

Are Reading Difficulties Associated With Poor Verbal Learning Skills? Evidence From the Fast-Mapping Paradigm

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Abstract—The main purpose of the current study was to examine the effectiveness of the mechanism of learning new words among typical readers and those with developmental reading difficulties. Twenty-three poor readers and twenty-two typical readers performed a fast mapping word learning task. Three variables were measured; the learning rate, the identification ability after learning and the recognition of the referents of learned new words. The results revealed that the performances of the typical readers were significantly higher than those of the poor readers in all measures. The results were discussed in light of the verbal efficiency framework and the poor visual-phonological associations among the poor readers.

Index Terms—reading, verbal learning, fast mapping, word learning, Arabic language

I. INTRODUCTION

The process of reading acquisition is considered as a complex one which is contributed by the development of cognitive, psycho-linguistic, and perceptual processes (Catts, Fey, Zhang, & Tomblin, 1999; Deacon & Kirby, 2004; Fletcher, Francis, Carlson, & Foorman, 2004; Saiegh-Haddad & Geva, 2008; Schatschneider, Snowling, 2001). Different researchers associate the process of reading acquisition with the domain of written language acquisition, and assume that verbal efficiency can predict the effectiveness of acquiring different language skills, including the process of acquiring the written code of language (Nation & Snowling, 2004; Perfetti, 2007; Torgesen, 2002).

Various studies have shown that subjects with intact language skills were more able to acquire reading and writing skills than readers with impaired language skills. For example, children with specific language impairments (SLI) are at a high risk of developing reading disabilities, and the percentage of comorbidities of children with reading disabilities among SLI children is relatively high (Bishop, 2009; Nihart, et al., 2009; Vandewalle, Boets, Ghesquière, & Zink, 2010). However, some researchers try to distinguish between the linguistic bases of the two disabilities, but there is a qualification among different researchers that since the two disabilities are attuned to linguistic factors this can explain the source of the high comorbidity between them (Fraser, Goswami, & Conti-Ramsden, 2010; Wong, Kidd, Ho, & Au, 2010). Bishop and Snowling (2004), for example, argue that children with reading disabilities enjoy normal syntactic skills despite their phonological deficiencies, while children with SLI have difficulties with the syntactic aspect of language without difficulties in phonological processing. In addition, Bishop and Snowling (2004) assume that other children with reading difficulties who are not defined in one of the two abovementioned populations will not necessarily exhibit syntactic or phonological difficulties, and their reading difficulties are not related to aspects of language processing.

Anyway, verbal efficiency refers to different aspects of language acquisition and cannot be restricted only in terms of syntactic development or phonological processing. For example, the acquisition of new words, including the associations between the semantic and the phonological representations, is an important element in the development of the verbal efficiency among children (Dockrell & Messer, 2004). Children who demonstrate effective learning and verbal skills are those who are able to rapidly develop phonological-semantic associations and are considered to have more effective learning and verbal processes than children who are late in the development of their vocabulary (Gray, 2004). In other words, the efficiency of semantic representations which are related to the phonological representations of the acquired words is the main axis in the development of vocabulary among children. Various researchers describe the development of the phonological-semantic associations during the vocabulary acquisition among children as a

cognitive process based on mapping the meaning of the heard phonological pronunciation from several known and unknown alternatives (Dollaghan, 1985). The child will learn that the new phonological pronunciation will be connected to an unknown referent that is presented, since other referents, which are presented as alternatives are already familiar in terms of their phonological representations. In this way, the individual concludes that there is a high probability that the new pronunciation s/he hears may represent the referent s/he does not know among the number of alternatives presented. This process is known as the "fast mapping" during the learning new words (Bion, Borovsky, & Fernald, 2013; Carey, 1978; Carey & Bartlett, 1978). In order to successfully use the fast mapping process, a child must possess the ability to use "referent selection" and "referent retention" of a novel word. Accordingly, it was reported that fast mapping efficiency among preschoolers is related to intact language development (Rice, Buhr, & Nemeth, 1990).

With regard to the relationship between verbal efficacy, in general, and the efficacy of developing reading skills among children, various researchers believe that deficits in various components of verbal efficacy (i.e., phonological, semantic, syntactic, and morphological) are related to reading difficulties and can predict inefficiency in reading and spelling skills and comprehension (Nation & Snowling, 2004; Perfetti, 2007; Scarborough, 1990; Torgesen, 2002). Moreover, the slowness in the development of different linguistic skills among children with reading difficulties may also be affected by the difficulty of reading acquisition in a parallel manner (Cain & Oakhill, 2011). Therefore, the relationship between reading difficulties and lack of linguistic efficacy may be mutual. If this is the case, there is high probability that readers with atypical reading will exhibit difficulties at different levels of verbal efficacy. For example, it could be assumed that poor readers will exhibit low efficacy in learning new words compared to typical readers. It is important to note that most of the studies that examined the linguistic efficacy of developmental reading difficulties focused mainly on phonological processing (Vellutino, Fletcher, Snowling, & Scanlon, 2004) and morphological awareness (Deacon, Parrila, & Kirby, 2008), when very few studies were interested in the effectiveness of the development of semantic knowledge and vocabulary among readers with atypical reading. Accordingly, the main purpose of current study is to examine the effectiveness of the mechanism of learning new words among poor readers compared to readers with typical reading development.

II. METHOD

Participants: The study tested a total of 45 3rd grade typical and poor readers (*Typical readers, N=22, Poor readers, N= 23*, which were sampled from five different Arab schools in north of Israel. Entering the schools was allowed after getting the approvals and consents of the parents and the school managers. All participants were speakers of the northern Palestinian vernacular of Arabic. See table 1 for age average and gender distribution within the different groups.

TABLE 1
AGE AVERAGE AND GENDER DISTRIBUTION WITHIN THE DIFFERENT GROUPS

Reading Group	Females	Males	Age \pm SD
Typical	10	13	10.39 \pm 18
Poor	10	12	10.4 \pm 19

Screening for the poor readers was based on "Low achievement models" (Fletcher & Denton, 2003; Jimenez, Siegel, & Lopez, 2003; Lyon, Fletcher & Barnes, 2002). Low achievement models as they described by Lyon, Fletcher, & Barnes (2002) are those models based on the use of achievement markers can be shown to have a great deal of validity. accordingly, If groups are formed such that the participants do not meet criteria for intellectual disability and have achievement scores below the 16th percentile, a variety of comparisons show that the subgroups of low achievers that emerge can be validly differentiated on external variables and help demonstrate the viability of the construct of reading difficulties. Based on this way of screening, the first step in the screening procedure was administering a random selection of students with intact and poor reading skills according to their reading fluency scores as were reported by their schools. Students falling below the 16th percentile of according to their schools reading fluency scores were selected as having reading difficulties. However, students with reading fluency scores that fall between the 25th to the 75th percentiles were selected as typical readers. Students who were reported to have emotional, sensory or neurological disturbances were excluded from the study.

Procedure and testing: In order to test the ability for learning new words, a testing tool was developed for the purposes of present study in light of the fast-mapping paradigm (Bion, et al., 2013). Each participant was tested during three trials as following:

The learning trail: At this level, the subject was trained in learning pseudowords that refers to unfamiliar presented image. For this purpose, 20 unknown images were used. The learning process was carried out according to several stages. In the first stage, the participant was presented with an unfamiliar image along with a familiar image. The unfamiliar image represents a new object image represented by an unknown word (pseudoword). Accordingly, the participant was required to infer the image that is suitable to the heard pseudoword. For example, the experimenter pronounces the following sentence "please point to the <Juri> and not to the chair", while the " Juri" refers to the name of the unfamiliar object which presented by the unfamiliar image, accordingly, the participant is supposed to conclude that the unfamiliar image is the suitable one. In the second step the process is trained two times but now each time with

another different familiar image. After completing the training trails, by using the other two familiar images, the experimenter moves to a new step of new pseudoword training. After completing the training with the "referent target images" that are intended for the learning process, the experimenter return from the beginning of the process in order to ascertain which words are still remembered. The process was repeated until the participant showed a complete learning of the all the pseudowords. The number of the repetitions of the learning trails was recorded for each student and constituted the "learning rate variable".

The identification trail: This level was performed 15 minutes after finishing the learning trail for each participant. The purpose of this trail was to check whether the students were still able to identify the new words they had learned. In each step, each participant was presented with two images that were part of the previous learning trails. The participant heard a pseudoword which represents one of the two images and was asked to identify the appropriate image that matches the heard pseudoword as it was learned in the previous step. The percentage of the accuracy performance was recorded for each student.

Retrieval trail: This step was performed immediately after the identification trail. This trail is actually testing the naming ability of the images that were learned. The participants were presented with the images that were used during the learning stage and in a random manner, while each participant was asked to name the presented image by its appropriate pseudoword as it was learned during the learning stage. The percentage of accuracy in performance is recorded for each student.

III. RESULTS

Analysis of variance was used for investigating the differences between the poor and the typical readers in performing the different trails. Table 2 presents the means and SDs of the performances in the different conditions within the two groups of readers.

The analysis of variance showed a significant difference between the two groups regarding the learning rate $F(1, 44) = 33.68, p < .001 (\eta^2 = .44)$. In addition, significant differences were revealed for the identification trail $F(1, 44) = 16.77, p < .001 (\eta^2 = .28)$, and for the retrieval trail $F(1, 44) = 240.64, p < .001 (\eta^2 = .84)$.

TABLE 2
MEANS \pm SDS OF THE PERFORMANCES OF THE TWO GROUPS OF READERS IN THE DIFFERENT CONDITIONS

Reader	Learning Rate	Identification	Retrieval
Typical	3.17 \pm .43	19.8 \pm .4	11.81 \pm 1.43
Poor	3.93 \pm .43	18.5 \pm 1.41	4.75 \pm 1.59

IV. DISCUSSION

The study findings clearly show that poor readers exhibit lower performance on all the indices associated with the verbal learning task than children with typical reading development. For the poor readers group, more steps are needed to internalize the meaning of a new word through a fast mapping process. It seems that the lack of verbal efficacy that may explain their difficulty in learning reading is a broad basis for the lack of effectiveness in the learning and meaning of new words (Nation & Snowling, 2004; Perfetti, 2007; Scarborough, 1990; Torgesen, 2002).

The lack of verbal efficiency is reflected in the necessity of a large number of learning stages among readers with reading difficulties to internalize the new words. This situation is associated with the difficulties of those learners in learning new words also orthographically. Orthographic learning requires assimilation of the connection between the orthographic pattern of the decoded word and its phonological pronunciation (Snowling, 1998, 2001). Readers with reading difficulties have slow and inefficient demonstrations at this level of learning the orthographic-phonological connections (Vellutino, et al., 2004). Moreover, their difficulties are also evident in the spelling level when there is a lack of efficiency in the level of orthographic retrieval according to the phonological pronunciation that is heard and accordingly, spelling errors occur as a result (Abu-Rabia & Taha, 2004).

The findings of the current study show that the same state of lack of efficacy was also evident in the level of identification as an additional measure of the efficacy of verbal learning that was tested. Children with reading difficulties performed less well at the level of identification of the image representing the phonological pronunciation that was heard. By looking at this part of the identification of the image representing the word being used as an analogy of recognition the orthographic pattern according to the phonological pronunciation, it can be assumed that the ineffectiveness of the phonological-visual learning mechanism is another explanation that may explain the lack of efficiency at this level. Therefore, this finding may also explain the lack of effectiveness in the extent of the phonological-orthographic associations that can be expressed in the absence of increased reading and spelling efficiency among readers with reading difficulties (Abu-Rabia & Taha, 2004). The performance of the phonological retrieval task in accordance with visual stimulations, which is also significantly lower among students with reading difficulties, may add further support to the inefficiency of the phonological-visual learning mechanism and may support further explanation about reading and spelling difficulties among poor readers.

The claim of inefficiencies at the level of phonological-visual associations adds to the claim of verbal inefficiency among readers with reading difficulties and shed light from another direction on explaining the findings beyond the claim of general verbal inefficiency among those readers. Such an argument has been presented in the past by various researchers. For example, Breznitz (2006) postulated the lack of synchronization between the phonological and visual modules among dyslexic readers as an estimated source of reading difficulties among them. The absence of synchronization may impair the reading fluency and the rate of phonological retrieval according to the orthographic stimuli presented to the reader.

In addition to the above-mentioned postulation regarding the inefficient phonological-visual associations, recently different researchers postulates that the developmental reading difficulties among poor readers are associated with poor detecting of statistical regularities of written stimuli, because of poor statistical learning process (Arciuli, 2018; Vandermosten, Wouters, Ghesquière, & Golestani, 2019). Statistical learning (hereafter: SL) is defined as a cognitive process by which the individual learns about the frequencies of the occurrence and re-occurrence of events (Aslin & Newport, 2009; Romberg & Saffran, 2010). Recent research findings indicated that the acquisition of language skills, and even written orthographic regularities might be a result of implicit learning which is affected by the frequencies of the exposure to such regularities (Aslin & Newport, 2009; Romberg & Saffran, 2010; Taha & Khateeb, 2018; Treiman & Kessler, 2006; Treiman, Gordon, Boada, Peterson, & Pennington, 2014). Therefore, it was found that this cognitive tool has an essential role in learning letters shapes (Treiman, 2018; Treiman & Kessler, 2011, 2021). In addition, it was suggested that reading abilities among both adults and children are highly correlated with the ability to extract visual statistical structures from the environment such like orthographic regularities and grapheme written features (Deacon, Conrad, & Pacton, 2008; Gabay, Thiessen, & Holt, 2015; Kessler, 2009). Recent studies indicated that dyslexic readers showed poor performances in tasks which were designed to measure the effectiveness of the SL, suggesting that the difficulties of the dyslexic readers in detecting statistical regularities might explain their developmental difficulties in reading acquisition (Arciuli, 2018; Vandermosten, Wouters, Ghesquière, & Golestani, 2019). Therefore, it might be suggested that in light of the fact that SL plays an essential role in language acquisition, and while the developmental reading difficulties of poor readers might be associated with poor SL skills, hence it might explain the inefficiencies of such group of readers in performing language learning tasks which are based on detecting the occurrence and re-occurrence of events based on the frequencies of matching, such like the fast-mapping tasks. Further research is suggested to examine the correlations between the performances in SL tasks and word learning tasks.

In sum, the findings may support the claim that verbal inefficiency may be the basis for explaining the difficulties of poor readers in expanding their vocabulary beyond the direct result of their poor reading experience and their poor exposure to print and texts. However, the explanation about the ineffectiveness of phonological-visual synchronization processes should not be dismissed as an estimated source of the ineffectiveness of the learning of phonological-visual associations. Yet, the processes of phonological-visual associations are considered as important processes during the fast-mapping task, however, current directions of research, such like the above mentioned SL might shed the light about better understanding the difficulties of poor readers in verbal learning tasks in general. Accordingly, further research that will examine the effectiveness of verbal learning without relying on phonological-visual associations tasks is needed to better address the claim of verbal inefficiency among readers with reading difficulties.

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