generalize across languages (Share, 2008).

While there are differences, researchers agree that cognitive predictors are common across all languages, albeit to differing degrees (Ziegler and Goswami, 2005; Caravolas et al., 2012). Among these are Phonological Awareness (PA) [1] and Rapid Automatized Naming (RAN) [2]. Over the first years of acquisition one can observe a gradual shift from PA to RAN as a predictor, with PA being important for a longer period of time in deeper orthographies [3]. PA can be shown to contribute to individual variance in literacy development across languages (Moll et al., 2014). In several studied languages, PA was the best predictor of reading accuracy and spelling whereas RAN was the best predictor of reading speed.

Beginning reading and spelling acquisition therefore depends on phonological awareness and the ability to manipulate phonemes and graphemes in the process of phonological recoding of new words in orthographies of all depths. This holds true also for German.

Self-teaching theory (Share, 1995) is currently the most plausible model to explain the process of reading and spelling acquisition and the training of these relevant cognitive skills. It is based on the idea that children rely and build on phonological decoding skills to learn novel words. The combination of contextual inference, usage of inner lexicon and phonological recoding is then accompanied by the self-teaching strategy as a mechanism

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[1] Phonological awareness involves the detection and manipulation of sounds within words - not necessarily involving the written word.

[2] A task that measures how quickly individuals can name aloud an object shown in a picture, including letters.

[3] Orthographic depth relates to the amount of context necessary in order to identify the correct phoneme-grapheme correspondence. For example 'Sp' vs. 'Sn' needs the following letter to determine correct choice of phoneme /ʃ/ vs. /s/. Depth can depend on syllable, word-level or even sentence level and is language dependent. A flat orthography such as Finish does not need context. In contrast English and French ('aimait' vs. 'aimaient', 'aimé' vs. 'aimer') are deep orthographies.

to grow the reader's orthographic lexicon (Ehri, 2005; Share et al., 1984; Jorm et al., 1984; Cunningham et al., 2002; Bowey and Muller, 2005).

Given this theory of self-teaching, the presentation of items to a learning reader is an important consideration in first grade texts (called primers from here on). To our knowledge, these have not been examined in detail. In our previous work we showed that children's orthography skills lack regarding highly frequent, regular German spelling patterns (such as 'li**e**be', 'ke**nn**en') (Berkling and Lavalley, 2015). Unfortunately, the data for that study did not emphasize the relation to the teaching methods and motivated the need for further study and corpora. Indeed, we found that first grade primers indicated a lack of progression regarding these same regularities that students were having problems with (Berkling et al., 2015).

The work presented here catalogues criteria based on literature in the field of spelling and reading acquisition across disciplines and applies these in an analysis of various well-known primers. Correlating the effect of item presentation with student orthographic abilities or reading proficiency is beyond the scope of this paper but represents a clear next step resulting from a deeper understanding of how teaching materials should be constructed.

The rest of this paper proceeds as follows. Section 2 will compile the latest research results to create the theoretical foundation of the evaluation criteria; the tools for taking a critical look at primary materials used to teach reading and writing. Section 3 lists the primers that have been analyzed. Section 4 describes the system to automatically analyze the texts. Section 5 then discusses how the primers perform with respect to some of the criteria and Section 6 draws some conclusions and outlines some of the next steps in this research.

2 Theory

Self-teaching theory (Share, 1995) states that children are able to establish specific orthographic knowledge through reading experience. Translating letter strings into phonological code, called phonological recoding, is then also used in spelling productions. This has become a widely accepted model for both reading and spelling ac-

quisition across languages (Caravolas et al., 2001; Caravolas and Volin, 2001; Martinet et al., 2004; Ziegler et al., 2014; Cunningham, 2006).

As a consequence of this, model item selection for reading material, especially in primers, for both reading and spelling acquisition may be of great importance. "Self-teaching opportunities afforded by phonological recoding represent the "cutting edge" of reading development not merely for the beginner, but throughout the entire ability range."(Share, 1995, p.155). Therefore, the items must be sequenced, and must either present a self-teaching or practice event for the student.

The goal of this section is to create the argument for item selection criteria that presents items in such a way as to build on the child's previous skills and produce the highest quality lexical entries in order to prepare for second grade reading skill acquisition to build on.

The following principles for item selection in primers are supported by literature findings as we will argue below. They are interdependent:

1. Train PA through phonological recoding while supporting natural sensitivity for regularities

2. Provide pressure for lexical restructuring through progression (presenting successfully more difficult words)

3. Take care with words that don't generalize

2.1 Training PA within Patterns

Phonological Awareness Through Manipulation:
Phonological awareness is trained by providing a network of graphemes and phonemes in various combinations to allow the student to train grapheme-phoneme correspondence and blending which does not happen through repeating words but through presenting many words with the same structure ('hat', 'cat', 'rat' provides more learning than 'hat', 'hat', 'hat'). According to (Melby-Lervag and Hulme, 2010), training children to manipulate phonemes in unfamiliar words improves phonemic manipulation and serial recall of those words.

Regularities:
Regularities are taught through phonics (Pinnell

et al., 1998), the method of scope and sequencing learning material in stages of complexity accompanied by explicit teaching of the material and phenomena that are introduced with each step. Recently, this was confirmed by a meta study on this topic (Galuschka et al., 2014). Duncan shows that phonics instruction increased explicit syllable and rime awareness as well as phonological awareness (Duncan et al., 2013). The effectiveness of teaching through patterns has been widely studied, including their effect on both reading and spelling (Ehri, 1987; Cunningham, 2006; Castles and Nation, 2006; Pacton et al., 2001; Anderson and others, 1977).

Children are very sensitive to the orthographic regularities of their writing system from an early age (Ouellette and Senechal, 2008; Pacton et al., 2001) and produce spellings that conform to the orthographic conventions of their writing system. In French, general orthographic knowledge of regularities influences the recall of newly learned orthographic representations (Pacton et al., 2014; Pacton et al., 2013; Sobaco et al., 2015). Readers learn about spelling patterns that recur in different words, these larger units are then used to form connections to remember words (Bhattacharya and Ehri, 2004). Thus students create patterns based on reading input items that they apply both in reading fluency and spelling skills. Conversely, this also means that showing wrong patterns will result in wrong generalizations, such as is the case with the use of the letter <i> in German children's spelling for /i:/ (Berkling and Lavalley, 2015) as in 'Tiger'. Having seen a larger number of first items in a primer that end in the letter <a>, such as 'Oma', 'Mama', 'Lula', 'lila' and 'Tiger' or 'Igel', a child might be inclined to apply the trained pattern and generalize to a new word /liːbɐ/ and spell it as 'liba' instead of 'lieber'.

There are two key insights towards practice:

- Children generalize rapidly from presented items towards patterns.

- This process has been proven in several languages, regardless of orthographic depth.

2.2 Lexical Restructuring and Progression

Input hypothesis (Krashen, 1981) states that learning moves in stages, where only one new item is presented at a time, building the learning material from simple to more complex items. This should be taken into account when selecting items for the reader. A word like 'Weihnachtsmann' would therefore not be in the 'i+1' scope [4] of a beginning reader and can not serve as an input item for self-teaching. Ability to read begins with simplest conventions at the beginning (Treiman and Cassar, 1997) and expands to more complex ones later on (Pacton et al., 2002), as has been shown in English and French, supporting the idea of allowing for a progression from simple to more complex in reading materials.

Lexical restructuring is a result of self-teaching opportunities at well designed steps of progression. Lexical quality hypothesis (Perfetti and Hart, 2002) states that words vary in the quality with which different aspects of their form and meaning are represented in memory. As the form relates to phonology, morphosyntax and orthography, items should provide these kinds of pressure for lexical restructuring and generalization (by providing new combinations of letters with slowly increasing difficulty, not promoting memorization). Improving the inner lexicon but also supporting emerging phoneme awareness is based on reading input in a similar manner across languages (Ziegler and Goswami, 2005; Ziegler and Goswami, 2005; Mann and Wimmer, 2002; Duncan et al., 2006).

Ignoring Progression:
Acquisition of more difficult words when the mapping between phonemes and graphemes is still unstable may lead to shallower learning and weaker orthographic representation and are prone to disappear in the long term (an example might be 'Fahrrad' spelled as 'Farhad'). Children more sensitive to the frequencies of phoneme-grapheme mappings are better able to detect inconsistencies and memorize these for novel irregular words (Biname and Poncelet, 2016). The study emphasizes the importance for children to master phonological recoding during the first

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[4]'i+1' relates to the next unlearned step that is within the grasp of a student given the current knowledge.

years of school in order to establish their orthographic learning abilities for the large number of words to come in further years of study. Only after learning patterns ('gehen', 'wehen'), students become sensitized to nuances in orthographic detail (for example 'drehen', 'dehnen') (Cunningham, 2006; Share, 2004). Words perceived as irregular effect both reading and writing. Wang (Wang et al., 2012) shows that irregular words are not only decoded less accurately but also encoded less well.

There are two key insights towards progression:

- Security in a lower level of acquisition makes the next level of difficulty possible.

- Ignoring sequences can lead to problems with recall in spelling and reading.

2.3 High Frequency Words

One exception to perceived irregularities are high frequency words (HFW). HFW have a regularity at the text level in that they appear very frequently (40-50% in a normal text) and are often function words. According to Gough (Gough, 1983), these words are predicted 40% of the time. They tend to be 1-Syllable words and often do not follow spelling patterns (for example "ihn"). According to (Ehri, 2005), any word that is read sufficiently often is a sight word. Many studies show that orthographic information is acquired fairly rapidly (Manis et al., 1993; Reitsma, 1983a; Reitsma, 1983b) and the child will recognize these frequent words visually. Therefore, HFW do not represent a self-teaching event to acquire en/decoding patterns for generalization to new words.

There are two key insights to emphasize regarding the use of HFW in item selection:

- Learning around 100 of these HFW will help a beginning reader to quickly be able to read almost half of the occurring words in any text, providing positive feedback.

- These words do not provide practice for self-teaching orthographic principles to support learning future unknown words.

2.4 Summary

The points discussed above are highly interrelated. Important considerations are the continuous training of phonological awareness through recoding within patterns and then moving on to new patterns as the preceding ones have been mastered. These steps provide practice and lexical restructuring in a controlled manner. As learning takes place rapidly, item selection is of crucial importance in the beginning.

The rest of the paper will examine a number of German primer texts with respect to these criteria. As the texts are examined, it is important to keep in mind that the first-grade materials are not limited to the text in the primers. Therefore, this analysis is only an approximation of the input that children receive in first grade teaching environments.

3 Corpus

A selection of well-known primers was taken that represent different ideologies regarding item presentation.

Syllabic Method: This methods assumes that reading is best taught starting with the syllable. Therefore, the book starts with teaching syllables instead of letters in isolation. Usually, this method also distinguishes stressed from unstressed syllables ('Mutter'). An example of such a primer is 'ABC der Tiere' (Handt et al., 2010). The first words in one of the versions consists of one page repeating the word 'mu'. Both letters are learned in the context of the syllable and not in isolation.

Analytic-Synthetic Method: This method assumes that there is more or less a 1-1 correspondence between phoneme and grapheme with some more nuances that are postponed to a later stage, without following a phonics approach. Examples tending in this direction to varying degrees are 'Kunterbunt' (Bartnitzky, 2009), 'Jo-Jo' (Namour et al., 2011), and 'Tinto' (Anders and Urbanek, 2004). It is assumed that after introducing letters 'Ii,Aa,Oo,Nn,Mm,Ll,Tt', the student can read 'Tina', 'Oma', 'Ali', 'Ana', 'Lila' by sounding out the letters. (The ensuing difficulty for children to decode (read) 'lieber' or encode (write) /liːbə/ with these training samples may be under-

estimated.)

The Whole Word Method: This method extends the previous with extensive practice at the word level. 'Tobi' (Metze, 2002) shows a tendency in this direction. The text has since been adapted to include syllables.

Phonics Method: The phonics approach emphasizes regularity ('lieber', 'Diener', 'bieter') over simplification ('lila', 'oma'). There are old primers from the turn of the century that exemplify this method, such as what will be called 'Alte Fibel' (Stöwesand, 1903) in this paper. Patterns are important and treated differently from 'HFW'. There is a clear progression from what the author deems 'easy' to 'difficult' in relation to patterns in typically German words.

4 System

In order to analyze the texts with respect to the criteria established in Section 2, a means of categorizing items (words) used in the primers is needed. The goal is to study the use of regularities in presented items because these support learning and generalizing from seen items to new words. Table 1 lists the most important categories of words, distinguishing regular spelling patterns in German from other categories of words. The regular word occurrences in learner texts are important to identify because they support self-teaching events at the beginner level. In its simplest form, there is the 2-syllable trochee (stressed/unstressed 'Betten') and the 1-syllable form that derives its spelling from the latter ('Bett'). The other listed categories include low-frequency exceptions (these do not help to generalize), high frequency words (these are quickly memorized as whole-word image and support reading but not generalization) and longer words ('Handschuh', 'vergehen'), regular but very difficult for the early stages. A hypothesis yet to be studied is that complex onset may prove difficult for children to learn, a reason to distinguish this additional category. Finally, the category 'other' encompasses word structures that inherently do not generalize to other German words as they do not conform to German orthography. Together, these categories cover items seen in the text. The automated classification algorithm needed to process large quantities of words is described in this section.

Software modules form the basis for analyzing the primers' texts building on the one described in (Berkling et al., 2015). The system proceeds in three steps. First, the pronunciation of each item is obtained with speech synthesis supporting tool Balloon (Reichel, 2012). Given a text, Balloon returns pronunciation, morpheme and syllable boundaries. In a second step, this output enables the construction of the correct grapheme sequence [5].

Word Type	Description or Example	Self-Teaching Event
HFW	100 most frequent words = %45 of all words	memorized
1-syllable short vowel	Bett (1Sv)	yes
1-syllable long vowel	saust, lieb (1SV)	yes
2 syllables short vowel one consonant	Sonne, Wonne (Betten)	yes
2 syllables short vowel two consonants	fester, Äste (besten)	yes
2 syllables long vowel	Nadel, geben (beten)	yes
complex onset	Klasse, klapper	yes
other	Lulu, Lala, Auto	not generalizable
aa,oo,eh,	Boot	exception
ck, tz, ng	Bäcker	exception
too long	Weihnachten Sommerferien	too difficult

Table 1: List of identified 'Word Categories' for the purpose of this study.

Finally, the graphemes can be assigned to allowed positions in the regular German syllable as shown in Table 1. $K1$, $K2$ etc. are column names

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[5]Examples of grapheme assignment difficulties are 'a-n-||-n-eh-m-en' /nn/ vs. 'a-nn-e' /n/ depends on the morpheme boundary provided by Balloon; 'W-e-s-p-e' contains /sp/ vs 'g-e-sp-ie-l-t' /ʃp/; 'n.äh.r.en' vs. 'n.ä.h.en'. Graphemes in this context are letter sequences used for teaching purposes (sp, nn, h, sch,...).

for each of the allowed positions of graphemes. Depending on how these columns are filled, the words are then classified into the proposed categories (Berkling et al., 2015).

Regular words can be categorized according to the table above. When position $K(shortV)$ is filled, the vowel must be short. When the Rime is not filled, it is a 1-syllable word. The following are some examples:

1. 2-syllable, long vowel: K1-V-K1-Rime ('b-e-t-en')

2. 2-syllable, short vowel with one consonant phonemes: K1-v-K(shortvowel)-K1-Rime ('B-e-tt-en'), because K(shortvowel) and K1 after the syllable boundary are a single grapheme (indicated by '!')

3. Short vowel with two consonant phonemes: K1-v-K(shortvowel)-K1-Rime ('b-e-s-t-en')

Words in category 'other' are identified, when graphemes occur in non-allowed positions. They are not typically German words and do not generalize. Examples are 'Auto', 'Mama','Lula', where 'a' and 'o' are not allowed vowels in the second, unstressed syllable.

Further, high frequency words ('HFW') are distinguished in a separate category (Quasthoff and Richter, 1998), the list of words used to select this set are statistically those 100 words that make up the top 45% occurrences in normal German texts.

Words that do not fit into the 1- or 2-syllable category and are 'too long' (for primers), including prefix or composites ('vergehen', 'Weihnachtsmann' or 'Handpuppe') are listed in a separate category. They are easily identified by their number of syllables.

Spellings that follow German structure but exhibit irregular graphemes in consonants (such as 'ck') or vowels (such as 'oo') are categorized separately according to vowel and consonant exceptions.

Complex onsets, when columns $K1$ and $K2$ are both filled in the first syllable, are categorized separately in 'complex', regardless of whether they have one or two syllables.

The output of this algorithm produced a sequence of categories, one for each word of the entire text. This sequence is then analyzed regarding regularities it item presentation of any text. By inspection, few words are misclassified and the small number of mis-classifications do not affect the overall analysis results. An example of word classification output of this system is given below:

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s e i n      (HFW)
s i n d      (HFW)
i s t        (HFW)
f e s t      (1−Syllable short vowel)
r e i s t    (1−Syllable long vowel)
s a u s t    (1−Syllable long vowel)
a l t        (1−Syllable short vowel)
k l a p p e r (Comlex onset)
n u d e l    (2−Syllable long vowel)
s o n n e    (2−Syllable short vowel)
e n t e      (2−Syllable short vowel)
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Word	Core	Morpheme Boudary	K1	K2	Vowel	K (shortV)	Syll	K1	K2	Morpheme B.	Rime
schnell	schnell	||	sch	n	e	l	.		l	||	
streben	streb	||	st	r	e		.	b		||	en
zielen	ziel	||	z		ie		.		l	||	en
ziehen	zieh	||	z		ie		.	h		||	en
essen	ess	||			e	s!	.	s!		||	en
lecker	leck	||		l	e	c!	.	k!		||	er
fasten	fast	||	f		a	s	.	t		||	en

Figure 1: *System of splitting graphemes into allowed syllable slots.*

5 Results

5.1 Practice and Patterns

Practice can be achieved at the level of phonemes, syllables (patterns) or words.

At the phoneme level, Table 3 (see Appendix) lists the letters and their frequency of usage within the patterns of trochee mentioned in Section 4 over the first 1300 words for the example of 'Alte Fibel'. It is more or less representative of all other primers. At this level of practice there is no visible difference. Regarding practice at the syllable and word level, Table 2 lists the lexical diversity and syllable diversity after the first 1300 word in

each of the primers. Most of the primers are more or less similar. The outlier is 'Alte Fibel' with a much larger lexical diversity. At the same time, the number of total used syllables is lower, indicating the use of shorter words. Looking at the syllable diversity, it can be seen that the reader is presented with a significant larger number of syllables than in any of the other readers (769 syllables, the runner up being 'Tinto' with 610). At the syllable level, the learner has been exposed to a larger number of self-teaching opportunities both at syllable and word level.

Figure 2: *% distribution of word category usage for regular patterns and HFW.*

Title	LD	# Syllables	SD
ABC der Tiere	.39	1951	.24
JoJo	.32	1999	.21
Tinto	.45	1938	.31
Kunterbunt	.37	1979	.26
Tobi	.41	1937	.28
Alte Fibel	.62	1784	.43

Table 2: Statistics for each of the analyzed primers after the first 1300 words. LD=Lexical Diversity (Types/Tokens). SD=Syllable Diversity, using counts for types and tokens at syllable level. High diversity means more practice on new words/syllables.
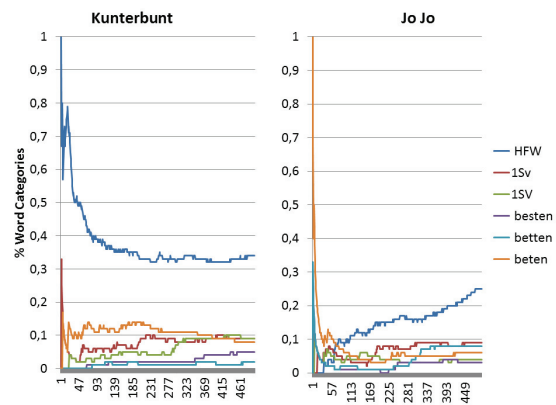
Figure 3: *% distribution of word category usage for regular patterns and HFW.*

5.2 Progression

Being exposed to a larger number of self-teaching opportunities may be difficult if these are not taking place within known patterns. This presupposes a progression at the pattern level.

Figures 2, 3 and 4 depict the percentage of 'word category' usage in the text seen up to a given point in time (marked by the number of words seen so far on the y-axis). 'Tobi' exhibits a natural combination of word categories in use from the start. 'Tinto' has a slightly manipulated higher frequency of HFW and 1-syllable words. 'Kunterbunt' starts with a large proportion of HFW with all other patterns appearing in equal measure. 'Jo-Jo' has a very low number of both HFW and regular words in the beginning. Both 'ABC der Tiere' and 'Alte Fibel' are different from the other primers. 'ABC der Tiere' exhibits a very high usage of 1-syllable words and a late but strong start of HFW (also usually 1-syllable
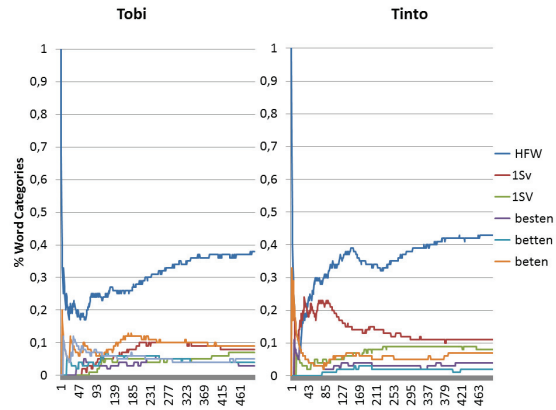
words). 'Alte Fibel' is the only primer that shows a very clean separation in time for all different patterns. Starting the reader off with HFW and 1-syllable words of both long and short vowel types, 2-syllable words are introduced much later, one pattern at a time, only then moving on to words that include complex onset.

5.3 Function Words (HFW) and Non-Pattern Words

High Frequency Words: The natural occurrence frequency of HFW in a normal text is around 40-45%. By the end of the text, all primers reach about the level of 30-45%. It is interesting to note that 'Alte Fibel' de-emphasizes HFW in favor of self-teaching events that help students to generalize to new words. Figure 5 will show that
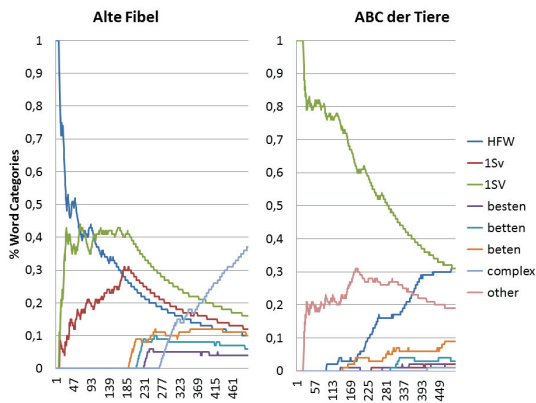
Figure 4: *% distribution of word category usage for regular patterns and HFW. This graph includes 'other' and 'complex onset'.*

Figure 5: *Progression of word type % that make up the text as seen until word n. 'Alte Fibel' and 'ABC der Tiere' exhibit a clear contrast in approach during the first thousand item presentations while looking similar at the end. 'Alte Fibel' has almost no words of category 'other'.*

this is a temporary condition in the beginning of the book before moving to above 30% towards the end of the book.

Irregular Words: Irregular words are those that do not conform to the German spelling system, that is their patterns do not generalize to new words that are frequent in German. Their use not only does not generalize but may induce self-teaching events that will create patterns that are false. Since learning takes place with very few examples, these self-teaching events can affect further reading ability because the student fails to generalize to be able to read new words that have a different pattern from the ones learned in the beginning. It also has an effect on spelling as discussed in Section 2. It is therefore interesting to see if and how 'other' words (not conforming to the German spelling system, like 'Auto' or 'Oma') are used in the beginning. The percentage of 'other' words in the text is plotted over time in terms of words seen (x-axis) in Figures 6 and 7. It is interesting to note that 'Alte Fibel' has virtually none of these types of words. 'ABC der Tiere' has a consistent 20% of such words in the beginning (plotted in Figure 4). All primers exhibits a fairly high % of words that do not generalize to the regular patterns that appear in the German language. The percentage is especially high in the first presented items. Many of these words may be names and introduce the people in the story. In order to see whether these words become HFW through high usage, Figure 8 plots the number of words
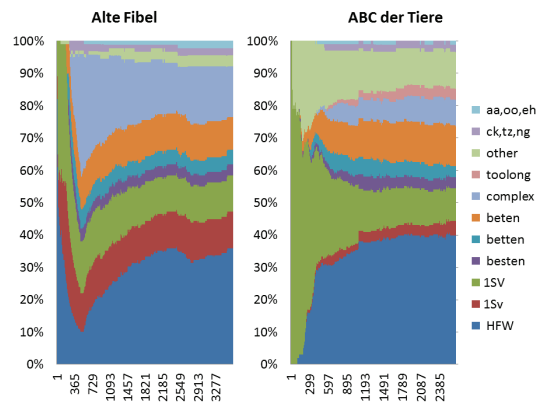
in this category and shows their distribution over the top most frequent words. What we would like to see is a large number of repetitions and few words of this type to prevent pattern formation across many self-teaching events and encourage visual recognition. 'Jo-Jo' and 'Tobi' show this profile while 'Kunterbunt' has a large number of 'other' words with low frequency count of each as do 'ABC der Tiere' and 'Tinto'.

Irregular spellings that are part of the German orthographic system like 'ck' instead of 'kk' or 'oo' in 'Boot' do not appear in the first items for both 'ABC der Tiere' and 'Alte Fibel' while they appear in all other primers. Irregular spellings are rare but have a low frequency and so do not necessarily move into visual recognition automatically for readers. They may or may not confuse the learner in the early pattern construction phase.

5.4 Summary

The theoretical background on what is known about reading and spelling acquisition in the context of the self-teaching theory provides guidelines for a structured approach towards analyzing the selection of items presented to beginning readers. Primers are an indicator of the order in which these are presented to children in the classroom.

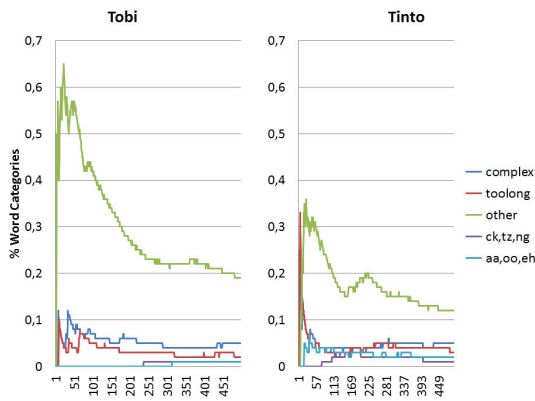In theory, practice, patterns, progression after

Figure 6: *% distribution of word type usage for irregular and more difficult patterns.*
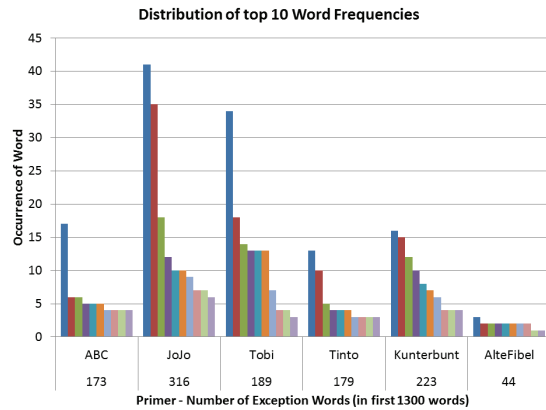

Figure 8: *Distribution of 10 most frequent non-regular words. Word list differs for each book.*

6 Conclusions

The main contributions of this paper are twofold:

- An overview of theoretical background to establish criteria for reading and writing teaching materials

- followed by an automated quantitative analysis of primers based on automated speech and text processing technology.

Given the theoretical background on what is known about reading and spelling acquisition, several points for evaluation of input items have been motivated through the literature and various primers were analyzed with respect to these criteria. It was shown that there are very different approaches for item presentation. It is also important to note that the input items are not restricted to the primers. However, the chosen method will most likely extend to the additional materials. These different methods for item presentations will have an effect on spelling and reading ability and this effect needs to be studied and understood in more detail. The presented analyses provide a small window on the learning materials with imperfect automated tools. It is well known that context effects are important in self-teaching events. These have not been addressed in the present analysis. Also, generalizability of items to new items can be quantified and will be part of future work in this area. The next step is to correlate orthographic skill acquisition with the quality of teaching material.
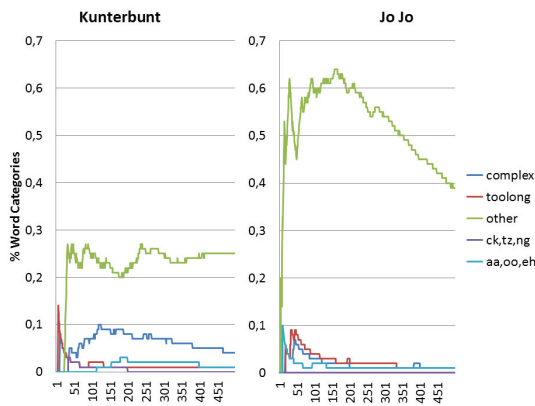

Figure 7: *% distribution of word type usage for irregular and more difficult patterns.*

mastery and careful use of items that do either not provide a self-teaching event ('HFW') or provide a wrong self-teaching events ('other') can be used to analyse the texts.

In all accounts, practice, patterns, clear progression and careful use of 'HFW' and 'other', as well as special attention to irregularities in German orthography, 'Alte Fibel' outperformed todays' primers. Other primers exhibit partial aspects in which they adhere to theoretical propositions on presenting items.

Research tells us that learning takes place quickly given the correct presentation of items. There is a clear need to study what the effect is on reading and spelling depending on item selection that places more emphasis on 'other' especially in the first items that are presented.

Appendix

K1v	K1v	K2v	K2v	V	V	vK1	vK1	K1e	K1e	K2e	K2e	Rime	
	89		147	e	52		102		64		155		207
h	21	w	21	a	43	l	20	g	26	l!	16	en	96
sch	20	r	15	o	29	n	18	d	21	l	14	e	60
s	15	m	11	ei	20	l!	16	t	18	n!	13	er	26
d	13	l	9	i	15	n!	13	s	15	n	5	el	21
v	11	n	8	ü	10	t!	12	t!	12	m!	4	te	2
st	11			ie	10	s!	11	s!	11	m	3	ern	2
sp	9			u	9	m!	4	f	9	t	1	et	2
f	8			ä	6	ch	4	b	8			ten	1
b	6			äu	5	f!	3	z	6			es	1
g	3			ö	5	s	3	ch	5				
k	2			au	5	m	1	k	4				
z	2			eu	2	p	1	h	4				
p	1					p!	1	f!	3				
						f	1	p	2				
						t	1	ß	2				
								p!	1				

Table 3: Distribution of letters and their occurrence frequency for "Alte Fibel". The other primers have similar distributions.(! denotes a letter in a double consonant, like "bit!t!er".)

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