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Using multiple measures of language dominance and proficiency in Farsi-English bilingual children

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This paper aims to identify effective means of measuring dominance and proficiency in bilingual children. Thirty-seven Farsi-English Heritage language speaking children from 6;1 to 11;6 were assessed on their vocabulary, morphosyntax, and narrative microstructure skills in both languages to address whether there is a difference between their proficiency in Farsi as a heritage and English as a majority language, how the scores on the vocabulary, morphosyntax, and narrative microstructure tasks relate to one another, and based on the results of each task in both languages if any of the children are at risk for a Developmental Language Disorder. Vocabulary was assessed using the LITMUS-Cross-Linguistic Lexical Task (CLT), morphosyntax using the LITMUS-Sentence Repetition (SR) tasks, and Narrative microstructure using the LITMUS-Multilingual Assessment Instrument for Narratives (MAIN). Individual language proficiency was identified via an in-depth profile analysis for each participant who looked at their performance on all experimental tasks in both languages. The data demonstrated that on the vocabulary and narrative tasks the participants were more dominant in English than in Farsi, while on the sentence repetition task there were no significant differences between the two languages. Correlation analyses showed that vocabulary scores were strongly correlated to the sentence repetition scores and the microstructure scores. The English and Farsi sentence repetition scores also correlated moderately with the microstructure scores within each language. Profile analysis showed that no child within the study scored <1.5 or 2 standard deviations below the mean on more than two tasks in both languages. However, interesting patterns emerged indicating that some participants had a greater proficiency in one language vs. the other language. The results from this study showed that measuring language within a single domain (e.g., morphosyntax) is not enough to identify a bilingual child's language dominance and/or proficiency. Instead, an in-depth profile analysis and language assessments across various language domains need to be done in order to appropriately measure language dominance and proficiency. Consequently, this study supports the importance of measuring language across multiple domains in studies of bilingual children. The clinical significance of appropriately identifying language dominance and proficiency was also shown, as such information would allow clinicians to make more appropriate clinical decisions.

KEYWORDS

dominance, proficiency, bilingualism, heritage language, majority language, vocabulary, morphosyntax, narratives

1. Introduction

Bilingualism refers to the knowledge and command of two or more languages to different degrees (Montrul, 2008). Over the years researchers have identified multiple types of bilinguals, each with varying degrees of language input and output. Simultaneous bilingual children are exposed to two languages generally from birth or within the 1st year, while sequential bilinguals can either be defined as early or late sequential bilinguals (Unsworth, 2015; Montrul, 2016). The former refers to those who first acquire one language and then develop a second one before formal literacy in the first language has set in and late sequential bilinguals are defined as those in which the second language develops after literacy in the first language has begun, usually at around the age of 5 or 6 (Ortega, 2020). Over the past two decades the literature has begun to focus on another type of bilingual speaker known as *Heritage speakers* (*HSs*; Benmamoun et al., 2013). HSs are considered second or third generation immigrants where the minority language spoken in the home by their parents is the heritage language (HL) and the majority language (ML) is the language spoken at school and/or in the greater society. The ML generally eventually develops into the dominant language (Montrul, 2016). While our knowledge of bilingualism has increased significantly, questions remain as to how to test the language abilities of a bilingual child's two languages as well as how to identify language dominance and proficiency. It is crucial to be able to test children in both their languages and identify their dominance and proficiency for both educational and clinical/diagnostic purposes (Kohnert, 2010). The present study addresses dominance and proficiency using several measures of language skills that target expressive and receptive vocabulary, as well as morphosyntax and narrative microstructure in primary school Farsi-English bilingual children living in Canada. The study also aims to identify if any of the participants are at risk for developing a Developmental Language Disorder (DLD) by assessing the children' language skills in both their languages (Kohnert, 2010).

1.1. Dominance and proficiency

Questions about language dominance and proficiency and how these are defined have been discussed at length (Silva-Corvalán and Treffers-Daller's, 2015; Treffers-Daller's and Korybski, 2015). Language proficiency is based on the child's overall abilities in a language, while language dominance is measured based on how proficient a child is in a particular language in comparison to another one considering external factors such as exposure and use (Silva-Corvalán and Treffers-Daller's, 2015; Treffers-Daller's and Korybski, 2015). It is common to find that bilinguals are more dominant or proficient in one language. Even when acquiring both languages from birth simultaneously, children are generally more dominant in one vs. the other language. While dominance and proficiency are very often used as ways to distinguish between different acquisition patterns in children and to examine cross-linguistic interactions, there are conflicting views on their validity as useful explanatory constructs. The reason for this is because dominance and proficiency change constantly throughout the lifespan as a function of the amount of input and use of one's languages. A child's dominance level often shifts when they start school and start using the school language (Kohnert and Bates, 2002; Silva-Corvalán and Treffers-Daller's, 2015; Montrul, 2016). For example, Kohnert and Bates (2002) did a cross-sectional study of school age Spanish-English children and found that when they started learning English at school, their knowledge of English took over Spanish at around the age of 11; however, the production of English took over Spanish at around the age of 14 (Kohnert et al., 1998). What is important to note, is that the shift in dominance is a gradual process and occurs in different domains at different times (Bedore et al., 2012). Regardless, of the conflicting views, it is important to measure language dominance and proficiency in bilinguals, as this would allow for greater cross study comparisons (Luk and Bialystok, 2013; Silva-Corvalán and Treffers-Daller's, 2015; Treffers-Daller's and Korybski, 2015). How are dominance and proficiency measured?

Self-ratings by adults or parental ratings for children are common means of measuring language dominance and proficiency (Bedore et al., 2012). However, parental ratings are sometimes inaccurate because language proficiency is constantly changing and a parent might not interact with a child in both their languages in order to provide accurate data. Bedore et al. (2012) argue that more direct measures of language knowledge (e.g., analysis of language performance elicited by an oral narrative) would provide a more objective measure of language dominance and proficiency. In their study, they measured language dominance in a group of 1,192 Spanish-English 5 year old children to address if different measures of language experience and ability would lead to the same classification of language dominance. Therefore, they measured dominance via a parental questionnaire, as well as an English semantics and morphosyntax assessment and found that the measure used does matter. While the tests for semantics and morphosyntax were able to classify the children into different dominance categories, the test of semantics proved to be a stronger measure. A study by Meir (2018) also suggests that numerous quantitative measures can be used to identify the language dominance of a bilingual child. These include measures of mean length of utterance (MLU), directionality of code-switching, parental ratings, exposure patterns, vocabulary, and/or morphosyntax. It is important to note that a single measure is not sufficient to capture the multidimensionality of dominance and proficiency. Among scholars in the field, it is becoming increasingly prevalent to use more than one measure to identify language dominance and proficiency. Meir and Armon-Lotem (2017) and Meir (2018) measured language dominance in a group with Russian as a HL and Hebrew as the ML of the society. In both studies, they identified language dominance in the two groups through scores of language proficiency. Language proficiency in HL Russian children was measured using a battery of tasks which provided data on object naming, production of case, and verb inflection. Language proficiency scores for ML Hebrew were obtained via tests for expressive vocabulary, sentence repetition, sentence comprehension, expression, pronunciation, and storytelling.

Although it has been shown that it is important to use multiple measures to measure language dominance and proficiency, many studies have used only lexical measures as a means to operationalize these concepts (e.g., Lambert et al., 1959; Fishman and Cooper, 1969; Cromdal, 1999; Bialystok et al., 2008; Reyes and Azuara, 2008; Silva-Corvalán and Treffers-Daller's, 2015; Treffers-Daller's and Korybski, 2015). Vocabulary is considered a good measure of language dominance for a variety of reasons. Firstly, vocabulary and grammar are known to be strongly related (Bates and Goodman, 1999; Tomasello, 2000). Secondly, lexical knowledge influences performance on online tasks (Bialystok et al., 2008). Finally, lexical knowledge is a significant prerequisite of academic achievement in both monolingual and bilingual children (Treffers-Daller's and Korybski, 2015).

The present study uses a range of measures to address dominance and proficiency in bilingual children. It also provides insights into the relationship between these measures within each language in a group of school–aged bilingual children who have Farsi as their HL and English as their ML. Such knowledge is important for clinicians, such as speech and language therapists, in terms of diagnosing a language disorder. Despite the critical role of measurement of dominance and proficiency in the identification of language disorders in bilingual populations, there is relatively limited research investigating these constructs separately in multiple domains across languages. This study aims to add to the literature by indicating that accurate measures of dominance and proficiency in bilingual children are significant for researchers and clinicians alike.

1.2. Language acquisition in the heritage language

HSs acquire their HL naturalistically from the home environment. HSs can be simultaneous bilinguals, acquiring both their HL and the ML in early childhood, or sequential bilinguals, acquiring the HL first before acquiring the ML when they start school (Rothman et al., 2016). Ultimately, the ML ends up becoming the stronger or more dominant language in adulthood (Montrul, 2016). Regardless of language dominance, language proficiency levels in the HL of the children varies greatly (Montrul, 2016). For example, some HSs can be highly fluent and literate in their HL, while others have very little expressive ability and are only able to understand the HL.

Due to the variability in their proficiencies, the grammatical systems of HSs vary significantly. However, less is known about their vocabulary skills. The vocabulary skills of HSs have not been studied as much as their morphosyntactic skills. This is problematic, as attrition affects the lexicon earlier and more significantly than it does so for morphosyntax (Gharibi and Boers, 2016). It is important to measure the vocabulary skills of HSs, as research shows that vocabulary and grammar are significantly correlated (Gharibi and Boers, 2016; Montrul, 2016; Hamann and Abed Ibrahim, 2017). In addition, research states that the vocabulary abilities of HSs tend to be lower than that of homeland speakers (Hoff and Core, 2013; Montrul, 2016). An example of this can be found in a study by Gharibi and Boers (2016). To investigate the vocabulary skills of both simultaneous and sequential HSs in comparison to their monolingual counterparts, they studied two groups of children: (1) Thirty Farsi-English bilinguals living in New Zealand and (2) Thirty monolingual Farsi children living in Iran. All participants were administered a receptive and a productive vocabulary task. The study showed that overall the monolinguals outperformed the bilinguals in both tasks. However, the gap for the simultaneous bilingual group was much greater. A study by Hamann and Abed Ibrahim (2017) also demonstrated that bilingual children lagged behind monolingual children in terms of receptive and productive vocabulary. Apart from vocabulary, HSs have often been found to fall behind their monolingual counterparts in certain areas of grammar (Montrul, 2008; Cabo and Rothman, 2012; Benmamoun et al., 2013; Thordardottir and Brandeker, 2013; Hamann and Abed Ibrahim, 2017). According to Benmamoun et al. (2013) HSs tend to keep the basic and core principles of grammatical systems (e.g., noun-verb distinctions). However, the aspects of syntax that involve higher levels of grammar (e.g., complex syntax) are often under-developed in HSs. Therefore, it is important to measure a child's language proficiency using language tasks which are able to provide information on a range of linguistic domains. Measuring language proficiency across language domains would provide a more accurate measure of a child's true language skills in each of their languages.

1.3. The relationship between vocabulary and morphosyntax

There is a vast amount of research looking at the relationship between vocabulary and grammar in both monolingual and bilingual children. However, less research has looked at different language domains in the same group of bilingual children (Jia et al., 2002; Chondrogianni and Marinis, 2011; Thordardottir and Brandeker, 2013). Jia et al. (2002) measured the association between the development of the L1 and L2 in Mandarin-English speaking young adults living in the US. The participants provided self-ratings of language proficiency for each language and were given tests to measure their vocabulary and morphosyntactic skills in both languages. The results showed that the participants who had better overall performance in the ML generally underperformed in the HL. Chondrogianni and Marinis (2011) looked at vocabulary and morphosyntax in the same group of bilingual school-age children with Turkish as their HL and English as their ML. The results showed that in their ML the children performed better on the tasks that targeted general comprehension of grammar and production of tense marking morphology, but they had a lower accuracy on the comprehension of single word vocabulary and (complex) morphosyntax (e.g., articles, passives, and wh-questions). This study was one of the few to examine different language domains at the same time in the same population of bilingual children, but did not measure the children's HL. Thordardottir and Brandeker (2013) compared the vocabulary and morphosyntax of a group of 5-year-old English and French monolingual children as well as a group of English-French bilingual children with varying degrees of exposure. The children were assessed via a parental questionnaire as well as on non-word repetition, Sentence Repetition (SR),

and vocabulary tasks. The monolingual children were tested in their native language while the bilingual children were tested in both English and French on all tasks. The study showed that SR scores were positively correlated with the vocabulary scores within languages, but no correlations were found between the two domains across languages.

The literature looking at language dominance and proficiency with respect to narrative microstructure has shown that children generally performed better in the majority language in comparison to the heritage language (Bohnacker, 2016; Méndez et al., 2018). The literature has also shown that children are required to reach a threshold level of vocabulary in order to be able to produce appropriate story narratives. Méndez et al. (2018) demonstrated that lexical abilities are highly associated to complexity measures in a bilingual child's languages during narrative retell tasks. Méndez et al. (2018) also indicated that vocabulary is a strong predictor of narrative skills in the majority language but not in the minority language.

1.4. The present study

The present study adds to the research on dominance and proficiency by focusing on the relationship between language domains—vocabulary, morphosyntax, and oral narratives in bilingual children with typical development. Assessing lexical and morphosyntactic skills in both languages will allow direct information to be obtained about language dominance and proficiency from multiple domains. In addition, evaluating domains separately in the same group of children will allow for differentiation between the two languages and a greater understanding of how each one develops individually.

The study has the following research questions:

1) Is there a difference between the children's proficiency in Farsi as a HL and English as a ML as measured by vocabulary, morphosyntax, and narrative microstructure?
2) How do the scores on the vocabulary, morphosyntax, and narrative microstructure tasks relate to one another?
3) Based on the results of each task in both languages, are any of the children at risk for a Developmental Language Disorder?

2. Methodology

2.1. Participants

A total of 38 heritage Farsi and majority English school aged children between the ages of 6;1 to 11;6 participated in the study. All children were living in Toronto, Canada at the time of testing and attended mainstream English language schools during the week and a Farsi Saturday school for 8 h each week. During their Farsi school they were taught Farsi reading, writing, and math and were required to speak Farsi throughout the day. Thirteen of the 38 children were also exposed to French to some degree, but exposure to this language was only a few hours at school. All children were exposed to Farsi before the age of 2 and all children had at least 2 years of exposure to English. One family was not able to provide demographic information and therefore results are only presented for 37 participants.

TABLE 1 Demographic information on the study's participants.

	Mean	Std. deviation	Min–max
Age at Testing (months)	103.81	14.03	73–139
Length of Exposure English (months)	63.27	25.51	8–109
Length of Exposure Farsi (months)	99.91	15.23	64–125
Total Use of English (%)	29.59	18.48	0–90
Total Use of Farsi (%)	74.45	19.68	20–100
Richness score English (score out of 18)	10.27	1.85	6–14
Richness score Farsi (score out of 18)	6.10	2.39	0–13
Total Parental Education (raw score in years)	17.87	2.62	13.50–23

The Questionnaire for Parents of Bilingual Children (PABIQ; Tuller, 2015) was used to collect background and demographic data on the participants of the study. Table 1 above provides demographic information in terms of Age at Testing (AaT), Length of Exposure (LoE), Total Use of each language in the home, Richness of each language obtained in the home, and Parental Education. Note that Total use is measured based on how much of a language the children were using with family members in the home, while Language Richness is based more on the level of engagement in watching TV, reading books, and storytelling, as well as the children's interaction with friends and family in the community.

When multiple languages are being used in a home, their use is often not balanced. This is shown in the study population by comparing the scores of Total Use in the home and Language Richness score. The results demonstrated that for the measure of Total Use in the home the children were more dominant in Farsi (M = 74.45) than English (M = 29.59). In contrast, the Language Richness score showed that the children were more dominant in English (M = 10.27) than Farsi (M = 6.10). In terms of socio-economic status based on years of education, both parents of all children had attended college or university, thus, putting them on middle to upper socio-economic status.

2.2. Tasks

The lexical task used in the study was the Cross-Linguistic Lexical Task (CLT; Haman et al., 2015). The CLT is made up of four tests—noun production, verb production, noun comprehension, verb comprehension and therefore allows for an overall measure of receptive and expressive vocabulary. In the current study, the British CLT (Haman et al., 2015) and the Farsi CLT (Talabi, 2018) were used. Both the British and Farsi CLTs have 32 items per test. The Farsi CLT was originally designed with pictures considered appropriate for Farsi children living in Iran but some pictures were deemed unethical (i.e., gun, knife etc.) for heritage Farsi speakers

in western communities. Therefore, one picture per sub-test was removed and a final adapted Farsi version with 31 items per sub test was used in the study. Subtests in both the English and Farsi CLT were counterbalanced during administration. The CLT tasks took about 15–20 min to complete. Administration of the CLT involved having the participants see the pictures on a computer screen and responses were transcribed during the task administration. Two practice items were presented at the start of each task to familiarize the participants with the tasks.

In addition to the lexical tasks, two sentence repetition (SR) tasks, each with 30 items, were used: the English LITMUS-SR-30 (Marinis and Armon-Lotem, 2015) and the Farsi LITMUS-SR-30 (Komeili et al., 2020). Both tasks were administered via a paper version in which the items were presented orally. This is considered a more clinically valid and realistic means of assessment, as it allows for greater rapport with the children. The participants were required to listen to the sentences and repeat them back verbatim. At the start of the SR tasks two practice sentences were provided to help the children understand how the task worked. All participants' responses were audio recorded and transcribed at a later date. The SR tasks were scored for accuracy: children were given a score of 1 if the sentence was repeated exactly as they were said and a score of 0 if one or more errors were made. Interrater reliability by a trained rater was done for both tasks and was found to be 90.7% for the LITMUS-SR English and 91.1% for the LITMUS-SR Farsi. Each task took about 15–20 min to complete.

The last tasks used in this study were the English and Farsi LITMUS-MAIN narrative tasks (Gagarina et al., 2012, 2019). The participants were assessed on their microstructure skills during a retelling task. Participants were told one story in Farsi and one in English (counterbalancing took place across sessions and participants) and were then asked to retell the story in their own words while looking at the pictures. During re-telling the children were not shown the entire picture strip and instead were shown the pictures in sections (i.e., first pictures 1 and 2, then pictures 3 and 4 and then pictures 5 and 6) and were asked to re-tell the story as it progressed. Prompts were provided when needed to obtain further information from the participants. Responses were audio recorded for later transcription.

The LITMUS-MAIN does not provide a specific scoring outline for microstructure. However, guidelines are given which suggest that a measure of complexity and length should be considered (Norris and Ortega, 2009). We chose to employ an analysis method which is widely used in second language acquisition research to analyze spoken data of second language learners. The framework, known as the CAF method (Housen and Kuiken, 2009), measures complexity, fluency, and accuracy of language performance and is believed to be a reliable indicator of proficiency. To obtain measures of complexity, accuracy, and fluency, the children's narratives were transcribed and broken down into Analysis of Speech Units (AS-Units). An AS unit is a syntactic unit similar to the C-Unit which is made up of the main clause and all of its subordinate clauses (Foster et al., 2000). The AS unit is considered an "idea unit" and clausal boundaries are identified based on intonation and pauses. In the present study two scores for each CAF component were identified. The complexity score was based on two valid measures—ratio of subordination (RS) and number of words per clause (NWC). These are known as valid measures of complexity in the literature (Norris and Ortega, 2009) and were also part of those suggested by the MAIN guidelines. The RS was obtained by dividing the total number of clauses by the total number of AS units, while the NWC was obtained by dividing the total number of words by the total number of clauses. There were also two measures for accuracy—percentage of error free clauses (EFC) and percentage of correct verbs (TVC). For the first measure the total number of EFC was divided by the total number of clauses and a percentage was taken. Any error, for example phonological, lexical, grammatical, and morphological, impeding communication were considered. In addition, using a word from a different language (i.e., code switched) in a clause during the re-telling was also considered an error in this context, as the task instructions asked the children to complete each task in a single language (i.e., in monolingual mode). The second accuracy measure of TVC was obtained by taking the number of correct verbs as a proportion of the total number of verbs in the retelling. A correct verb was a verb with no semantic, morphosyntactic, or ordering errors. These measures are reported to be reliable indices of accuracy tapping into aspects of accuracy at global and local levels (Norris and Ortega, 2009; Tavakoli, 2018). Following the literature in this area (Tavakoli and Wright, 2020), fluency was measured in terms of speed, number of syllables per minute (SPM), and breakdown, number of filled pauses (NFP) per minute. Obtaining a measure of fluency could potentially demonstrate if there is any relationship between the children's vocabulary skills and their overall fluency when re-telling a narrative. The transcription, coding and scoring for both the English and Farsi LITMUS-MAIN followed the same procedure. Inter-rater reliability for transcription, coding, and scoring were obtained for 20% (seven narratives) of the data for all three components separately. Inter-rater reliability for complexity, accuracy and fluency in the Farsi transcription was 96.96, 93.86, and 98.9%, respectively and 98.35, 96.24, and 96.59% in the English transcriptions, respectively.

3. Results

3.1. Proficiency as measured by vocabulary

Descriptive data were first obtained and then a set of statistical analyses were conducted. The mean percentage and the standard deviations for the noun and verb comprehension and production tasks in English are illustrated in Figure 1A while those for the Farsi task are presented in Figure 1B. Percentages were used in the ANOVAs that address research question 1 while the raw scores were used in the correlation analyses for research questions 2 and 3.[1]

A repeated measures ANOVA was conducted with percentage scores to identify if there were any main effects of language,

1 In addition to the analyses presented, we conducted ANOVAs and partial correlations with age as an factor because the age range of the children was large. The results of these analyses were similar to the ones presented here.

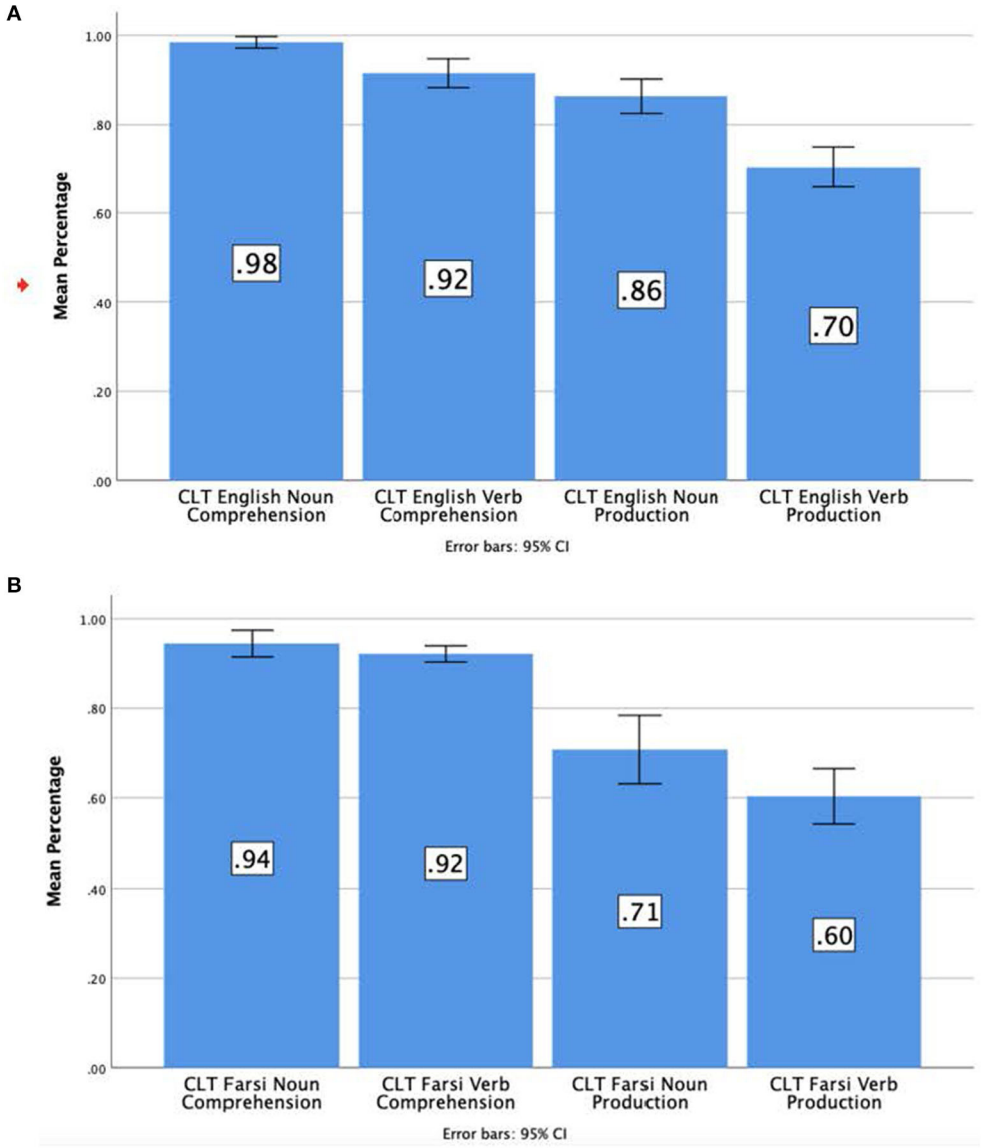

FIGURE 1
(A, B) Means of CLT percentage scores for the English and Farsi noun and verb comprehension and production tasks.

modality, or word type and if there were any interactions between these factors. The 2 × 2 × 2 repeated factors ANOVA with the factors Language (English and Farsi), Modality (comprehension and production), and Word type (noun and verb) showed significant main effects for all three factors: Language: $F_{(1,36)} = 6.666$ $p = 0.14$ $\eta^2 = 0.156$; Modality: $F_{(1,36)} = 258.956$, $p < 0.001$, $\eta^2 = 0.878$; and Word Type: $F_{(1,36)} = 108.395$, $p < 0.001$, $\eta^2 = 0.751$. Significant interactions were further observed between Language and Modality $F_{(1,36)} = 11.936$, $p = 0.001$, $\eta^2 = 0.249$; Language and Word Type $F_{(1,36)} = 10.284$ $p = 0.03$, $\eta^2 = 0.222$; and Modality and Word Type $F_{(1,36)} = 52.920$, $p < 0.001$, $\eta^2 = 0.595$. However, the three way interaction between Language, Modality and Word Type was not significant $F_{(1,36)} = 0.113$, $p = 0.738$, $\eta^2 = 0.003$. *Post-hoc* analyses in the form of pairwise comparisons were completed to identify where differences lay. The *post-hoc* analyses showed that participants performed significantly better in English than in Farsi in the production of both nouns and verbs [nouns: $t_{(36)} = 3.234$, $p = 0.003$; verbs: $t_{(36)} = 2.441$, $p = 0.02$]. However, in terms of comprehension they performed significantly better in English than in Farsi only in nouns [nouns: $t_{(36)} = 2.391$, $p = 0.022$; verbs: $t_{(36)} = -0.341$, $p = 0.725$]. These results show that the participants were more proficient in English than in Farsi both in terms of expressive and receptive vocabulary. However, the greater proficiency was mainly due to expressive language, as significant differences in production between the languages were found for both nouns and verbs while differences in comprehension were only found between the English and Farsi nouns. For this reason, in the correlation analyses between tasks in Section 3.4 we used for the CLT tasks a composite score of expressive vocabulary together for nouns and verbs.

3.2. Proficiency as measured by SR tasks

In order to further investigate the language proficiency of the children in terms of their morpho-syntactic abilities, analyses were conducted on the English and Farsi LITMUS-SR tasks. Descriptive data for the LITMUS-SR tasks are presented in Table 2.

A repeated measures ANOVA on the accuracy scores of the sentence repetition task with the factor Language with two levels (English and Farsi) did not show a significant difference between the two languages $F_{(1,36)} = 0.070$, $p = 0.793$, $\eta^2 = 0.002$.

3.3. Proficiency as measured by narrative microstructure

The descriptive statistics of the measures of narrative microstructure are presented in Tables 3–5 for each of the different microstructure components: complexity, fluency, and accuracy each for English and Farsi.

A set of six repeated measures ANOVAs were done on the LITMUS-MAIN microstructure measures, one per score with the factor Language (English and Farsi). There was a main effect of language with the scores in the English task significantly higher than in the Farsi task in the dependent Variables WPC, $F_{(1,36)} = 128.468$, $p = 0.001$, $\eta^2 = 0.781$; EFC, $F_{(1,36)} = 6.064$, $p = 0.019$, $\eta^2 = .144$; and TVC, $F_{(1,36)} = 5.448$, $p = 0.025$, $\eta^2 = 0.131$. The number of filled pauses was significantly higher in Farsi than English: NFP, $F_{(1,36)} = 17.031$, $p < 0.001$, $\eta^2 = 0.321$. Non-significant differences were found for RS, $F_{(1,36)} = 1.556$, $p = 0.220$, $\eta^2 = 0.041$ and for SPM, $F_{(1,36)} = 0.284$, $p = 0.597$, $\eta^2 = 0.008$.

3.4. Correlations between tasks

To address research question 2 and investigate how the results from the vocabulary, morphosyntax, and narrative microstructure tasks relate to one another, Pearson correlation analyses were conducted between the results from the three tasks in both English and Farsi and between the two languages.

3.5. Correlation between vocabulary and morphosyntax

The results of the correlation analyses between the CLT expressive scores and the SR scores, shown in Table 6 and Figures 2, 3 below, indicate a strong correlation between vocabulary and morphosyntax within each language.

TABLE 2 Descriptive data for English and Farsi LITMUS-SR tasks.

	Mean	Std. deviation	Min–max
SR English accuracy score	20.24	7.27	0–29
SR Farsi accuracy score	19.81	7.68	3–29

TABLE 6 Correlations between the CLT tasks and the SR scores in English and Farsi.

	CLT Exp Farsi	CLT Exp English	SR Eng	SR Farsi
CLT Exp Farsi	1	−0.300		0.724**
CLT Exp English		1	0.743**	

**Correlation is significant at the 0.01 level (2-tailed).

TABLE 3 Descriptive statistics for the microstructure complexity measures.

	Ratio of subordination (RS)			Number of words per clause (WPC)		
	Mean	Standard deviation	Range	Mean	Standard deviation	Range
English	2.05	0.43	1.20–3.00	6.02	0.58	4.86–7.21
Farsi	2.19	0.61	1–4	4.41	0.71	3.86–5.02

TABLE 4 Descriptive statistics for the microstructure fluency measures.

	Syllables per minute (SPM)			Number of filled pauses (NFP)		
	Mean	Standard deviation	Range	Mean	Standard deviation	Range
English	121.70	27.38	69–172	1.66	2.58	0–12
Farsi	118.61	37.70	32.82–201	3.77	3.57	0–12

TABLE 5 Descriptive statistics for the microstructure accuracy measures.

	Percentage of error free clauses (EFC)			Total verbs correct (TVC)		
	Mean	Standard deviation	Range	Mean	Standard deviation	Range
English	89.23	14.04	35.70–100	96.65	4.75	81.81–100
Farsi	79.56	18.21	28.57–100	91.00	12.71	42.85–100

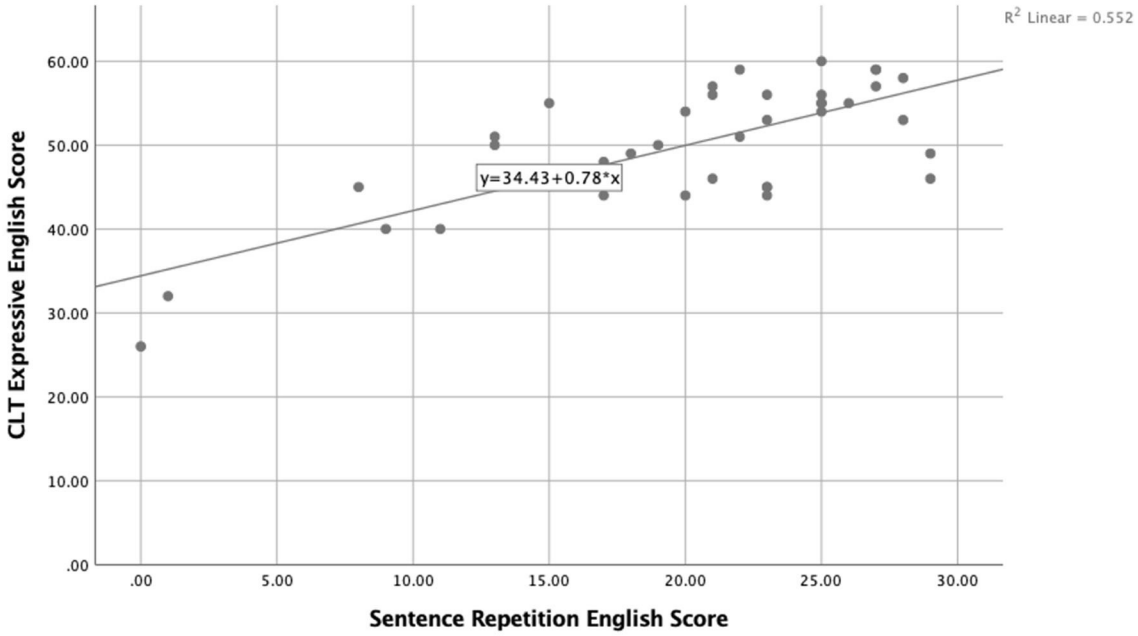

FIGURE 2
The relationship between the CLT Expressive English scores and SR English scores.

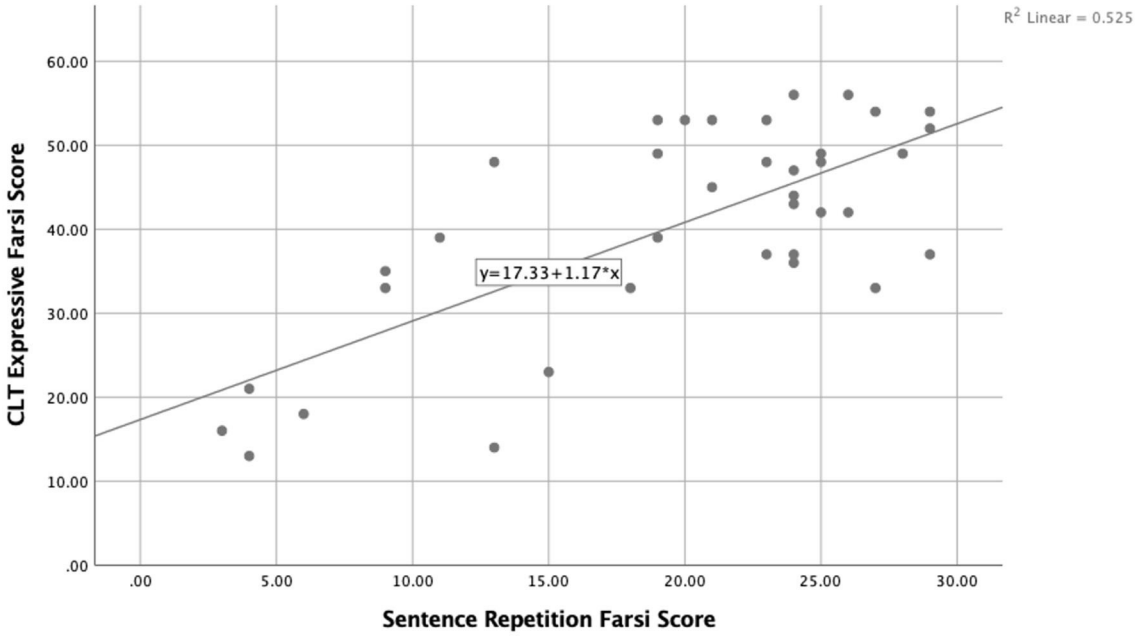

FIGURE 3
The relationship between the CLT Expressive Farsi scores and the Farsi SR score.

3.6. Correlations between vocabulary and narrative microstructure

To identify associations between expressive vocabulary and narrative microstructure scores within each language, two separate Pearson Correlations were done between the CLT Expressive English scores and the English microstructure scores and between the CLT Expressive Farsi scores and the Farsi microstructure scores. The results are shown in Tables 7, 8, respectively.

In both languages, the CLT Expressive English scores are moderately correlated with the fluency score SPM and moderately to highly correlated with the accuracy scores of TVC and EFC, but

they are not associated with the complexity scores RS and WPC or with the fluency score NFP.

3.7. Correlation between SR and narrative microstructure

To identify how the scores on the SR tasks relate to those on the narrative microstructure tasks in each language respectively, two separate correlational analyses were conducted, one for each language. The results of these analysis can be seen in Tables 9, 10 below.

The analyses demonstrated that the English SR task correlated with all three aspects of the microstructure—complexity (RS), accuracy (EFC and TVC) and fluency (SPM)—with the scores measuring morphosyntax (EFC and TVC) having the strongest correlations. The Farsi SR scores had a highly significant correlation with the fluency measure of SPM score and a moderately high significant correlation with the accuracy measures of EFC and TVC, but no significant correlations were found between SR and the complexity scores.

TABLE 7 Correlation analysis between CLT English and the microstructure scores in English.

		Complexity		Fluency		Accuracy	
	CLT English Exp	RS	WPC	SPM	NFP	EFC	TVC
CLT English Exp	1	0.219	−0.028	0.576**	−0.193	0.740**	0.537**
RS		1	−0.168	0.376*	−0.080	0.168	0.187
WPC			1	−0.165	0.024	0.170	0.016
SPM				1	−0.162	0.433*	0.267
NFP					1	−0.177	0.163
EFC						1	0.398*
TVC							1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

TABLE 8 Correlation analysis between CLT Farsi and the microstructure scores in Farsi.

		Complexity		Fluency		Accuracy	
	CLT Exp Farsi	RS	WPC	SPM	NFP	EFC	
CLT Farsi Exp	1	0.315	0.254	0.608**	−0.246	0.658**	0.683**
RS		1	−0.171	0.255	0.033	0.081	0.171
WPC			1	0.033	−0.138	0.107	0.069
SPM				1	−0.310	0.549**	0.422**
NFP					1	−0.165	−0.330*
EFC						1	0.825**
TVC							1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

3.8. Profile analysis

To address the third research question and identify whether any of the children are at risk for a Developmental Language Disorder (DLD), we looked at the participants' individual performance along all tasks in English and Farsi, as shown in Tables 11, 12, respectively. These results allow us to demonstrate the individual differences in our participants. The cells which are not highlighted show scores that are within 1.5 SD of the mean of the group. The scores highlighted in orange represent scores which were 1.5 SD below the group mean, while cells highlighted in red represent scores which were 2SD below the group mean.

The tables indicate that participants 8, 19, and 20 have low proficiency in English, as they were performing −1.5 and/or −2SD below the mean on most of the English tasks but do not have low scores in the Farsi tasks. On the other hand, participants 4, 25, 33, 35, and 36 have low proficiency in Farsi as they were performing −1.5 and/or −2SD below the mean on the majority of the Farsi tasks but their scores on the English tasks are within 1.5 SD. It is evident that no child in this study demonstrated low scores in both their languages. This indicates that none of the children appear to be at risk for a DLD.

4. Discussion

This section discusses how the results relate to the current literature. Each of the three research questions will be presented and discussed in separate sections. The limitations of the study as well as potential future research are discussed at the end of the discussion section.

4.1. Discussion of research question 1: is there a difference between the children's proficiency in Farsi as a HL and English as a ML as measured by vocabulary, morphosyntax, and narrative microstructure?

Language dominance and proficiency levels in bilingual children vary greatly (Montrul, 2008, 2016; Bedore et al., 2012) who are often more dominant in one language vs. another (Carroll, 2017). It is possible to have one HS who has high receptive and expressive language abilities in their HL, while another has very little expressive ability and is only able to understand the HL. Therefore, when discussing the language abilities of bilingual children, one must consider the degree of proficiency in both the HL and ML (Montrul, 2008, 2016; Bedore et al., 2012; Luk and Bialystok, 2013; Silva-Corvalán and Treffers-Daller's, 2015; Treffers-Daller's and Korybski, 2015). One of the most common measures of language proficiency and dominance

TABLE 9 Correlational analysis for the English SR scores and the English microstructure scores.

		Complexity		Fluency		Accuracy	
	SR	RS	WPC	SPM	NFP	EFC	TVC
SR	1	0.517**	−0.008	0.502**	−0.238	0.703**	0.520**
RS		1	−0.168	0.376*	−0.080	0.168	0.187
WPC			1	−0.165	0.024	0.170	0.016
SPM				1	−0.162	0.433**	0.267
NFP					1	−0.177	0.163
EFC						1	0.398*
TVC							1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

TABLE 10 Correlational analysis for the Farsi SR scores and the Farsi microstructure scores.

		Complexity		Fluency		Accuracy	
	SR	RS	WPC	SPM	NFP	EFC	TVC
SR	1	0.292	0.287	0.716**	−0.323	0.566**	0.587**
RS		1	−0.171	0.255	0.033	0.081	0.171
WPC			1	0.033	−0.138	0.107	0.069
SPM				1	−0.317	0.549**	0.422**
NFP					1	−0.165	−0.330
EFC						1	0.825*
TVC							1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

has been vocabulary tasks (Lambert et al., 1959; Fishman and Cooper, 1969; Cromdal, 1999; Reyes and Azuara, 2008; Treffers-Daller's and Korybski, 2015). Therefore, one of the tasks used to identify language dominance in the present study was the CLT Expressive and Receptive task for English and Farsi. The analyses showed no difference between the children's two languages in receptive vocabulary of verbs but an advantage was observed for English in their expressive vocabulary and receptive vocabulary in nouns. This suggests that children are mostly English dominant in their vocabulary.

Bilingualism is multifaceted, and therefore, language dominance and proficiency cannot simply be concluded based on one simple measure (Bedore et al., 2012; Treffers-Daller's and Korybski, 2015; Caffarra et al., 2016; Meir and Armon-Lotem, 2017; Meir, 2018). Vocabulary skills, although significant in demonstrating proficiency, are often positively and highly correlated with morphosyntax (Chondrogianni and Marinis, 2011; Thordardottir and Brandeker, 2013; Gharibi and Boers, 2016; Montrul, 2016; Hamann and Abed Ibrahim, 2017; Meir and Novogrodsky, 2020), implying a certain degree of overlap between the two. The multifaceted nature of bilingual communication, however, encouraged us to collect more evidence about the linguistic skills of the participants that allow for a comparison of their performance in English and Farsi on the SR and narrative microstructure tasks. The analyses on the SR tasks showed no differences in the children's scores between English and Farsi, indicating balance in their morphosyntactic abilities between the two languages. In contrast, the findings of the microstructure analyses showed that children produced more accurate, complex, and fluent oral narratives in the ML (English) than in the HL (Farsi). Of the three microstructure components, accuracy was the most sensitive dimension, with both accuracy measures being significantly higher in English than in Farsi. The complexity and fluency measures were also effective in highlighting the differences between the children's two languages with WPC demonstrating their ability to use more words per clause in English than Farsi, and NFP indicating they had a larger number of filled pauses in Farsi than in English. Given the ample research evidence supporting the reliability of CAF measures in representing language proficiency (Housen and Kuiken, 2009; Norris and Ortega, 2009), these findings are important as they suggest employing a microstructure analysis would be effective in identifying the differences between the bilingual children's proficiency in their two languages and highlighting the nuanced differences that remain unexplored when using other tasks (e.g., SR) that may be less sensitive than microstructure particularly for children at the end of primary/elementary school.

It should also be noted that dominance is a dynamic construct that changes with time and circumstances. Even though the participants in the current study started out as having Farsi as the dominant language on the basis of their total language use in the parental questionnaire, dominance appeared to shift such that as a group, the participants now seem to be English dominant based on the language richness score in the parental questionnaire as well as expressive vocabulary. The literature looking at language dominance and proficiency with respect to narrative microstructure has shown that the LITMUS—MAIN generally finds in favor of the ML (Hipfner-Boucher et al., 2015; Altman et al., 2016; Bohnacker, 2016; Kapalkova et al., 2016; Roch et al., 2016; Méndez et al., 2018; Hao et al., 2019). The findings of the present study reiterate those found in the literature such that the participants were found to be more proficient and dominant in the ML (English) than the HL (Farsi). The participants produced more complex, fluent and accurate oral narratives in the English than in Farsi. Of the three microstructure components—complexity, fluency and accuracy- the latter was the most telling as both accuracy measures were significantly higher in English than in Farsi.

4.2. Discussion of research question 2: how do the scores on the vocabulary, morphosyntax, and narrative microstructure tasks relate to one another?

A significant amount of research suggests that there is a relationship between vocabulary and grammar (Bates et al., 1988; Caselli et al., 1999; Thal et al., 2000; Devescovi et al., 2005; Hamann and Abed Ibrahim, 2017; Hoff et al., 2018; Kaltsa et al., 2020). However, these studies generally compared vocabulary and grammar in different groups of children. Research looking at the

TABLE 11 English profile analysis.

English raw scores on all tasks													
ID	CLTNP	CLTNC	CLTVP	CLTVC	CLTExp	CLTRec	SR task	RS	WPC	NFP	SyPM	EFC %	TVC %
1	29	31	27	29	56	60	25	1.7	5.53	0	160	100	100
2	26	30	20	28	46	58	21	2.27	6.12	1.29	79	88	100
3	26	30	19	25	45	55	23	1.67	6.87	3.58	109.25	86.67	95
4	27	31	22	29	49	60	18	1.22	7.18	2.35	97.6	100	100
5	29	31	27	30	56	61	21	1.67	5.36	0	127.9	92	100
6	29	31	26	30	55	61	25	1.88	5.53	0	84.34	95	94
7	28	31	22	29	50	60	19	1.81	6.35	7.88	126.09	100	100
8	20	31	12	25	32	56	1	1.67	6.4	0	69	40	81.81
9	25	31	25	29	50	60	13	2	5.86	0	123.29	81.81	95.8
10	23	30	21	29	44	59	23	2.25	5.22	0	133.47	83.33	85.71
11	26	31	23	30	49	61	29	2.09	6.78	0.67	128.27	95.6	100
12	32	31	23	29	55	60	15	1.2	6.16	2.46	98.63	94.44	100
13	26	31	14	27	40	58	11	1.5	4.86	1.39	114.42	80	86.67
14	30	31	24	30	54	61	25	2.5	6.08	12	121.33	92	100
15	29	31	26	30	55	61	25	2.5	5.92	1	172	100	100
16	32	31	27	31	59	62	27	3	5.88	0	148.23	100	100
17	26	31	19	30	45	61	23	2.5	5.95	0	139	85	95.83
18	26	31	18	28	44	59	20	2	7.21	0.71	80.71	92.8	93.75
19	16	25	10	14	26	39	0	1.75	5.14	7	81.00	35.57	100
20	23	28	17	23	40	51	9	1.875	6.67	1.75	69.9	86.67	94.12
21	24	28	21	30	45	58	8	1.8	6.67	4	132	90	86.9
22	29	31	25	28	54	59	20	2.00	7.14	0	151.91	100	100
23	32	31	21	28	53	59	23	2.28	6.25	1.09	120	87.5	93.3
24	29	31	26	28	55	59	26	2.38	6.16	2	132	78.94	100
25	31	31	28	31	59	62	27	2	5.82	0	106.78	100	100
26	31	31	25	29	56	60	23	1.9	6.71	0.67	115.33	90.47	96
27	31	31	27	31	58	62	28	2.67	5.92	0.76	126.07	83.3	100
28	25	31	26	28	51	59	22	2	5.38	2.3	114.23	100	100
29	31	31	26	29	57	60	21	2.09	6.17	0	169.28	86.96	96.15
30	32	31	25	30	57	61	27	2.44	5.59	1.05	163.16	100	100
31	25	31	21	27	46	58	29	2.75	6.09	0	135.43	100	100
32	25	29	23	28	48	57	17	1.92	5.87	0	143.82	86.95	92.59
33	32	31	28	28	60	59	25	2	5.22	2.45	128.57	100	100
34	30	31	23	31	53	62	28	2.8	5.64	0	143.25	92.85	96.77
35	25	30	19	30	44	60	17	2.33	5.71	0.63	85	90.47	95.65
36	32	31	27	30	59	61	22	1.45	6.13	0	138.75	93.75	100
37	30	31	21	28	51	59	13	2.3	5.65	4.29	133.71	91.3	96
Mean	27.62	30.51	22.54	28.35	50.16	58.86	20.24	2.06	6.02	1.66	121.70	89.23	96.65
−1.5 SD	22.1 (22)	28.68 (29)	15.96 (16)	24.33 (24)	38.75 (39)	52.87 (53)	9.34 (9)	1.37	5.15	5.53*	80.63	61.55	89.52
−2 SD	20.26 (20)	26.85 (27)	13.76 (14)	22.39 (22)	34.94 (35)	50.88 (51)	5.7 (6)	1.15	4.86	6.82*	66.94	68.17	87.15
SD	3.68	1.22	4.39	2.98	7.61	3.99	7.27	0.43	0.58	2.58	27.38	14.04	4.75

*For NFP the SD was added as the more filled pauses per minute the more disfluent the child. Numbers in brackets are the decimal scores rounded to the nearest whole numbers, in order to make cut-off values clearer.

The cells which are not highlighted show scores that are within 1.5 SD of the mean of the group. The scores highlighted in orange represent scores which were 1.5 SD below the group mean, while cells highlighted in red represent scores which were 2SD below the group mean.

TABLE 12 Farsi profile analysis.

	Farsi												
ID	CLTNP	CLTNC	CLTVP	CLTVC	CLTExp	CLTRec	SR task	RS	WPC	NFP	SyPM	EFC	TVC
1	26	32	17	28	43	60	24	1.5	4.71	2.86	154.3	100	100
2	20	28	19	30	39	58	19	2.25	5.15	6.04	92.62	67	82.14
3	19	32	14	30	33	62	27	1.78	5.25	10.11	99.1	62.50	87.5
4	13	27	8	27	21	54	4	2.13	3.06	5.55	94.44	52.90	61.50
5	26	31	21	27	47	58	24	2.36	4.07	0	156.36	100	100
6	28	31	20	25	48	56	13	2.2	3.95	0.44	43.43	77.30	91.30
7	17	32	18	27	35	59	9	4	4.08	11.68	82.83	83.33	88.46
8	27	32	21	26	48	58	23	1.46	4.95	0.6	105.45	94.73	100
9	29	31	20	30	49	61	25	2.09	5.82	1.84	137.14	69.56	93.75
10	20	31	16	31	36	62	24	2.22	4.35	0	126.23	95.00	100
11	19	32	18	28	37	60	29	2.09	4.82	0	129.33	73.90	86.20
12	19	27	14	25	33	52	9	1.67	3.5	6.96	63.21	75.00	95
13	26	31	19	30	45	61	21	2	3.7	1.5	201	95.00	100
14	27	32	22	30	49	62	19	1.9	5.52	4.39	147.07	90.47	100
15	24	32	25	30	49	62	28	1.8	4.44	0	146	94.44	100
16	20	32	17	31	37	63	23	2.54	4.86	2.9	105.48	71.43	84.38
17	30	32	26	29	56	61	26	2.11	4.32	1	147	100.00	100
18	30	31	18	28	48	59	25	3.57	4.56	4.15	85.38	73.00	96.29
19	29	31	24	29	53	60	19	2.63	4.14	5.52	108.95	61.90	92
20	29	32	27	29	56	61	24	2.1	5.48	3.83	128.94	76.19	85.71
21	28	32	25	31	53	63	21	2.46	3.06	4.28	146.57	81.25	93.75
22	29	32	24	29	53	61	20	2.16	5.07	0.77	146.34	100	100
23	9	31	14	28	23	59	15	1.5	4.08	4.28	72.86	83.30	91.67
24	27	32	25	30	52	62	29	3.43	4.54	5	178	95.83	100
25	7	26	7	29	14	55	13	2.42	3.41	0	120.33	35.29	58.82
26	18	30	21	29	39	59	11	1.36	4.8	6.67	94.17	100.00	100
27	22	31	20	28	42	59	26	2.84	4.46	2.38	147.62	75.60	89.59
28	20	32	17	28	37	60	24	2.11	3.52	12	112	94.70	94.40
29	29	32	25	30	54	62	27	2.38	4.58	0	158	94.70	95.23
30	28	31	26	29	54	60	29	2.8	4.68	1.5	163.5	82.14	97.00
31	23	31	21	26	44	57	24	2.8	3.64	0	143.25	82.14	100
32	29	31	24	30	53	61	23	1.83	4.81	7.5	125.25	81.81	100
33	10	20	6	25	16	45	3	1	4.86	9.13	63.91	28.57	42.85
34	22	32	20	30	42	62	25	2.06	5.19	1	130.5	100.00	100
35	9	25	9	28	18	53	6	2.15	4.93	3.47	71.37	53.50	79.30
36	6	24	7	28	13	52	4	1.22	4.36	1.54	32.82	55.56	90.90
37	17	29	16	28	33	57	18	2.18	3.2	10.59	137.65	85.71	89.47
Mean	21.92	30.27	18.67	28.54	40.59	58.81	19.81	2.19	4.41	3.77	118.61	79.56	91.00
−1.5 SD	11.28 (11)	26.15 (26)	10.12 (10)	26.02 (26)	21.92 (22)	53.14 (53)	8.29 (8)	1.28	3.35	9.13	62.06	52.25	71.94
−2 SD	7.74 (8)	24.77 (25)	7.17 (7)	25.18 (25)	15.70 (16)	51.25 (51)	4.45 (4)	0.97	3.00	10.71	43.21	43.14	65.58
SD	7.09	2.75	5.75	1.68	12.45	3.78	7.68	0.61	0.71	3.57	37.70	18.21	12.71

*For NFP the SD was added as the more filled pauses per minute the more disfluent the child. Numbers in brackets are the decimal scores rounded to the nearest whole numbers, in order to make cut-off values clearer.

The cells which are not highlighted show scores that are within 1.5 SD of the mean of the group. The scores highlighted in orange represent scores which were 1.5 SD below the group mean, while cells highlighted in red represent scores which were 2SD below the group mean.

relationship between vocabulary and grammar in the same group of children is far less common with only a few studies noted to date (Jia et al., 2002; Bohman et al., 2010; Chondrogianni and Marinis, 2011; Thordardottir and Brandeker, 2013; Meir and Novogrodsky, 2020). These studies all showed that vocabulary and morphosyntax were correlated within each language, however, results differed on correlations found cross linguistically. The findings of the current study are in line with Thordardottir and Brandeker (2013) and Meir and Novogrodsky (2020), suggesting that vocabulary and grammar are positively and significantly correlated within each language but not across the two languages. It should be noted that, although there are significant correlations between vocabulary and morphosyntax there is also individual variability in the children's performance as shown in the participant's profiles (see Tables 11, 12). The lack of cross linguistic correlations between the English vocabulary scores and the Farsi SR scores or vice versa suggests that vocabulary and morphosyntax develop in each language separately. Therefore, if we want children to develop both languages adequately, it is important to provide sufficient input and exposure to both languages because vocabulary and morphosyntactic skills will not transfer from one language to the other.

The literature has shown that children are required to reach a threshold level of vocabulary to be able to produce appropriate story narratives (Pearson, 2002; Uccelli and Paez, 2007; Karlsen et al., 2016; Méndez et al., 2018; Hao et al., 2019). The current study reiterates the previous findings that vocabulary correlates with narrative microstructure within each language. However, how vocabulary and microstructure are related in terms of accuracy, fluency, and complexity is unclear from previous research because there are discrepancies between previous studies. For example, Kambanaros et al. (2014), found no correlations between vocabulary and narrative complexity, while Méndez et al. (2018) showed that lexical abilities are highly associated to complexity measures in a bilingual child's languages during narrative retelling tasks. Méndez et al. (2018) also indicated that vocabulary is a strong predictor of narrative skills in the ML but not in the HL. The differences between the results of these studies can be explained in the light of the different narrative tasks and complexity measures they employed. While Méndez et al. (2018) used the *Frog where are you?* narrative retelling task and measured complexity in terms of subordination and length, Kambanaros et al. (2014) used the Bus Story task and other measures of complexity.

Overall, our results suggest that within each language children produce more accurate and fluent narratives when they have higher vocabulary skills. In terms of complexity, although the present study measured complexity using the same method as Méndez et al. (2018), we did not find a correlation between vocabulary and complexity, which is in line with Kambanaros et al. (2014). Methodological differences between the current study and Méndez et al. (2018) can account for the discrepancies found in the results. The methodological differences potentially affecting the results can be summarized in relation to sample size (14 participants in Méndez et al., 2018 vs. 37 in the current study), the narrative task (the *Frog Story* in Méndez et al., 2018 vs. the LITMUS-MAIN in the current study), the average age of the participants (younger in Méndez et al., 2018 than in the current study), and the different language pairs in terms of language distance (Spanish-English in Méndez et al., 2018 vs. Farsi-English in the current study).

In addition to correlations between vocabulary and microstructure, we found that the results of the SR tasks correlated with the microstructure within each language. These findings are in line with the studies by Hesketh (2004), Ellis (2005), Erlam (2006), and Bowles (2011), each of which looked at how language performance on an oral imitation task compared to performance on an oral narrative task. All four studies found that performance on the sentence imitation tasks was highly correlated to the oral narrative tasks. In terms of the measures of accuracy, fluency, and complexity, our participants' scores on the Farsi SR task were significantly correlated to the accuracy and fluency scores on the Farsi LITMUS-MAIN. The correlations were even stronger for the English tasks in that the scores on the English SR task related to the scores on all three aspects of the microstructure (complexity, fluency, and accuracy), although the correlations with the accuracy scores were the strongest. This is similar to Hesketh (2004) who found significant correlations between accuracy scores on the narrative task and scores on the sentence elicitation task.

4.3. Discussion of research question 3: based on the results of each task in both languages, are any of the children at risk for a Developmental Language Disorder?

In order for a bilingual child to be diagnosed as having a DLD, they need to have a score of <2SD below the mean on at least two language measures in both their languages (Kohnert, 2010; Leonard, 2014). Since the children in the present study were tested in both languages across various language domains, we were able to determine if any of the children were at risk for DLD. The prediction was that no child in the sample would be at risk for DLD, as they were reported to be typically developing (TD) and had no previous clinical diagnosis. This hypothesis was confirmed. The analysis showed that no child scored −1.5 or −2 SD below the mean on more than two tasks in both languages. However, interesting patterns emerged indicating that some participants had a greater proficiency in one language vs. their other language due to dominance effects. For example, participants 8, 19, 20, and 21 demonstrated a low proficiency in English, as they had low scores on multiple English tasks. Looking at their demographic data, these children were exposed to English before the age of 4 and had two Farsi speaking Parents. However, participant 19 (age 6;20) arrived in Canada when he was 4;5, although parental reports indicated that he was exposed to English from birth via television and movies and that he attended English classes in Iran before the age of 4. It is possible that his low language scores in English could be the result of limited amount of time residing in an English-speaking society and limited amount of schooling in English. On the other hand, participants 4, 25, 33, 35, and 36 had low proficiency in Farsi, as they were performing −1.5 and/or −2SD below the mean on the majority of the Farsi tasks, while their scores on the English tasks were within 1 SD. These children were all exposed to Farsi from birth and to English before the age of 4. An exception is participant 35 who had some low scores in Farsi. This child had one parent who was not a Farsi speaker suggesting Farsi was not a common home language between the parents. However, the child

spoke Farsi fluently and was able to produce a narrative with appropriate complexity, fluency and accuracy. She was exposed to both English and Farsi from birth and used both languages regularly with friends and family. The results suggested that no child was at risk for DLD, as none of the participants had significant difficulties in both languages.

The findings from this study demonstrate the importance of testing bilingual children in both their languages across various language domains. The results indicate that it is possible to see low language scores in one language but not in the other language. To have a valid and reliable assessment of bilingual children's proficiency, it is necessary to have a sufficiently broad and rich sample of their language performance across their two languages. Using single measures of proficiency in one of their language systems may fail to provide an insight into their linguistic abilities. If appropriate testing is not done in both languages, misdiagnosis of a language impairment may occur. From a clinically practical perspective, it is often not possible to test children in both languages, as clinicians may not have access to the appropriate testing material and/or to speak the HL of the child. To make up for such limitations, therefore, conducting parental questionnaires or interviews to obtain information on the child's language history is extremely important. The information obtained by parents can, to some extent, help clinicians identify the child's language dominance and proficiency and potentially aid in the diagnostic process.

5. Conclusions

5.1. Limitations and future directions

This study provides new insights into the importance of measuring language dominance and proficiency via different language tasks that measure different language domains and demonstrates that the different language domains interact with one another in bilingual children. Future research can build on the current study by exploring other language groups as well as looking at how internal and external factors come into play. Similar studies using the same methodology can be used comparing TD bilingual children to bilingual children with DLD. While there is a breath of studies which compares the language performance of TD bilinguals to either monolinguals or bilinguals with DLD, very few of these studies look at the interactions between all three language domains in addition to the influences of internal and external factors on those domains within the same group of children. Replication studies using different language combinations will allow for greater generalization of the results and would help in terms of diagnostic purposes. However, any future studies need to take into account the limitations set forth by the current study. The first limitation was the small sample size. This study focused on TD children and was attempting to identify information on the language skills of TD Farsi-English bilingual children which could potentially be used for diagnostic purposes. Consequently, having a much larger sample size would have been more favorable. In addition, a larger sample size would be more representative of the population. A second limitation of the study was that in many ways the sample was rather homogenous in that the participants were all from families from middle to upper socio-economic status (SES) in Toronto, both parents of all children attended at least some kind of higher education programs (college or university), and the majority of the children had been exposed to Farsi from birth. A sample with children from both high and low SES as well as children with different ages of onset would be more representative of the variability of the population of Farsi speaking children growing up in Canada.

5.2. Conclusion

Two main conclusions can be drawn from this study. The first is that while the results indicated that overall the participants in this study were English dominant, an in-depth analysis of performance via profile effects demonstrated that some children had greater proficiency in Farsi while others had greater proficiency in English. These findings show that dominance and proficiency are two distinct constructs; it is important to measure language dominance and proficiency via multiple language domains because differences between these domains may emerge. This points to the significance of identifying individual profile effects across the domains. Bilingual children can have low proficiency in both languages but still have one language as more dominant (i.e., be their stronger or preferred language). For HS we know that dominance shifts through the lifespan often with the HL becoming less dominant and the SL becoming more dominant but there is a lot of individual variability between children. Therefore, both dominance and proficiency need to be measured and considered in research and practice across multiple language domains. Secondly, vocabulary is highly correlated with morphosyntax and is also related to the complexity, accuracy and fluency of oral narratives within languages.

Using multiple language measures and profile effects in this study and conducting rigorous analyses of the data have provided a more in-depth understanding of bilingual linguistic abilities in this sample. The present study is novel in that no known study to date had identified language dominance and proficiency in such a broad and in-depth manner. The results also demonstrate the importance of testing bilingual children in both their languages across a number of language domains in order to obtain a more accurate picture of their language skills in the HL and ML. Theoretically, such information enriches the literature by providing further information on the language skills of these types of dual language learners. Detailed and accurate information on the language abilities of a child in both their HL and ML helps reduce the potential for misdiagnoses to occur and ultimately leads to better treatment outcomes.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

This study has been reviewed by The School of Psychology and Clinical Language Sciences Research Ethics Committee, University of Reading and has been given favorable ethical opinion for

conduct (2018-102-TM). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

MK collected and analyzed the data. All authors contributed to the conceptualization, design of this study, and write up of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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