International Journal of Research Studies in Education
2023 Volume 12 Number 6, 29-38

The simple view of reading in light of effects of vocabulary and working memory in Greek-Turkish bilingual children with and without dyslexia

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ISSN: 2243-7703
Online ISSN: 2243-7711

Received: 26 April 2023 **Revised**: 15 May 2023 **Accepted**: 31 May 2023 OPEN ACCESS
Available Online: 31 May 2023 **DOI**: 10.5861/ijrse.2023.37

Abstract

This study investigates the reading skills of bilingual children with and without dyslexia in light of *Simple View of Reading* (SVR) and effects of vocabulary and verbal working memory (VWM) in both languages. Under SVR, reading consists of decoding and language comprehension. Many studies have shown that reading comprehension in bilinguals is lower than their monolingual peers. These differences are not due to decoding but due to language comprehension, and, mostly, due to their lower vocabulary size in each language (Melby-Lervåg & Lervåg, 2014). Bilingual children with dyslexia have issues with decoding; their language comprehension is, subsequently, also affected (Joshi, 2018). Earlier studies noted that vocabulary is correlated with reading comprehension in typically developing (TD) bilingual children (Harkio & Pietilä, 2016) and in children with dyslexia (Joshi et al., 2010). The role of VWM in reading comprehension is still unclear in bilinguals. To this end, twenty-four bilingual children with and without dyslexia were tested by means of a large battery in both Greek and Turkish (a fluid intelligence task, two expressive vocabulary tasks, two VWM tasks and two reading tasks). Results have shown that the two groups did not differ in their fluid intelligence or VWM in both languages. However, differences were found in all other tasks. Moreover, decoding skills of children with dyslexia were impaired compared to those of TD bilinguals. Finally, reading comprehension is correlated with vocabulary and VWM in both languages in TD bilinguals; while similar correlations were found only in the dominant language of children with dyslexia.

Keywords: reading skills, vocabulary, verbal working memory, bilingualism, dyslexia

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1. Introduction

Bilingualism and dyslexia can be two distinct areas of study; however, they can overlap. Dyslexia affects a person's written skills and it can affect individuals regardless of their language or culture (Protopapas, 2019). According to *Simple View of Reading* (SVR) reading comprehension consists of two components: (a) decoding and (b) linguistic comprehension. This model suggests that successful reading depends on both of these components working together. Decoding skills are equally or more developed in typically developing (TD) bilinguals than their TD monolingual peers (Babayigit, 2014; Novita et al., 2022). On the contrary, decoding is impaired in monolingual and bilingual children with dyslexia; however, decoding skills might exhibit a greater variance in bilinguals with dyslexia (Hedman, 2012). In respect to linguistic comprehension, TD bilingual children exhibit lower performance than TD monolingual children due to their lower vocabulary and morphosyntactic abilities (Papastefanou et al., 2021). Monolingual children with dyslexia also show lower linguistic comprehension but due to their poor decoding skills (Høien-Tengesdal, 2010). These issues may be more prevalent in bilingual children with dyslexia (Kormos, 2017). In addition, when it comes to bilingual children with dyslexia, there are more things to consider; since they transfer skills between languages (Cummins, 1979) and the development of these skills is affected by contextual factors (e.g., input and literacy practices; Papastefanou et al., 2021). Another important issue is that bilingual children with dyslexia confront difficulties in both languages (Eikerling et al., 2022) and they have to be, thus, examined in both languages. Nevertheless, they are often examined in one of their languages and, predominately, in the language of the community, which is often the minority language of the bilingual speaker (Kormos, 2017). Additionally, the diagnostic instruments are similar to those used for monolingual speakers, and., subsequently, inappropriate for an accurate diagnosis.

The role of vocabulary knowledge and verbal working memory (VWM) seems to be crucial in the development of reading skills of TD monolingual and bilingual children (Orsolini et al., 2022), since VWM enhance the development of vocabulary and vocabulary further boosts the development of morphosyntax. Both vocabulary and morphosyntax aid, thus, the development of reading skills in an indirect way (Raudszus et al., 2018). This correlation is understudied and remains unclear in monolingual and bilingual children with dyslexia.

1.1 The Simple View of Reading

Reading is a complex procedure that according to the SVR model consists of two aspects, (a) decoding and (b) linguistic comprehension (Hoover & Gough, 1990). First, when we read a text, we decode the written symbols (graphemes) and match them to the phonemes in order to move on to the next step, which is linguistic processing so as to understand the text. People with learning disabilities or language disorders may have difficulties in one, or both, aspects (Catts et al., 2006). Decoding is related to phonological awareness, grapheme knowledge, orthographic and morphological awareness, as well as rapid word naming (Carlisle, 2004; Carlisle & Katz, 2006). Phonological awareness is the ability to perceive and realize the phonological structure of language. It is the individual's ability to know that language is made up of sounds and to be able to analyze and synthesize parts of speech into simple phonological units. It is also the explicit knowledge of our linguistic processes, when we know the sounds of words and can segment words into phonemes, syllables (Bialystok et al., 2003). Regarding the second aspect of reading, language comprehension, presupposes lexical and morphological knowledge, but also the consideration of the context.

1.2 Reading skills in monolingual and bilingual children with and without dyslexia

According to the SVR model, decoding and linguistic comprehension have a strong relationship that

changes over time in TD monolingual speakers (Dujardin et al., 2023). TD bilinguals' decoding skills are equally or more developed compared to their TD monolingual peers (Novita et al., 2022; Babayigit, 2014). The transparency of the language plays a significant role (Seymour et al., 2003); hence, monolingual children whose L1 is shallow or transparent, reading comprehension appears to be affected by the development of phonological awareness up to the age of 10 years (Protopapas et al., 2013). It is worth noting that during the same period TD monolingual children have significantly developed their language skills. But what about TD bilingual children? Some studies have shown that the reading comprehension of TD bilingual children is lower than that of monolingual children (Papastefanou et al., 2021). These differences are not due to decoding, an ability that may be more developed in bilingual speakers, but to language comprehension (Melby-Lervåg & Lervåg, 2014), and mainly to lower vocabulary knowledge (Lervåg & Aukrust, 2010). In fact, some studies show that there is not a simple correlation between reading comprehension and language abilities, but that the latter are a predictive indicator of the former (Melby-Lervåg & Lervåg, 2014; Papastefanou et al., 2021). Different are the findings from longitudinal studies of TD bilingual children in Canada, which suggested that bilinguals have similar abilities to monolinguals in terms of reading comprehension (Orsolini et al., 2022). The case of Canada is notable, since bilinguals receive similar language input at school and in the community. From the above we deduce that we have to consider various variables in the investigation of reading comprehension, such as language proficiency of the speaker in both languages, but also contextual factors, such as input received by the speaker and the literacy they receive in each language (Dickinson & Porche, 2011).

Decoding skills of monolingual and bilingual children with dyslexia are deviant; however, in bilingual with dyslexia decoding skills might exhibit a greater variance than their monolingual peers with dyslexia (Hedman, 2012). Their language comprehension is, subsequently, also affected (Joshi et al., 2010). Monolingual children with dyslexia also show low linguistic comprehension but due to their poor decoding skills (Høien-Tengesdal, 2010). These issues may be more prevalent in bilingual children with dyslexia (Kormos, 2017). Similar to TD bilingual children, bilingual children with dyslexia transfer skills between languages (Cummins, 1979). Bilingual children with dyslexia confront, thus, issues with both aspects of reading comprehension in both languages (Eikerling et al., 2022). Hence, valid identification of dyslexia in bilingual speakers requires consideration of both languages (Hedman, 2012; Kormos, 2017).

1.3 The impact of vocabulary and verbal working memory abilities on reading skills

A question that has interested research on reading comprehension is whether vocabulary and VWM affects reading comprehension.

Research on the impact of vocabulary knowledge in reading comprehension has increased considerably recently (Protopapas et al., 2013; Cho et al., 2019). Previous studies exhibited that vocabulary knowledge is linked with reading comprehension in monolingual and bilingual children (Tunmer, & Chapman, 2012; Harkio & Pietilä, 2016). In other words, the more words a speaker knows the higher reading comprehension they achieve. In a similar vein, children's accuracy in word identification tasks associates with vocabulary and reading comprehension (Eikerling et al., 2022). According to the Lexical Quality Hypothesis, the development of vocabulary knowledge enhances the mental lexicon; thus, the lexical representations and the morphosyntactic awareness improve the reading comprehension (Perfetti, 2007; Cho et al., 2019). Studies in bilinguals have shown that vocabulary knowledge is correlated with reading comprehension in TD bilingual children (Harkio & Pietilä, 2016) and in bilingual children with dyslexia (Joshi et al., 2010).

Studies have shown that VWM is correlated with reading comprehension in monolingual children (Orsolini et al., 2022). The connection seems to be more indirect, that is, VWM affects lexical and morphosyntactic development and not reading per se (Raudszus et al., 2018). Significantly fewer studies examine the contribution of VWM to reading development in bilingual children. Some of them have found that VWM predicts decoding and reading comprehension (Swanson et al., 2017). While other studies emphasize that VWM indirectly contributes to reading comprehension, as has been observed in monolingual speakers (Raudszus et al., 2018).

There are studies that they do not find a link between VWM and reading comprehension in bilingual children, even though this link is found in the corresponding monolingual group (Orsolini et al., 2022). Studies on VWM in monolingual and bilingual children with dyslexia have shown that their VWM abilities lag behind (Alt et al., 2022) and they seem not to differ because of bilingualism (Vender et al., 2020). Studies that have investigated the link between vocabulary and working memory in TD children and in children with learning difficulties attested that these two variables are not linked in children with learning difficulties (Dosi & Gavriilidou, 2020).

From the above we deduce that reading comprehension is a multifaceted procedure with different parameters affecting its development. Therefore, we have still many aspects to consider and explore in order to gain a better understanding of how language works.

2. The present study

Aims & research questions and hypotheses **-** The present study aims to investigate the reading skills of bilingual children with and without dyslexia in light of SVR and effects of vocabulary and VWM in both languages. Three research questions were, thus, set:

- Does reading comprehension of bilingual children with dyslexia differ compared to those of TD bilingual children; and if so, are these differences detected in both languages?
- Does reading mode (decoding) affect the reading comprehension in both language of both groups?
- Are other variables, such as vocabulary and VWM, correlated with reading comprehension and if so, are they linked in a similar way in both languages and in both groups?

Continuing the reasoning of previous research, we hypothesized that (1) TD bilingual children will exhibit higher reading comprehension in both languages compared to the bilingual children with dyslexia (Kormos, 2017); (2) children with dyslexia will encounter more difficulties in decoding than TD bilingual children (Hedman, 2012); and, (3) more correlations will be found in TD bilinguals than bilinguals with dyslexia (Dosi & Gavriilidou, 2020).

Participants **-** Twenty-four Greek-Turkish bilingual children with and without dyslexia (9-12 years old) participated in the study. Twelve of them were TD bilingual children and the other twelve were bilingual children diagnosed with dyslexia (henceforth DD). All children lived in Greece; however, they were dominant in Turkish. All children were matched for their gender, socioeconomic status and chronological age. Informed consent in writing was obtained beforehand from parents or guardians. All procedures performed in the study were in accordance with the ethical standards of the institutional Ethics Committee of Democritus University of Thrace (60589/2111/31-8-2018) and the national research committee.

Material and scoring **-** A large battery in both Greek and Turkish was administered to all participants. The battery consisted of screening tasks [i.e., a fluid (non-verbal) intelligence task, two expressive vocabulary tasks in both languages, two VWM tasks in both languages] and main tasks (two reading tasks) in both Greek and Turkish.

Screening tasks **-** The fluid intelligence task (Raven et al., 2008) examined participants' non-verbal intelligence in order to exclude children with lower than normal intelligence. However, all participants had normal intelligence and no one was excluded. The total score was 36 points. The expressive vocabulary task was standardized in Greek (Vogindroukas et al., 2009) and the same task was adapted in Turkish. The last picture which was culturally inappropriate was replaced by an appropriate one. Pictures were shown to participants and they have to name them. The total score of each task was 50 points. In the VWM task (Alloway, 2007) participants have to recall orally a sequence of spoken digits in reverse order of that was uttered by the researcher. The difficulty was progressively increased over successive blocks. Accurate recall of four out of six trials per block allowed participants to continue to the next block; if they were not reached four accurate recalls, the test

stopped. The total score was 36 points. This test was also given in Greek and Turkish.

Main tasks **-** The reading test was part of the Reading Test A (Padeliadou & Antoniou, 2007). Two texts were used "The Exploration" and "The Education of Alexander the Great". The first text was also used in Turkish; it was translated and adapted accordingly; while the second text had a different topic, because Alexander the Great is not culturally related. Therefore, we used the text "Fanatik kadın taraftar" ("Fanatic female fan"), which refer to a female fan of Fenerbahçe, who is a lawyer. The first text in both languages was read aloud by the researcher and the child had a hard copy in front of them; while the second text in both languages was read aloud by the participant. Each text was followed by seven comprehension questions. Questions were multiple choice and included the detection of specific information, the choice of an accurate title, finding synonyms or exclusion of irrelevant information. In order to answer to the questions, participants may go back and forth. The total score of each task was 14 points.

Reliability **-** Answers were checked by two researchers. Since most of the tests were standardized or extensively used in previous studies, there was no need for reliability check. To further check the reliability of the reading tasks, a Cronbach's Alpha coefficient was calculated. The result was .873 suggesting a high degree of internal consistency.

Data analyses **-** Independent samples t-tests were performed in order to answer to the first research question. For the answer of the second research question paired-sample t-tests were performed for each group separately. In a similar manner, bivariate correlations were performed for each group separately, including the following tests as variables (the expressive vocabulary tasks, the two VWM tasks and the two reading tasks). The results will be presented in percentages.

3. Results

Some differences were attested between the two groups in the screening tasks (Figure 1). The two groups did not differ in terms of their fluid intelligence (81.5% vs. 80.6%; t (22) = .402, p = .692) and VWM in both languages (VWM in Gr: 19.4% vs 21.3%; t (22) = -1.483, p = .152; VWM in Turkish: 23.1% vs. 22.2%; t (22) = .371, p = .714). However, significant differences were found in vocabulary in Greek (63.3% and 49.3%; t (22) = -7.989, p < .001) and in Turkish (90% and 79.3%; t (22) = 5.204, p < .001). TD bilinguals had higher vocabulary knowledge both in Greek and in Turkish compared to DD bilinguals. Comparisons within each group have shown that both groups are more dominant in Turkish than in Greek (63.3% vs. 90%; TD: t (11) = -32.820, p < .001; and 49.3% and 79.3%; DD: t (11) = -4.690, p = .001).

Differences were also found in the reading task between groups (Figure 2). Bilinguals with DD had lower comprehension than TD bilinguals (Greek: 35.7% vs. 64.3%; Turkish: 61.9% vs. 83.3%). More specifically, differences were found in the overall scores of the reading task (t (22) = 6.141, p < .001), as well as in the first and second text (t (22) = 2.345, p = .028; t (22) = 4.553, p = .001; respectively), in Greek. Similar is the picture in the reading task in Turkish (overall scores: t (22) = 7.462, p < .001; text 1: t (22) = 9.950, p < .001; text 2: t (22) = 4.062, p = .002).

Comparisons within groups in terms of the comprehension in the two texts have shown that 1st test achieved higher scores than the 2nd both in Greek (52.4% vs. 23.8%) and in Turkish (66.7% vs. 67.1%) only in the DD group (t (11) = 4.690, p = .001; and t (11) = 4.690, p = .001; respectively); while no differences between the two texts were found in the TD group (Greek: 71.4% vs. 67.1%; t (11) = 1.535, p = .153; Turkish: 95.2% vs. 71.4%; t (11) = 1.542, p = .151).

Different correlations were found within each group (see Table 1). In the TD group reading comprehension in Greek correlated with vocabulary knowledge and VWM in Greek (r (12) = .982, p < .001 and r (12) = .982, p < .001; respectively). Similarly, reading comprehension in Turkish correlated with vocabulary knowledge and VWM in Turkish (r (12) = 1.000, p < .001 and r (12) = .988, p < .001; respectively). Correlations were detected

only between reading comprehension in Turkish and vocabulary knowledge and VWM in Turkish (r (12) = .663, p = .019 and r (12) = .945, p < .001; respectively) in the children with DD.

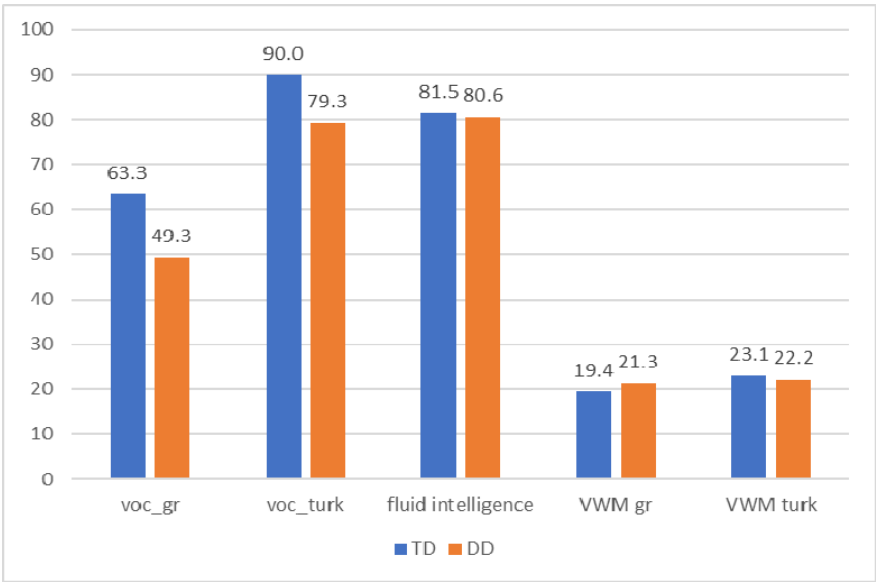

Figure 1. Groups' performance on screening tasks

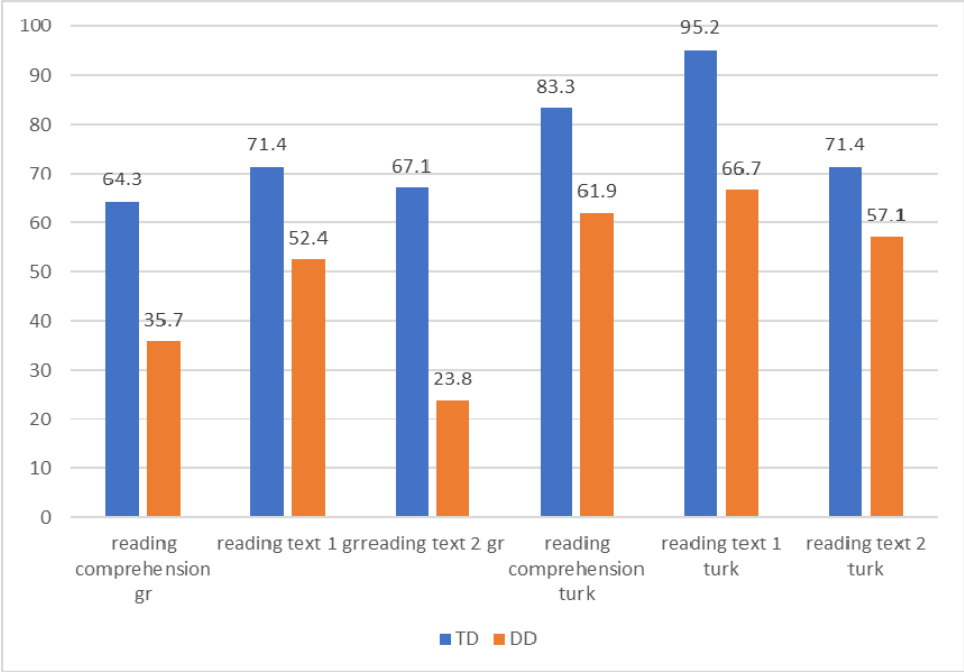

Figure 2. Groups' performance on reading task

4. Discussion

The conducted study examined the reading comprehension of Greek-Turkish bilingual children with and without dyslexia in relation to their vocabulary knowledge and VWM abilities in both languages.

The first research question referred to possible differences in reading comprehension in both languages of TD bilingual children compared to those of bilingual children with DD. The first hypothesis was fully confirmed. TD bilinguals had higher performance in reading comprehension in both languages than bilinguals with DD.

These differences are due to higher vocabulary knowledge that the former group had compared to the latter one (Joshi et al., 2010; Hedman, 2012). Moreover, the differences seem to arise from the lower decoding abilities that the bilinguals with DD have, since they answered more accurately to the questions in the first text that is read by the examiner; once they did not have to do the decoding (Hedman, 2012; Kormos, 2017).

Table 1

Correlations between reading comrehension, vocabulary and VWM

		voc gr	***voc turk***	***VWM gr***	***VWM turk***
TD BL	***reading compr gr***	*r (12) = .982, p < .001	r (12) = .000, p = 1	*r (12) = .982, p < .001	r (12) = .339, p = .280
	reading compr turk	r (12) = -.189, p = .556	*r (12) = 1.000, p < .001	r (12) = .000, p = 1	*r (12) = 988, p < .001
DD BL	***reading compr gr***	r (12) = .359, p = .251	r (12) = .189, p = .556	r (12) = -.327, p = .299	r (12) = .000, p = 1
	reading compr turk	r (12) = -.327, p = .299	*r (12) = .663, p = .019	r (12) = .000, p = 1	*r (12) = .945, p < .001

significant correlations were marked with an asterisk (*)

This leads to the second research question which was about the reading mode and whether it affected the reading comprehension in both languages of both groups. The hypothesis that children with DD will encounter more difficulties in decoding than TD children was fully confirmed. More specifically, in the text that was read by the examiner bilinguals with DD gave more correct answers in both languages than the text that was read by the participant aloud. The finding is in line with previous studies, since children with DD have issues in decoding which affect their reading comprehension (Høien-Tengesdal, 2010; Hedman, 2012; Kormos, 2017). The same finding was not detected in TD bilingual children, who achieved similar performance in both texts in both languages, suggesting that their difficulties in reading comprehension arise form difficulties in language comprehension and not in decoding (Lervåg & Aukrust, 2010; Melby-Lervåg & Lervåg, 2014; Papastefanou et al., 2021).

The third research question concerned the interrelation of different variables, such as vocabulary and VWM, with reading comprehension in both languages. Third hypothesis was partially confirmed; indeed, more correlations were found in the TD group. Vocabulary and VWM were, thus, correlated with reading comprehension in both languages, further confirming similar findings that are detected in monolinguals (Chapman, 2012; Protopapas et al., 2013; Tunmer, & Harkio & Pietilä, 2016; Cho et al., 2019; Eikerling et al., 2022). This finding also indicates that the improvement in vocabulary knowledge leads to an enhancement in reading comprehension, i.e., language comprehension (Perfetti, 2007; Eikerling et al., 2022). In addition, VWM seems to be required in order to maintain the context in order to answer to the comprehension questions (Orsolini et al., 2022). The lack of finding similar link in both languages in bilinguals with DD and the detection of the same interconnection only in participants' dominant language suggests that higher language proficiency or more exposure to language may be needed for this connection to emerge (Haastrup & Henriksen, 2000; Vermeer, 2001) or that these skills and abilities do not work in the same way in children with language impairments (Dosi & Gavriilidou, 2020).

5. Conclusion, educational implications, limitations and further research

The study investigated the reading skills of bilingual children with and without dyslexia considering the effects of vocabulary and VWM in both languages of the children. Their performance was also discussed in light of SVR. Results indicated no differences between the groups in fluid intelligence and VWM (in both languages). Nevertheless, differences were detected in vocabulary knowledge in both languages, indicating that bilinguals with DD had lower vocabulary knowledge in both languages than TD bilinguals. Differences were also found in reading comprehension, where TD achieved higher performance both in Greek and in Turkish. Participants with DD lower performance is due to issues in both decoding and language comprehension, while TD bilinguals face difficulties just in language comprehension. Vocabulary and VWM seemed to correlate with reading

comprehension in a different way in bilinguals with and without dyslexia. Reading comprehension correlated with vocabulary and VWM in Greek and Turkish in TD bilinguals. The same link was found in bilinguals with DD only in their dominant language, i.e., Turkish.

The outcomes of the present study have educational implications for teachers who work with bilingual students with and without dyslexia. First and foremost, the findings suggest that TD bilingual children have issues with language comprehension; thus, vocabulary and morphosyntax have to be boosted. Subsequently, input in oral and written language has to be enhanced. Bilingual learners with DD also face difficulties in decoding which further hamper their reading comprehension. Therefore, educators who work with bilingual children with DD have to improve both aspects of reading comprehension (decoding and language comprehension). The last finding that verified the link between reading comprehension and vocabulary and VWM in TD bilingual learners further confirms the need for enhancement of both linguistic and working memory abilities in order to improve reading comprehension. The fact that this correlation was detected only in the dominant language of bilinguals with DD possibly suggest that the interrelation of the aforementioned variables need more exposure to language to emerge.

The present study had also some limitations. More specifically, the cohort was rather small. Therefore, findings cannot be overgeneralized. More research to this direction is needed in order to obtain more robust data. Moreover, all bilinguals were dominant. Future research can test balanced bilinguals and compare the outcomes. Additionally, monolingual participants were not included, since this study aimed to discuss the SVR in bilingual participants with and without dyslexia and to identify whether they face similar or different issues by reading comprehension. Future research can also include monolinguals with and without dyslexia and compare their performance. Finally, in the present study participants were exposed to languages with transparent orthographies. Future research can examine languages pairs with different orthographic systems (transparent vs. non-transparent).

Conflict of interest - The authors declare that they have no conflict of interest.

Ethical approval - All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional Ethics Committee of Democritus University of Thrace (60589/2111/31–8-2018) and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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