

# The basis of Reading fluency in first grade of Hebrew speaking children

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## Abstract

The present study examines the contributions of several different cognitive and literacy skills to reading fluency in Hebrew among Grade 1 students. The main objective of the study was to examine what predicts word reading fluency at two crucial points during Grade 1: mid-year, before a multi-tiered intervention, and again 12 weeks later at the end of the year, after the intervention. A total of 47 first graders in Israel were assessed on cognitive and literacy tasks before and after an implementation of intervention. Our preliminary results demonstrate that in Hebrew orthography, there is a rapid growth in word reading fluency during Grade1. One skill, syllable deletion, predicts reading fluency by the middle of Grade 1. By the end of Grade 1, two skills predict word reading fluency: RAN and syllable deletion. The results call attention to the pedagogical need to monitor this skill in Hebrew and emphasize the need to include fluency theoretically in models of reading as well as in related practice of early reading development in Hebrew orthography.

## **Introduction**

In 1981 the late Prof. Zvia Breznitz published her doctoral dissertation which focused on reading fluency in first grade. She was a pioneer in her field and understood the importance of fluency many decades before the topic became main stream in reading research. Not only did she conduct cognitive, and intervention studies for her dissertation, she also conducted teacher interviews. One of the most interesting findings of her dissertation was the negative attitude teachers have towards focusing on reading rate. Prof. Breznitz continued her passion for fluency research and intervention for over three more decades and her work influenced thousands of children around the world. In this chapter which we dedicate to her memory, we wish to continue her work and to push forward the idea that fluency, especially in the Hebrew orthography, must be given more stress and focus. This chapter will examine reading fluency skill in Hebrew orthography as well as the underline processes that contribute to fluency at the very early age of acquisition in the first grade.

A meta-analysis conducted by the National Reading Panel (NRP, 2000) demonstrated that reading fluency is one of the key components to success in reading and that it is essential that it be taught to developing readers. Since the beginning of the 21st century, reading fluency has taken its place with phonemic awareness, word decoding, vocabulary, and comprehension as critical components of effective reading instruction (Rasinski, Blachowicz, &Lems, 2012).

Oral reading fluency is a complicated, multifaceted process that involves the coordination of many processes and subskills involved in reading (Wolf &Katzir, 2001). Most of the research on the development of reading fluency has focused on the English orthography and on later stages of reading acquisition, especially in second and third grade. In this chapter, we wish to examine the role of fluency in a relatively unstudied orthography–Hebrew. In addition, we wish to track the onset of the development of reading fluency from the beginning of first grade. In this chapter we will first review definitions of fluency, then the possible predictors of word reading fluency, the characteristics of Hebrew orthography and the development of word reading in Hebrew.

Researchers have begun to broaden the definition of fluency beyond a simple calculation of the rate of correctly read words. For example, Wolf and Katzir (2001) defined fluency as integrated with developmental and componential processes. According to their definition, developing reading fluency is the product of the initial development of accuracy and the subsequent development of automaticity in underlying sublexical processes, lexical processes, and their integration in single-word reading and connected-text reading. These include perceptual, phonological, orthographic, and morphological processes at the letter, letter-pattern, and word levels, as well as semantic and syntactic processes at the word level and connected-text level. In line with Wolf and Katzir, Hudson, Pullen, Lane and Torgesen (2008), suggested that fluent reading is the result of a large number of sub-processes that must be accomplished efficiently and automatically and that interact with each other. These include automatic access to letter-sound relationships, quick and accurate operation of phonemic analysis and blending processes, automatic access to knowledge of phonograms, a large number of words that can be recognized "by sight", quick access to vocabulary knowledge, and efficient operation of basic information processes.

Historically, the study of reading has focused largely on accuracy in single word reading, rather than on the accurate and rapid reading of connected text (Kame'enui & Simmons, 2001). Thus, a conception of fluency that focused on the combination and outcome of speed and accuracy at the word level was considered an indicator of overall reading competence (e.g., Fuchs, Fuchs, Hosp & Jenkins, 2001; Meyer & Felton, 1999). Consequently, fluency is often measured by the number of correct words read aloud in one minute (e.g., Fuchs, Fuchs, & Maxwell, 1988; Shinn, Good, Knutson, Tilly, & Collins, 1992; Torgesen, Rashotte, & Alexander, 2001). According to the NRP, accuracy is universally assumed to precede rate in development (National Reading Panel, 2000). However, it is interesting to examine whether accuracy is acquired at different timing in different orthographies.

### **Possible predictors of Word Level Fluency**

Based on the current definitions that place fluency as the outcome of multiple lower level processes, many studies across different orthographies have found

phonological processing, rapid letter naming, working memory, vocabulary and dictation to be good predictors of reading, especially in regular orthographies. Phonological awareness (PA) is the ability to manipulate the sounds in spoken language. Phonological awareness has been found to be a strong predictor of reading fluency in many languages such as English (Papadimitriou & Vlachos, 2014; Macdonald, Sullivan & Watkins, 2013; Solari et al., 2014), French, Dutch, Hungarian (Vaessen, Bertrand, Denes & Blomert, 2010), and German (Landerl & Wimmer, 2008). Recent studies have examined the universal and language-specific roles of PA in different languages. For example, an examination of the word reading skills of second graders in five different European languages of varying degrees of transparency demonstrated that phonological awareness was the main factor associated with early word reading performance, although its impact was modulated by the transparency of the orthography, such that PA had a higher impact in less transparent orthographies (Ziegler et al., 2010).

Another main predictor of fluency is Rapid Automatized Naming (RAN), as speed is an important component of both fluent reading and rapid naming (Cardoso-Martins & Pennington, 2004). It has been consistently found to be related to fluency of reading in English (Bowers, 1995; Cardoso-Martins & Pennington, 2004; Morris et al., 1998; Pennington, Cardoso-Martins, Green & Lefly, 2001; Katzir et al., 2006) as well as in other languages, such as Finnish (Koponen, Salmi & Eklund, 2013) Italian (Tobia & Marzocchi, 2014), German (Landerl & Wimmer, 2008), French, Dutch, and Hungarian (Vaessen, Bertrand, Denes & Blomert, 2010).

While some studies point to similar predictive power across languages for PA and RAN (Caravolas et al., 2012; Furnes & Samuelsson, 2011; Vaessen, Bertrand, Denes & Blomert, 2010), others have shown that the roles of PA and RAN are not the same in all orthographies. For example, Mann and Wimmer (2002) examined 100 German children and 60 American children at the end of kindergarten, first grade, and second grade. They found that phonological awareness was the only significant predictor of reading accuracy and speed in English. In German, however, RAN was the only significant predictor of reading speed. Furthermore, in a study of 110 English-speaking children and 70 Greek-speaking children in first grade, RAN was a predictor of later reading fluency in English in second grade, but this was not the case in Greek (Georgiou, Parrila & Papadopoulos,

2008). It seems possible that while they have both been proven to be important to reading, PA and RAN play different roles at different points in time and in different orthographies.

### **Hebrew orthography**

Reading instruction of the pointed Hebrew script takes place in Grades 1 and 2. In pointed Hebrew, diacritics carrying most of the vowel information of a word are present with the consonant letters of the word. This allows a nearly unambiguous conversion of spelling to sound. In Grades 3 and 4, children are expected to gradually proceed to reading without vowel diacritics. In the absence of diacritics, orthographic ambiguity is frequent. Some textbooks presented during this two-year transitional period are printed in a partially pointed script containing only some diacritics. By the end of Grade 4, children are expected to have mastered reading of the unpointed script, and from Grade 5 onward, readers of Hebrew are exposed almost exclusively to unpointed texts.

### *Reading development in Hebrew*

Several studies examined the relationships between PA and reading in first grade. Bentin and Leshem (1991) reported a strong correlation between PA and Hebrew reading by the middle of first grade. Share (2008) suggested that, at this point in development, decoding skill in Hebrew orthography may be more comparable to that of English speakers later in the year.

There are few studies of reading fluency development in Hebrew. Shany, Bar On and Katzir (2012) examined the development of reading in Hebrew orthography in the pointed script, of a nationally representative sample of children in Grades two, four, and six. Rate and accuracy for four different pointed orthographic structures were collected: letter-diacritic mark combinations, legal pseudowords, illegal pseudowords, and real words. The results indicate that rate develops linearly from Grade two through Grades four and six with respect to all four orthographic structures. However, steep development was demonstrated for word reading rate, as compared to moderate progress for the other two structures.

Bar-Kochva and Breznitz's work so far has been the only one that examined the longitudinal trajectory of word reading fluency development (Bar-Kochva, 2011). Their first longitudinal study examined children from kindergarten until the end of second grade (Bar-Kochva & Brenitz, 2013). As reported, fluency of silent word reading and oral text reading measures improved from first grade to second grade. However, oral word reading fluency was not enhanced. Among first and second grade students, RAN contributed to fluency measures. Interestingly, the contribution of phonological awareness to fluency measures in first grade, decreased in second grade. In a second study, they examined Hebrew readers transitioning from the third to the fourth grade (Bar-Kochva & Breznitz, 2014). Phonological awareness explained a considerable amount of variance in accuracy in reading all forms of script across these two years. The role of RAN in fluency in reading the pointed and partially pointed forms of script was significant and similar in both grades, whereas the role of RAN in fluency in reading the unpointed script was restricted to Grade 4. In addition, the relations between phonological awareness and fluency in reading were restricted to Grade 4. The reason for these developmental fluctuations is hard to deduce from the current data. These patterns are different from learning to read in a less transparent orthography like English and may be influenced from the shift from reading pointed to unpointed Hebrew in fourth grade. Katzir, et al. (2012) conducted a within- and between-group comparison of word reading fluency and accuracy among fourth grade English and Hebrew-speaking children, respectively, as well as an examination of the role of phonological awareness in predicting word reading in each language. For Hebrew-speaking children, phonological awareness added unique variance to timed vowelized and unvowelized word reading measures (i.e., TOWRE in Hebrew; 11 and 13% respectively) after controlling for vocabulary. For English-speaking children, phonological awareness did not add any significant variance after accounting for vocabulary knowledge in both timed and untimed word reading. They conclude that there are orthography-based processes at play and that learning to read in different orthographies creates differences in reading fluency and accuracy even at the later stages of reading in fourth grade.

Thus, whereas in shallow orthographies the grapheme–phoneme conversion is efficient, deep orthographies demand identification of larger orthographic units than

letters. Shany, Bar-On and Katzir (2012) claimed that orthography might affect the timing at which accuracy is acquired among novice readers. The study of Caravolas, Lervåg, Defior, Málková&Hulme (2013) confirmed this claim. In this study a cross-linguistic comparison of growth in reading was made between consistent and inconsistent orthographies. English speakers (i.e., inconsistent orthography) from reception year and Czech and Spanish speakers (i.e., consistent orthographies) from final kindergarten year participated until the end of second grade. A main result of this study was slower growth and development in English reading compared to more consistent orthographies. In this context, Hebrew orthography which contains two versions of script, a transparent (i.e., vowelized) and an opaque (i.e., unvowelized) script, appears to be a unique case for examination (Katzir, Schiff & Kim, 2012).

Hebrew readers acquire reading by using the shallow pointed system (Shany, Bar-On & Katzir, 2012), a system that is classified as consistent orthography (Katzir, Schiff & Kim, 2012). Therefore, at the end of first grade they are expected to achieve proficiency in decoding (Share & Levin, 1999). However, Share & Levin (1999) pointed out rapid mastery of learning to read Hebrew compared to English. Thus, accuracy of decoding among Israeli children in first grade was found comparable to the performance of English children in grade 5

In conclusion, fluency is much affected by the transparency of the orthography, both in the rate of development as well as in the factors that influence it in different stages of development. Our study took a very fine grained look at a wide array of factors cognitive and linguistic ones that may influence reading fluency development at the early stages of reading acquisition in Hebrew.

### **Current study**

Most studies on word reading fluency have been conducted on English-speaking children (Share, 2008) reading the notoriously opaque English orthography. In view of the differences found between different orthographies, there is a need for more examination of the development of reading fluency skills in more consistent writing systems, such as Hebrew. In addition, it is necessary to explore the development of this crucial skill,

especially during the first grade in Hebrew, since it is expected to be acquired fast due to the consistency of the orthography. The present study examines the contributions of several different cognitive and literacy skills to reading fluency in Hebrew among first grade students. The main objective of the study was to examine what predicts word reading fluency at two crucial points during first grade: mid-year, before a multi-tiered intervention, and again 12 weeks later at the end of the year, after the intervention. Four research questions guided the current study:

1. What is the course of development of word reading fluency in Hebrew during first grade?
2. Which lower level components included in recent definitions of fluency (phonological awareness, rapid naming, etc.) are associated with word reading fluency by the middle of first grade and by the end of first grade?
3. What skills from the middle of first grade predict word reading fluency at the same point in time?
4. What skills from the end of first grade predict word reading fluency at the same point in time?

### **Intervention**

In this study we administered a pilot intervention program (Lipka, Katzir, & Shaul, in preparation) which addresses the multiple sources of word reading difficulties in children. The main goal of the “OR” innovative intervention program for the first grade was to promote foundational literacy, cognition and emotionally readiness for learning skills by integrating for the first time those three domains into a range of cyclical activities.

The intervention consists of two books/themes per unit and each unit consists of 9 scripted lesson plans. Overall, a total of 18 intervention sessions were given. The program was implemented twice a week in each classroom for a period of 45 minutes in the second half of the year within the school hours for 3 months.

Children were first screened in order to build a cognitive and linguistic profile for each child. Then they were grouped into small homogeneous groups of 5 children based

on their cognitive, literacy and emotional readiness profiles described below. The whole class worked on a similar shared book, yet each group received intervention around their needs in decoding, vocabulary, memory, and at a level which was matched to their ability. All the children in the classroom received the intervention at the same time on the same timeslot. All the children participated in all sessions.

The program was delivered by the homeroom teacher, who led each lesson and by three trained master students that were specialized in literacy. Both teachers and students received specific training on the program materials.

### **Participants**

Participants of this study were 47 first grade children, 28 (59.57%) boys and 19 (40.43%) girls studying in the same school. Age ranged from 6 to 8 years ( $m=6.77$ ,  $SD=0.4$ ). The study included all of the children who were enrolled in two classes at the school. All children came from a middle-low SES.

### **Measures**

A battery of literacy-related measures was administered in the middle of the first grade, pre-intervention, and at the end of the first grade, upon completion of the intervention program.

Early Literacy measures

*Phonological awareness.*

Syllable Deletion (Shany & Ben Dror, 1998) and Phoneme Deletion (Schwartz, 2006). These tests included three types of tasks (syllable, first phoneme, and last phoneme deletion) in which participants were required to delete a given syllable or phoneme from a spoken word in Hebrew. For example, ‘‘Say *mispar* (‘number’). Now, say *mispar* without *mis*’’; each test list included 10 words. In the phoneme deletion task the deletion resulted in the formation of nonwords. In the syllable deletion test the deletion resulted in the formation of a word. The maximum possible score for each test was 10, internal consistency (alpha) for syllable deletion was .85, first phoneme deletion was .94, and last phoneme deletion was .93.

2. Letter recognition: In this test the child was presented with 3 printed letters on an otherwise blank sheet of paper (size A4). The child was asked to identify the letter that the examiner said orally. The test contained 10 trails with 3 Hebrew letters in each, and the final score was the number of correct letters the child identified. The maximum possible score was 10. Internal consistency (alpha) was .64 .

### Word reading and fluency

Test of Word Reading Efficiency (TOWRE; Schiff et al., 2006; adapted from Torgesen et al., 1999): The child was instructed to read aloud as many words as quickly as possible in order to examine reading speed under timed conditions (45 seconds). The list contained 104 words ordered by increasing difficulty in the number of syllables, phonological structure, length, frequency, and morphological complexity. Scores ranged from 0 to 104, reflecting the number of accurate words the participant read in 45 s, with higher scores indicating higher reading speed.

### Naming

1. Naming objects (Shatil, 1995): The child had to name, as fast as possible, 21 pictures of objects (such as house, dog, and tree). Each test had 5 different stimuli which were repeated several times, the total time of naming was measured as well as the number of errors in each test.

2. Naming letters (Shany, Laxman, Shalem, Bahat,&Zieger, 2006): The child had to name, as fast as possible,50 letters (such as ל,א,ב,ג,ד,ה). Each test had 5 different stimuli which were repeated 1times, the total time of naming was measured as well as the number of errors in each test.

### Procedure

The pre and post tests were individually administered over two sessions by trained Master's students in a quiet room at the school. Each session lasted approximately 20-30 minutes

## Results

First, in order to determine what the role of word reading fluency is, we report the descriptive statistics for the cognitive and literacy measures by the middle of first grade and by the end of first grade. Table 1 presents a summary of combined results from *t*-tests comparing literacy and cognitive skill from the middle of the first grade to the end of the first grade.

**Table 1** Descriptive statistics and *t*-test results at the middle and at the end of first grade

Variables	Middle of 1 <sup>st</sup> grade		End of 1 <sup>st</sup> grade		<i>p</i>
	Mean	SD	Mean	SD	
RAN letters time	64.54	21.40	51.80	15.58	.000**
RAN objects time	66.15	17.60	60.97	12.64	.007**
Syllable deletion percent	23.96	24.75	71.26	26.83	.000**
Initial phoneme isolation percent	61.36	31.59	62.00	34.94	.711
TOWRE word reading	6.95	13.91	28.31	11.58	.000**

Note. TOWRE = Test of Word Reading Efficiency (Torgesen, Wagner, & Rashotte, 1999); RAN = Rapid Automatic Naming;

\* $p \leq .05$ , \*\*  $p \leq .01$

Overall, results demonstrate a statistically significant improvement in most of the measures from the middle of the first grade to measures that were assessed by the end of the first grade. In the measure of PA, however, there was an improvement in syllable deletion, but not in initial phoneme isolation. More importantly, the students improved markedly in word reading fluency. By the middle of first grade they read an average of about 7 words in 45 seconds and by the end of the year they read about 28 words within the same time frame, demonstrating the rapid growth of this skill during the first grade.

The next goal was to examine which components included in recent definitions of fluency (phonological awareness, rapid naming, vocabulary, etc.) are associated with word reading fluency by the middle of first grade and by the end of first grade. Table 2 and Table 3 present the correlations between the measures in the middle of the first grade, and at the end of the first grade.

**Table 2** Correlations between measures at the middle of first grade

Variables	1	2	3	4	5	6	7
1. TOWRE Word reading	-						
2. Initial phoneme isolation	.33*	.51**	-				
3. Syllable deletion	.67**	.7**	.57**	-			
4. RAN letter naming	-.46**	-.59**	-.49**	-.55**	-		
5. RAN object naming	-.31*	-.32*	-.26	-.48**	.68**	-	

\*p≤.05, \*\* p≤.01

**Table 3** Correlations Between Measures at the End of Grade 1

Variables	1	2	3	4	5	6	7
1. TOWRE Word reading	-						
2. Initial phoneme isolation	.46**	.6**					
3. Syllable deletion	.57**	.76**	.49**				
4. RAN letter naming	-.29	-.23	-.28	-.17			
5. RAN object naming	-.51**	-.48**	-.24	-.33*	.51**		

\*p≤.05, \*\* p≤.01

As shown in these tables, word reading fluency in the middle of Grade1 was correlated with all measures. At the end of Grade1, word reading fluency was also correlated with all other measures, but with RAN letter naming.

The third research question examined what skills from the middle of the first grade predict word reading fluency at the same point in time. To answer the following question, a stepwise multiple regressions were carried out. Results are presented in Table 4.

**Table 4.** Stepwise regression results for word reading fluency at the middle of first grade

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Predictors	R	R <sup>2</sup>	ΔR <sup>2</sup>	ΔF
Syllable deletion	.67	.44	.44	24.37*

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\*p≤.00,

Table 4 demonstrated that syllable deletion as measured by the middle of grade 1 explain 44% (p<.01) of the word reading fluency variance measured at the middle of first grade. Our next goal was to examine what measures predict word reading fluency at the end of the first grade. Table 5 presents a regression model to determine the variance contributed to word reading fluency measures at the end of the year.

**Table 5.** Stepwise regression results for word reading fluency at the end of Grade 1

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Predictors	R	R <sup>2</sup>	ΔR <sup>2</sup>	ΔF
Syllable deletion	.57	.33	.33	21.37*
RAN Object naming, time, (in s)	.66	.44	.11	8.82*

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\* p≤.01

Syllable deletion measured at the end of the first grade explained 33.0% of the variance (p<.01); and RAN at the end of the first grade added to the explanation an additional 11% of the variance (p <.01). Taking it all together, syllable and RAN explain 44% of the the word reading fluency variance measured at the end of first grade.

In summary, our first research question examined what the development of word reading fluency is in Hebrew during the first grade. Our preliminary results demonstrate that in Hebrew orthography, there is a rapid growth in word reading fluency during the first grade. Lower level components such as phonological awareness predicts word reading fluency at the middle of first grade and that syllable deletion and RAN predicts word reading fluency at the end of first grade.

## Discussion

In this chapter, we suggest a preliminary model of the development of early reading fluency in first grade Hebrew speaking children. The case of Hebrew as a transparent orthography is interesting in order to understand the processes that are involved at the very beginning of reading acquisition. The results demonstrated that in Hebrew orthography, there is a rapid growth in word reading fluency during the first grade. Lower level components such as phonological awareness, rapid naming, and dictation predict word reading fluency at the middle of first grade and at the end of first grade. Three skills predict reading fluency by the middle of first grade: RAN, syllable deletion and dictation. By the end of first grade, two skills predict word reading fluency: RAN and syllable deletion.

Our study is one of the first longitudinal studies of the Hebrew orthography in the first grade that examined word reading fluency. As in other transparent orthographies, we found that first grade literacy skills developed rapidly for most children. The transition from reading accuracy to reading fluency (Chall, 1983) in Hebrew, is especially rapid due to the transparent nature of the orthography at that stage, and occurs not towards the end of second grade but has its first indicators by mid first grade, with a rapid growth from the middle to end of the first grade.

The second goal of the study was to examine the relationships between word reading and cognitive skills as were measured by the middle and by the end of the first grade. Results of this study demonstrate that the construct of word reading fluency is complicated and provide support to a more broad definition of fluency that takes into consideration skills such as PA, word dictation, memory and more. Future research should examine additional linguistic and cognitive skills (such as visual perception and attention) in relation to word reading fluency.

Overall, results demonstrate that phonological awareness was significant variable that predicted reading fluency at the middle and at the end of the first grade. The RAN objects predicted word reading fluency by the end of the year. The results are consistent with

previous studies that examined Hebrew-speaking learners at higher grades that found that phonological awareness plays an important role in word reading fluency (Ziegler et al., 2010; Katzir et al., 2012). It is interesting to note that syllable deletion by the middle and by the end of the first grade was the only phonological awareness skill that predicted word reading fluency in the first grade. It might be the case that because Hebrew is a syllabic language, the ability to manipulate words in the syllable level contributes to the fluency at that stage because this skill is being mastered

Not surprisingly, RAN was found to be another variable that contributed to word reading fluency in the first grade. This finding is consistent with many other studies demonstrating the contribution of RAN to fluent reading (Kim, Park & Lombardino, 2015; Martins, Green, & Lefly, 2001; Katzir et al., 2006)

The current study examined the development of word reading fluency at two points in the first grade. The study demonstrated that word fluency in this grade changes rapidly and as such, needs close monitoring developmentally. Our study demonstrated that one variable, syllable deletion, by the middle of first grade, explained 44% of word reading fluency. By the end of first grade, two variables, RAN and syllable deletion, explained 44% of word reading fluency. The change in reading fluency from the middle to the end of the year in first grade, as was observed by the t-test comparison, calls attention to the pedagogical need to monitor this skill in Hebrew and emphasizes the need to include fluency theoretically in models of reading as well as in related practice of early reading development in Hebrew.

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