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Speech Disfluencies in Bilingual Lebanese Children Who Do and Do Not Stutter

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ABSTRACT

Purpose: Prior studies have shown that bilingual children who do not stutter (CWNS) exhibit a high number of disfluencies in both languages, increasing the risk of misidentification by speech-language pathologists as children who stutter (CWS). Conversely, there is a risk of misidentifying CWS with a relatively low incidence of disfluencies as CWNS. This study aims to explore the qualitative and quantitative distinctions in speech disfluency profiles between CWNS and CWS. The assessment covers both the dominant and nondominant language to examine the impact of language dominance on disfluency patterns.
Method: A total of 92 Lebanese bilinguals (70 CWNS and 22 CWS) from 4;06 to 7;06 (years;months) were included. Language dominance was determined based on parental assessments. Spontaneous and narrative speech samples were collected for each child in both languages and all stuttering-like disfluencies (SLD) and other disfluencies (OD) were coded.
Results: On average, CWNS showed a significantly lower percentage of total SLD, weighted SLD, SLD subtypes, and iterations compared to CWS. However, the number of disfluencies of CWNS exceeded monolingual clinical standards. Language dominance did not impact SLD and OD percentages, but some differences for SLD subtypes emerged. Binary logistic regression analyses showed that repetitions and dysrhythmic phonations are good predictors for correct CWS or CWNS classification, in contrast to OD. A combination of predictors from both languages led to better classification than using predictors from either language alone.
Conclusions: The current study shows that speech disfluency percentages in bilingual CWNS typically surpass monolingual standards and can be at par with those of CWS. However, through careful consideration of disfluency characteristics, ideally in both languages, an accurate differential diagnosis of stuttering in bilingual children can be achieved.

In recent decades, the number of bilingual speakers around the world has increased rapidly. This expansion has also led to more bilingual children seeking speech therapy. Most importantly, the number of bilingual clients is higher compared to monolinguals, although bilingualism is not considered a risk factor for language development (Kohnert, 2010). Assessment methods that take into account the characteristics of bilingual language development in determining language, speech, or communication disorders are only sparsely available, increasing the likelihood of misdiagnosis (Arkkila et al., 2013). The current study investigates how to reduce this risk in the area of stuttering by assessing the disfluency profiles of both children who stutter (CWS) and children who do not stutter (CWNS) in their dominant and nondominant language. A better understanding of the connection between stuttering and bilingualism can pave the way to the development of improved assessment methods, which will enhance the accuracy of diagnosis and lead to better treatment outcomes (Choo & Smith, 2020).

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In a study conducted by Byrd, Watson, et al. (2015), 14 speech-language pathologists (SLPs) assessed speech samples of a bilingual Spanish–English child who stutters and a child who does not stutter during a narrative retell task. While 71.4% of SLPs correctly identified the stuttering child, 85.7% mistakenly identified the nonstuttering as a stuttering child. SLPs' characteristics like years of experience, caseload, and professional background did not influence diagnostic accuracy. Saad Merouwe et al. (2023a) replicated and extended this study with 32 SLPs assessing Lebanese Arabic narrative speech samples of six bilingual CWNS and two bilingual CWS. Their study revealed frequent misidentifications, particularly with bilingual CWNS (44.8% false positives) compared to CWS (12.5% false negatives), be it that the rate of misidentifying CWNS was lower than in Byrd et al. Misidentification rates were driven by the frequency and types of stuttering-like disfluencies (SLD) identified in the CWNS speech samples. Furthermore, a study by Saad Merouwe et al. (2023b), using the same data set and methodology as their 2023a study, revealed that CWS generally received higher severity ratings for stuttering compared to CWNS. Only one nonstuttering child received similar ratings to both CWS.

Most importantly, both of the aforementioned studies showed that assessing whether bilingual children stutter based on speech disfluencies is difficult. This difficulty may be related to bilingual CWNS typically exhibiting a higher number of speech disfluencies in comparison to their monolingual counterparts. Recent studies have shown that a significant proportion of bilingual CWNS exceeds the criteria used as clinical thresholds of stuttering in monolinguals proposed by Ambrose and Yairi (1999), such as the 3% of SLD (Bakhtiar, 2024; Byrd, Bedore, & Ramos, 2015; Eggers et al., 2019, 2020; Rojas et al., 2023). Byrd, Bedore, and Ramos (2015) studied Hispanic CWNS aged 5–6 years, including Spanish-dominant, English-dominant, and balanced bilinguals. Based on narrative speech samples in both languages, the majority of the children (14/18) showed a high percentage of SLD, ranging from 3% to 22%. The most common SLD identified were monosyllabic word and sound repetitions, while the most common other disfluencies (OD) were revisions and interjections. Eggers et al. (2019) followed up on Byrd et al.'s study with a larger group of bilingual Yiddish–Dutch CWNS ($n = 59$) aged 6–7 and 9–10 years, all of whom were Yiddish dominant. Also here, the majority of participants exhibited a high proportion of SLD, on average above 3% in either language, with mean percentages ranging from 0.6% to 7.7% in the dominant Yiddish language, and from 0.3% to 9.1% in the nondominant Dutch language. Rojas et al. (2023) found similar results investigating speech disfluencies in narrative retell samples of typically developing Spanish–English bilingual children. They utilized a cross-sectional sample of 132 children enrolled in kindergarten through Grade 4. Also here, the mean percentage of SLD in both languages surpassed the risk threshold established for monolinguals, namely, 4.79% in English and 4.61% in Spanish. Also, a recent study by Bakhtiar (2024) involving 19 bilingual Cantonese-English–speaking children reported that between 21% and 68% of children exhibited more than 3% SLD across languages and speaking tasks, with a higher prevalence of SLD in the nondominant English language. In addition to the 3% SLD cutoff threshold, Ambrose and Yairi (1999, p. 904) introduced a weighted SLD measure, in which repetitions get extra weight when iterated more than once and dysrhythmic phonations (blocks, prolongations, and broken words) are counted twice. For this measure, the monolingual cutoff threshold was set at 4%. Eggers et al. (2019) investigated its pertinence on bilinguals and found that 63% of the bilingual children in their study also exceeded this threshold. The results of all these studies with different populations and linguistic dyads converge toward the same conclusion: Monolingual standards for basic and weighted SLD thresholds are not applicable to bilinguals. Additionally, Yairi and Ambrose (2005) proposed a set of seven minimal diagnostic criteria for identifying stuttering in young children who may be borderline cases, supplementing the 3% SLD and 4% weighted SLD thresholds with other criteria, such as 2.5% monosyllabic word repetition, 0.5% dysrhythmic phonation, and an average of 1.5 for repetition units. According to the authors, the stuttering diagnosis can be established if at least three of these criteria meet the specified values.

At any rate, it is evident that bilingual CWNS typically have a higher percentage of disfluencies than monolinguals. This could be attributed to bilinguals typically having a smaller lexicon in each of their languages (when compared to monolinguals), as a result of one language being more frequently used in certain domains, while the other language being more commonly used in other domains (Peña et al., 2016). In case words are known in both languages, they often have been encountered and used less frequently in each language, leading to weaker connections between semantic and phonological information (Gollan et al., 2005), which, in turn, leads to increased retrieval efforts accompanied by disfluencies such as repetitions, interjections, and revisions. In addition, the use of multiple languages or limited proficiency, especially in the nondominant language, may overload the language processing system of bilinguals, leading to disfluencies in speech (Carias & Ingram, 2006). It also has been suggested that an increased number of repetitions and other disruptions are needed to plan or monitor bilinguals' own speech output, particularly when expressing complex ideas involving spatial, temporal, or causal relationships (Fiestas et al., 2005; Loban, 1976).

Aims of the Current Study

The current study starts out to investigate whether a high prevalence of SLD is also discernible for bilingual CWNS growing up in a highly multilingual society like Lebanon. The prevailing language spoken in Lebanon is Lebanese Arabic, but both English and French are very common in private and public use. The multilingual diversity is also apparent in the educational system, where French, English, and standard Arabic are the languages of instruction (Thonhauser, 2000).

The study also investigates whether the number of SLD differs as a function of language dominance. Dominance refers to the relative strength of one's proficiency in each language, as well as the frequency and usage of those languages (Treffers-Daller, 2019). Although the number of studies is limited, we currently have more evidence that adults (Ardila et al., 2011; Gkalitsiou & Werle, 2023; Lim et al., 2008) and children (Bakhtiar, 2024; Eggers et al., 2019; Lim et al., 2008) who do and do not stutter exhibit more disfluencies in their nondominant language. Schäfer and Robb (2012) explained that a nondominant language implies a less developed language system, and Lee et al. (2014) suggested that using a language in which one has limited proficiency imposes greater cognitive and linguistic demands on the speech motor system, leading to more disfluencies. It may also be that the gap between the less and more dominant language is bigger in some studies than in others, yielding different SLD patterns for each language across studies. In the current study, all children have a clear dominant language, but at the same time strong skills in the nondominant one. In line with most previous studies, we expect a larger number of disfluencies in the nondominant language for both CWS and CWNS.

Finally, an important aspect of the study is to investigate how bilingual CWNS can be distinguished from CWS on the basis of their disfluency profiles. Previous research has shown that there exists overlap between CWS and CWNS in terms of frequency and type of SLD and OD (Byrd, Bedore, & Ramos, 2015; Eggers et al., 2019; Rojas et al., 2023; Saad Merouwe et al., 2019). This overlap may pose a dilemma in clinical decision making, as SLPs may misidentify a bilingual CWNS displaying a relatively large number of disfluencies as a CWS or a bilingual CWS with a relatively low number of disfluencies as a CWNS (Byrd, Watson, et al., 2015; Saad Merouwe et al., 2023a, 2023b). From a clinical perspective, it is important to determine whether an accurate assessment can rely solely on the dominant language, solely on the nondominant language, or whether the most accurate assessment can be achieved by considering disfluencies from both languages. This knowledge is particularly significant as SLPs may only be proficient in one of the languages spoken by bilingual clients. In certain immigrant situations, for example, the bilingual's dominant language may not align with the community language, and the SLP may lack proficiency in the client's dominant language. Given this context, our study explores the disfluency characteristics that play a crucial role in achieving the most precise assessment in each of these situations. Our approach involves assessing to what extent specific types of disfluencies are predictive in accurately classifying bilingual children as CWS or CWNS. As SLD predictors, we differentiate between repetitions, including monosyllabic word, sound, and syllable repetitions, and dysrhythmic phonation (i.e., blocks, prolongations, and broken words).

To summarize, the current study aims to examine and compare speech disfluency profiles of bilingual CWS and CWNS and to investigate the influence of language dominance on the manifestation of disfluencies. The major goal is to provide additional insights that help to identify stuttering in bilingual children based on the disfluency patterns. The specific research questions and hypotheses are the following:

1. Do bilingual CWNS exceed the clinical thresholds for monolingual CWS, such as the 3% SLD and 4% weighted SLD score? Our hypothesis is that, on average, they will exceed these thresholds.
2. Do bilingual CWNS and CWS differ in the frequency and type of disfluencies? Our hypothesis is that, on average, CWS will have more SLD than CWNS but that there will be some overlap in the SLD distribution of the two populations.
3. Does language dominance influence the manifestations of disfluencies in bilingual CWNS and CWS? Our hypothesis is that bilinguals will exhibit more disfluencies in the nondominant language compared to the dominant one.
4. Which speech disfluencies are predictive in classifying bilinguals as CWNS or CWS? We predict that the proportion of dysrhythmic phonation and the number of repetitions will be effective predictors for correct classification, in contrast to OD. We expect this pattern to hold in both the dominant and nondominant languages; we do not have a specific hypothesis as to whether the predictors are equally effective in each language, but we do anticipate that considering predictors from both languages leads to better classification than considering predictors of one language only.

Method

Participants

Participants were 92 bilingual Lebanese Arabic-French– or Lebanese Arabic-English–speaking children between 4.06 and 7.06 years of age, out of which 70 were CWNS and 22 were CWS. CWNS were recruited via an open call sent to mainstream Lebanese schools, and CWS were recruited through e-mails sent to all SLPs working in Lebanon. The study was approved by the ethics committee of Saint Joseph University of Beirut (CEHDF 1272). All parents of the participating children signed an informed consent.

The group of 70 CWNS (38 boys and 32 girls) included 49 children who spoke Lebanese Arabic–French and 21 who spoke Lebanese Arabic–English. From this group, 47 were Lebanese Arabic dominant, 16 were French dominant, and seven were English dominant. Their age was between 4.09 and 7.00 years (M = 5.97, SD = 0.58). Inclusion criteria were (a) speaking two languages of which one was Lebanese Arabic and (b) age-appropriate speech-language skills based on the Parents of Bilingual Children Questionnaire (PaBiQ; Tuller, 2015) and the teacher's and/or school SLP's report. Exclusion criteria were (a) parental and/or teacher concern regarding stuttering; (b) family history of stuttering; (c) history of stuttering therapy; and (d) reported intellectual, neurological, and/or learning disorders. The speech fluency evaluation was conducted by the first author, who is a multilingual stutter specialist with extensive experience in diagnosing and treating stuttering in bilingual children, and a native speaker of Lebanese Arabic, French, and English. The evaluation involved analyzing four audiovisual speech samples of each child, two in their dominant language and two in their nondominant language. The first author ensured that all disfluencies were displayed without tension and/or arrhythmicity, subsequently judging the samples as representative of typically developing children.

The group of 22 CWS (15 boys and seven girls) included 10 children who spoke Lebanese Arabic–French and 12 who spoke Lebanese Arabic–English, of which 19 were Lebanese Arabic dominant, two were French dominant, and one was English dominant. Their age was between 4.06 and 7.02 years (M = 5.73, SD = 0.67). Inclusion criteria were (a) speaking two languages of which one was Lebanese Arabic; (b) age-appropriate speech-language skills based on the PaBiQ and the treating SLP's evaluation; (c) diagnosed with stuttering by the treating SLP following a comprehensive assessment, including the affective, cognitive, behavioral, linguistic, and motor components; (d) regarded by the parents as having a stutter; (e) stuttering severity rated by parents as 2 or higher on an 8-point scale (0 = *no stutter*, 1 = *borderline*, 2 = *mild*, 3 = *mild to moderate*, 4 = *moderate*, 5 = *moderate to severe*, 6 = *severe*, 7 = *extremely severe*). Children with reported intellectual, neurological, and/or learning disorders were excluded. The diagnosis of stuttering for all CWS was confirmed by the first author based on (a) the four available speech samples and (b) a 20-min phone call with the parents to collect information about the history of stuttering (i.e., time since onset, development of the manifestations), the current symptoms, the child's reactionary attitudes, and the parental concerns. The first author completed the Stuttering Severity Instrument–Fourth Edition (SSI-4; Riley, 2009) based on the four speech samples (two in each language). The SSI-4 form was completed for each language separately, and the severity classification was determined by calculating the average of scores in both languages. One child was rated as mild, 11 were rated as moderate, five were rated as severe, and five were rated as very severe.

In summary, we have participants who speak Lebanese Arabic and French (n = 59) and Lebanese Arabic and English (n = 33). For the majority, the participants were dominant in Lebanese Arabic (n = 66), while others were dominant in French (n = 18) or English (n = 8). As we wanted to test the impact of language dominance on speech disfluencies, we determined the dominant and nondominant language for each participant. This implies that both the dominant and the nondominant language can be either of the three languages, be it that the dominant language is most often Lebanese Arabic and the nondominant one most often English or French. This constellation accurately reflects the multilingual reality in Lebanon. Thus, in the analysis regarding language dominance, each of the 70 CWNS and 22 CWS was assigned a dominant and a nondominant language.

Materials

Language Dominance

The bilingual profile of CWNS and CWS was established based on the PaBiQ (Tuller, 2015) during a 20-min phone call with the first author. The PaBiQ is a standardized tool that consists of 27 questions related to the child's language development (four questions), the language input and output in different situations before and after the age of 4 years (three questions), the current language skills in each spoken language (five questions), the current use of language in different situations (six questions), and the family's language history (nine questions). Based on the parents' answers, a language disorder risk index (no risk index), language proficiency score (per language), and language dominance score (linguistic richness index) are computed. The no risk index is based on factors that suggest the presence/absence of a language disorder, such as age of early lexical and syntactic acquisition, parental concern, and the presence of language difficulties in the family. A score between 19 and 23 is considered as an indication of typical speech-language development, while a score below 15 is an indication of atypical language development. The language proficiency score is based on parental ratings assessing children's current language skills in both the dominant and nondominant language, in comparison to monolingual peers. The linguistic richness index is calculated based on the parents' description of the frequency of use of each language and the quantity and quality of early exposure to each language; its maximal score is 50. The PaBiQ is widely used and was validated for the Lebanese population. Previous studies (Hallal et al., 2016) showed that the no risk index was highly predictive of a language disorder (U = 5, p < .001) and correlated positively with standardized measures of language production and comprehension (p < .001). The no risk index, language proficiency scores, and linguistic richness index of the PaBiQ for both CWNS and CWS are listed in the Appendix.

Speech Samples Collection

The first author, along with 11 trained undergraduate speech-language pathology students, collected the speech samples. The data collection was completed in a quiet room, at the child's school or home for CWNS and at the treating SLP's clinic for CWS. A spontaneous conversation and a narrative based on a picture book were video-recorded in the dominant and nondominant language, resulting in four speech samples per child. Each speech sample contained a minimum of 100 words. To provide a monolingual setting and minimize code switching as much as possible, two interviewers were involved in every data collection, one per language. In case the child used code switching, the interviewer continued stimulating the child in the language in which he was required to express himself. To collect the narrative samples, two wordless picture books, *Frog Goes to Dinner* (Mayer, 1974) and *Frog on His Own* (Mayer, 1973), were used, one per language. The interviewer presented the book to the child, who was then instructed to silently review each page in order to understand the storyline. Following this, the child was asked to tell the story while examining the pictures of the book, progressing page by page. To collect the spontaneous speech samples, standardized, open-ended questions were used (e.g., describe a day well spent with your family). To prevent methodological bias, counterbalancing was applied at three different levels: (a) For the picture books, the use of Lebanese Arabic versus French, or Lebanese Arabic versus English, was balanced across participants. (b) Half of the participants started with the spontaneous speech and the other half with the story telling. (c) Half of the participants started with their dominant language and the other half with their nondominant one.

The average number of words produced by CWNS was 580 words (SD = 258) in their dominant language and 557 words (SD = 193) in their nondominant language. For CWS, the average number of words produced was 584 words (SD = 215) in their dominant language and 611 words (SD = 252) in their nondominant language. A two-way analysis of variance (ANOVA) with participant group (CWS vs. CWNS) as between variable and language (dominant vs. nondominant) as within variable showed neither a statistically significant difference for language, $F(1, 90) = 0.006$, $p = .94$, $\eta_p^2 = .000$, nor for group, $F(1, 90) = 0.358$, $p = .55$, $\eta_p^2 = .004$. Also, the interaction between language and participant group was not significant, $F(1, 90) = 0.737$, $p = .39$, $\eta_p^2 = .008$. In other words, the number of disfluencies could not be ascribed to longer stretches of speech in one of the conditions.

Transcription and Disfluency Coding

The speech samples were orthographically transcribed in French, English, and Romanized Arabic. Disfluencies were identified and coded using a similar method to that of Byrd, Bedore, and Ramos (2015) and Ambrose and Yairi (1999). Disfluencies were categorized as SLD (i.e., monosyllabic word repetitions; part-word repetitions including syllable and sound repetitions; and dysrhythmic phonations including blocks, broken words, and prolongations) or OD (i.e., multisyllable word repetitions, phrase repetitions, interjections, unfinished words/sentences, and revisions). In line with Bedore et al. (2006), revisions were further specified as lexical, grammatical, or phonological.

Eleven undergraduate speech-language pathology students were trained by the first author in transcribing, identifying, and coding disfluencies. After the training, the speech-language pathology students independently transcribed and coded three speech samples. The disfluency codes were compared among the coders, and any disparities were addressed before progressing to the analysis of the complete data set. Interjudge reliability (.82) was then calculated, considering the average agreement index percentage between the first author's analysis and the students' analysis for 10% of the data set. This calculation incorporated point-by-point agreement for location and type, following the methodologies of Ambrose and Yairi (1999) and Suen and Ary (1989).

Mean SLD and OD frequencies were calculated using a word-based metric to allow for a comparison with the frequencies reported in previous bilingual and monolingual stuttering studies (e.g., Boey et al., 2007; Byrd, Bedore, & Ramos, 2015; Byrd, Watson, et al., 2015; Eggers et al., 2019, 2020; Leclercq et al., 2017; Pellowski

& Conture, 2002; Tumanova et al., 2014). The total number of words per speech sample was counted to calculate the frequency of disfluencies. Similar to Ambrose and Yairi (1999), isolated affirmatives or negatives and unintelligible utterances were not included in the counts and also repeated words and phrases were not counted, but words in revised phrases were. To determine the SLD percentages, the calculation involved summing up the SLD percentage in narratives and the SLD percentage in spontaneous speech for each language. These sums were then divided by the total number of words across both speech samples. The calculation of OD percentages was conducted in a similar manner. The mean number of iterations was calculated for all SLD repetitions, including monosyllabic word, syllable, and sound repetitions (cf. Pellowski & Conture, 2002). One iteration was defined as one extra production of a unit (e.g., there is one iteration in *b-ball* and three iterations in *b-b-b-ball*). In addition, the weighted SLD (Ambrose & Yairi, 1999) was computed by multiplying the average number of iterations by the sum of part-word and monosyllabic word repetitions per 100 words and adding the result to two times the number of dysrhythmic phonations. Disfluencies in both CWS and CWNS were additionally evaluated for rhythmicity and tension (Guitar, 2013). When an atypical rhythmic pattern was observed in the iterations (i.e., difference in the duration of the intervals, rapid bursts of the iterations within the repetition set), when abnormal tension was observed (e.g., facial grimaces), or when a change was noticed in the vocal pitch (indicative of tension), physical concomitants were scored following the SSI-4 classification (Riley, 2009). There were no arrhythmic iterations heard, no tension observed, and no change in the vocal pitch for any of the CWNS.

Statistical Analyses

The collected data were analyzed with the statistical software SPSS (Version 29). No systematic effects of elicitation mode (spontaneous vs. picture book) or elicitation mode by group on the manifestation of disfluencies were found, so we merged both types of speech samples. First, a one-sample *t* test was employed to assess the performance of bilingual CWNS against monolingual clinical thresholds. Subsequently, a series of two-way ANOVAs was conducted with SLD, weighted SLD, and all subtypes of SLD, as well as OD and average number of iterations as dependent variables, while language dominance was entered as an independent within variable and participant group as an independent between variable. Finally, we utilized binary logistic regressions to identify which disfluency variables were most predictive in classifying bilingual children as CWS or CWNS. First, we examined the dominant language's variables and nondominant language's variables separately, followed by an analysis in which variables of both languages were included. Given the relatively small number of participants, we decided to reduce the number of variables by combining all repetition measures (monosyllabic word, sound, and syllable) into a single variable for both the dominant (Rep_Dom) and the nondominant language (Rep_NDom). For example, if a participant had one repetition of a monosyllabic word (e.g., *car-car*), one sound repetition within a word (*p-pet*), and one syllable repetitions within a word (*ta-table*), the total number of repetitions was three. Additionally, we combined all dysrhythmic phonation measures (blocks, prolongations, and broken words) into a single variable for both the dominant (Dys_Dom) and the nondominant (Dys_NDom). Another variable considered was the average number of OD (OD_Dom, OD_NDom) in both languages, as previous studies have indicated that this variable may differentiate CWS from CWNS (e.g., Tumanova et al., 2014). There was a moderate level of correlation between the predictor variables (Spearman correlations of < .50 within language and < .63 across language, the highest correlation being .627 between Rep_Dom and Rep_NDom).

The models were constructed using the forward stepwise method, beginning with models that included the constant only (Step 0) and adding one variable at a time with a maximum of three explanatory variables to avoid overfitting (Steps 1–3a). The order of adding variables was kept consistent for both languages, starting with repetitions, followed by dysrhythmic phonations, and concluding with OD (note that altering the order produced identical results). In addition, models where predictors from both languages were entered were also considered (presented in Step 3b). To assess whether adding a new predictor improved diagnostic accuracy, likelihood ratio tests and associated χ^2 values were employed to determine if a simpler model differed significantly from a model with an additional predictor. The odds ratios (*OR*s) provided estimates of how much the probability of belonging to a particular group (CWS or CWNS) changed when a predictor's value increased by one unit.

Results

Suitability of Monolingual Clinical Thresholds in Bilinguals

Table 1 provides an overview of our participants' performance in the dominant and nondominant languages on the commonly used clinical measurements

Table 1. Percentage of stuttering-like disfluencies (SLD), part-word repetitions, monosyllabic word repetitions (MonoWR), dysrhythmic phonations, other disfluencies (OD), weighted stuttering-like disfluencies, and mean number of iterations, in the dominant and nondominant language, for children who stutter (CWS) and children who do not stutter (CWNS).

Clinical measurements	Participant group	Dominant		Nondominant	
		M (*SD*)	% > threshold	*M* (*SD*)	% > threshold
% SLD	CWNS	3.78 (2.16)	55.57	3.88 (2.15)	64.28
	CWS	13.21 (8.8)	100	12.59 (8.41)	95.45
% part-word repetitions	CWNS	0.89 (0.69)	14.28	0.81 (0.85)	14.28
	CWS	4.08 (4.02)	81.81	2.42 (2.55)	45.45
% MonoWR	CWNS	1.76 (1.46)	24.28	2.20 (1.53)	37.14
	CWS	4.46 (3.33)	54.54	5.82 (4.67)	77.27
% dysrhythmic phonations	CWNS	1.14 (1.12)	70	0.89 (0.84)	58.57
	CWS	4.92 (6.66)	90.90	4.37 (6.39)	90.90
% OD	CWNS	5.38 (2.35)	25.11	6.22 (3.53)	12.8
	CWS	6.91 (4.15)	27.27	7.11 (3.27)	40.9
Weighted SLD	CWNS	5.37 (3.38)	57.14	5.41 (3.21)	61.42
	CWS	23.30 (16.57)	100	22.26 (16.79)	100
Mean *n* Iterations	CWNS	1.11 (0.13)	0	1.15 (0.17)	7.1
	CWS	1.47 (0.33)	36.36	1.48 (0.42)	31.81
Mean *n* MonoWR Iterations	CWNS	1.13 (0.18)		1.17 (0.2)	
	CWS	1.48 (0.36)		1.51 (0.48)	
Mean *n* SndR Iterations	CWNS	1.02 (0.17)		1.07 (0.23)	
	CWS	1.44 (0.51)		1.34 (0.65)	
Mean *n* SylR Iterations	CWNS	1.01 (0.24)		1.07 (0.15)	
	CWS	1.41 (0.33)		1.33 (0.74)	

Note. SndR = sound repetitions; SylR = syllable repetitions.

established for monolingual speakers. At a group level, CWNS significantly surpassed the 3% clinical threshold for SLD, both in the dominant language, $t(69) = 3.01$, $p = .002$; $d = 0.361$, and in the nondominant one, $t(69) = 3.45$, $p < .001$; $d = 0.413$. At an individual level, 55.6% of CWNS exceeded the threshold in their dominant language, and 64.3% exceeded the threshold in their nondominant language. Likewise, the CWNS group did significantly surpass the cutoff score of 4% for the weighted SLD, both in their dominant language, $t(69) = 5.47$, $p < .001$; $d = 0.654$, and nondominant language, $t(69) = 5.96$, $p < .001$; $d = 0.713$, with 58.6% of CWNS exceeding this threshold in the dominant language and 64.3% in the nondominant one. We also evaluated the applicability of Yairi and Ambrose's (2005) proposed set of seven diagnostic criteria, namely, exceeding (a) 1.5% part-word repetitions, (b) 2.5% monosyllabic word repetitions, (c) 0.5% dysrhythmic phonations, (d) 3% total SLD, (e) 4% weighted SLD, (f) an average of 1.5 mean repetition units, and (g) 2% (part-word + monosyllabic word repetition) with two or more extra units. Applying these criteria to the results of each participant in the CWNS group showed that 57.14% (in the dominant language) and 55.71% (in the nondominant language) of our bilingual CWNS either met or exceeded at least three of these values. Note that these calculations were established on word-based metrics; syllable-based metrics would reduce the percentage of bilingual CWNS exceeding three of these criteria to 27.17% (in the dominant language) and 38.57% (in the nondominant language), percentages that are still notably high.

Effect of Participant Group and Language Dominance on SLD Percentages

Table 2 displays the percentages of all disfluency types for both groups in both languages, including the proportional distribution. The two-way ANOVA showed that CWS exhibited a higher SLD percentage compared to CWNS, leading to a significant main effect for participant group with a large effect size, $F(1, 89) = 66.77$, $p < .001$, $\eta_p^2 = .429$. In addition, the weighted SLD percentage and the percentage of each of the six subtypes (blocks, prolongations, and broken words as well as monosyllabic word, sound, and syllable repetitions) was significantly higher for CWS than for CWNS (all ps < .01, all $\eta_p^2 > .12$).

In contrast, there was neither an effect of language dominance, $F(1, 89) = 0.003$, $p = .953$, $\eta_p^2 = .000$, nor an

Table 2. Percentage of stuttering-like disfluencies (SLD) and other disfluencies (OD) in the dominant and nondominant language for both groups.

Type	Participant group	Dominant		Nondominant	
		M (*SD*)	Proportion	*M* (*SD*)	Proportion
Total SLD	CWNS	3.78 (2.16)		3.88 (2.15)	
	CWS	13.21 (8.8)		12.59 (8.41)	
Monosyllabic word repetition	CWNS	1.76 (1.4)	44%	2.2 (1.53)	57%
	CWS	4.46 (3.33)	30%	5.82 (4.67)	46%
Sound repetition	CWNS	0.48 (0.39)	12%	0.47 (0.47)	12%
	CWS	1.94 (2.16)	13%	1.46 (1.36)	12%
Syllable repetition	CWNS	0.41 (0.44)	10%	0.34 (0.56)	9%
	CWS	2.14 (2.19)	15%	0.96 (1.55)	8%
Prolongation	CWNS	0.97 (0.11)	24%	0.65 (0.77)	17%
	CWS	4.37 (0.93)	30%	2.83 (3.86)	22%
Block	CWNS	0.05 (0.10)	1%	0.05 (1.14)	1%
	CWS	0.66 (1.37)	5%	0.86 (2.33)	7%
Broken word	CWNS	0.35 (0.44)	9%	0.18 (0.23)	5%
	CWS	1.06 (1.75)	7%	0.67 (1.44)	5%
Total OD	CWNS	5.38 (2.35)		6.16 (3.53)	
	CWS	6.91 (4.15)		7.23 (3.27)	
Multisyllable word repetition	CWNS	0.39 (0.62)	7%	0.36 (0.45)	6%
	CWS	1.05 (1.16)	15%	0.39 (0.47)	5%
Interjection	CWNS	2.13 (1.71)	40%	2.24 (2.21)	36%
	CWS	3.13 (4.05)	45%	3.2 (3.41)	44%
Phrase repetition	CWNS	0.73 (0.79)	14%	1.05 (0.99)	17%
	CWS	1.1 (0.60)	16%	1.6 (1.23)	22%
Lexical revision	CWNS	0.25 (0.26)	5%	0.26 (0.41)	4%
	CWS	0.1 (0.15)	1%	0.11 (0.15)	2%
Grammatical revision	CWNS	0.46 (0.41)	9%	0.59 (0.58)	10%
	CWS	0.13 (0.14)	2%	0.34 (0.45)	5%
Phonological revision	CWNS	0.06 (0.12)	1%	0.06 (0.12)	1%
	CWS	0.04 (0.08)	1%	0.1 (0.27)	1%
Unfinished word/ sentence	CWNS	1.36 (0.87)	25%	1.6 (1.0)	26%
	CWS	1.36 (0.65)	20%	1.49 (0.83)	21%

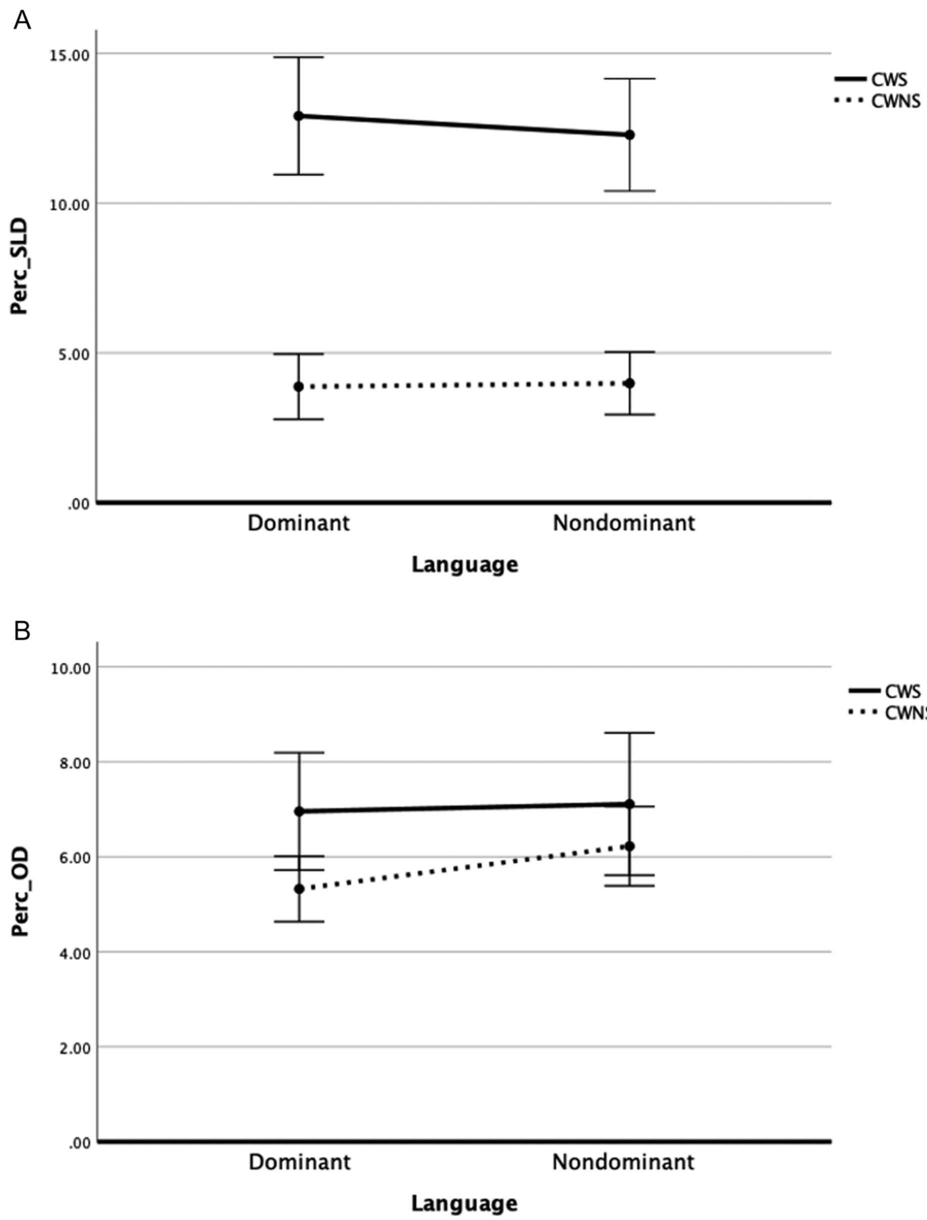
Note. CWNS = children who do not stutter; CWS = children who stutter.

interaction between language dominance and participant group for overall SLD, $F(1, 89) = 1.25$, $p = .265$, $\eta_p^2 = .014$; in both cases the effect size was small (see Figure 1a). Similarly, there was neither an effect of language dominance, $F(1, 89) = 0.756$, $p = .387$, $\eta_p^2 = .008$, nor an interaction between language dominance and participant group for weighted SLD, $F(1, 89) = 0.890$, $p = .348$, $\eta_p^2 = .010$; in both cases, the effect size was small. When considering the SLD subtypes, no language dominance effect was found for prolongations, $F(1, 89) = 1.31$, $p = .254$, $\eta_p^2 = .014$, and blocks, $F(1, 89) = 2.38$, $p = .126$, $\eta_p^2 = .026$. For the other subtypes, there was a language dominance effect. More monosyllabic word repetitions were made in the nondominant language than in the dominant one, $F(1, 89) = 12.04$, $p < .001$, $\eta_p^2 = .118$, whereas this was reversed for sound repetitions, $F(1, 89) = 4.22$, $p = .043$, $\eta_p^2 = .045$; syllable repetitions, $F(1, 89) = 21.38$, $p < .001$, $\eta_p^2 = .192$; and for broken words, $F(1, 89) = 6.31$, $p = .014$, $\eta_p^2 = .066$. The interaction between participant group and language dominance was only significant for syllable repetitions with no difference between the languages for CWNS, but more syllable repetitions in the dominant language than the nondominant one for CWS, $F(1, 89) = 17.26$, $p < .001$, $\eta_p^2 = .161$. For all the other subtypes, the interactions failed to reach significance (all *p*s > .05).

Effect of Participant Group and Language Dominance on OD Percentage

For overall OD percentage, there was neither an effect for participant group, $F(1, 89) = 3.30$, $p = .072$, $\eta_p^2 = .036$, nor for language dominance, $F(1, 89) = 0.904$,

Figure 1. (A) Effect of language dominance on the percentage of stuttering-like disfluencies (SLD) in children who stutter (CWS) and children who do not stutter (CWNS). The error bars denote the 95% confidence intervals. (B) Effect of language dominance on the percentage of other disfluencies (OD) in CWS and CWNS. The error bars denote the 95% confidence intervals.



p = .344, η_p^2 = .010, nor for the interaction between language dominance and participant group, $F(1, 89) = 1.25$, p = .265, η_p^2 = .014 (see Figure 1b). When examining the OD subtypes, an effect emerged for the interaction between language dominance and participant group for multisyllable word repetitions, $F(1, 89) = 3.09$, p = .001, η_p^2 = .343. This indicated a significant difference between both groups in the dominant language for multisyllable word repetitions, $F(1, 90) = 11.97$, $p < .001$, η_p^2 = .117, but not in the nondominant language, $F(1, 90) = 0.070$, p = .792, η_p^2 = .001. Significant differences between both groups were also observed in the dominant language for phrase repetitions, $F(1, 90) = 4.08$, p = .046, η_p^2 = .043; lexical revisions, $F(1, 90) = 6.18$, p = .015, η_p^2 = .064; and grammatical revisions, $F(1, 90) = 13.29$, $p < .001$, η_p^2 = .129. In the nondominant language, only phrase repetitions showed significant differences, $F(1, 90)$ = 4.67, p = .033, η_p^2 = .049.

Table 3. Results of the two-way analysis of variance with several number of iteration measures as dependent variables, language dominance as an independent within variable, and participant group as an independent between variable.

Number of iterations	Language dominance		Participant group		Language Dominance × Participant Group	
Type	***F***	***p***	***F***	***p***	***F***	***p***
Total	0.608	.438	52.81	< .001	0.393	.532
MonoWR	0.598	.441	41.69	< .001	0.000	.992
SndR	0.232	.632	20.85	< .001	2.25	.137
SylR	0.000	.989	16.37	< .001	0.281	.599

Note. MonoWR = monosyllabic word repetitions; SndR = sound repetitions; SylR = syllable repetitions.

Effect of Language Dominance and Participant Group on Iterations

Overall, CWS had significantly more iterations than CWNS, $F(1, 90) = 52.81$, $p < .001$, $\eta_p^2 = .370$. However, no significant effects were observed for language dominance or the interaction between participant group and language dominance. Focusing on the specific iteration types, CWS, compared to CWNS, had significantly more monosyllabic word, $F(1, 89) = 41.69$, $p < .001$, $\eta_p^2 = .319$; sound, $F(1, 73) = 20.85$, $p < .001$, $\eta_p^2 = .222$; and syllable repetitions, $F(1, 45) = 16.37$, $p < .001$, $\eta_p^2 = .267$. However, neither language dominance nor the interaction between participant group and language dominance showed significant effects for any of these repetition types (see Table 3).

Predictors Classifying Bilingual CWNS and CWS

While many CWS exhibit higher SLD percentages in both languages compared to CWNS, Figure 2 illustrates overlapping individual scores between the two groups, particularly in the range 3%–12%. This illustrates that accurately identifying stuttering in bilingual children based on SLD percentage is not straightforward. Therefore, different binary logistic regression analyses were conducted (for the dominant and nondominant languages separately and combined), aiming to identify the most predictive variables for participant group classification (see Table 4).

Figure 2. Percentage of stuttering-like disfluencies (SLD) in the dominant and nondominant language for each participant.

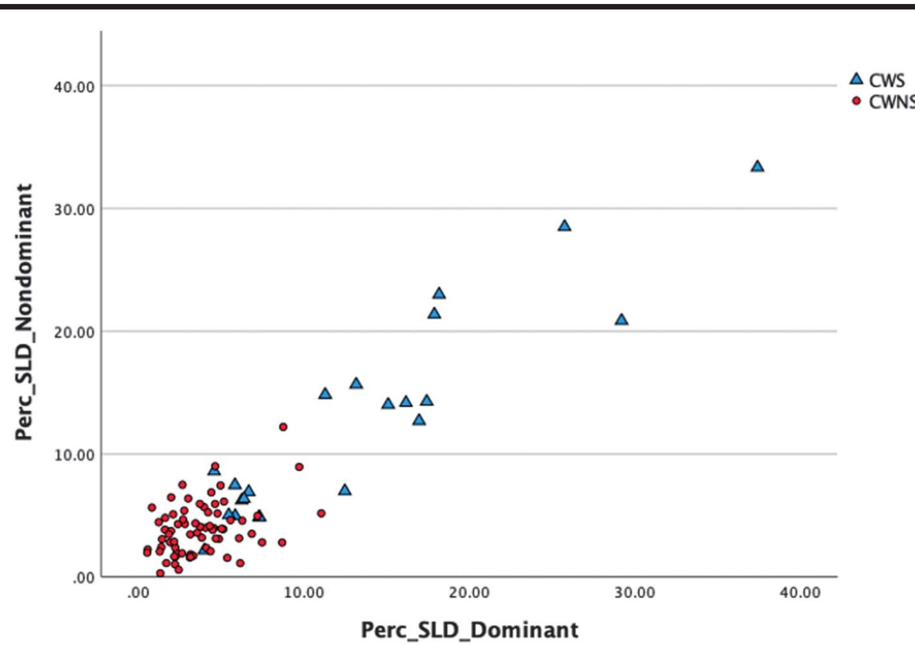


Table 4. Statistical specification of binary logistic regression models in the dominant language, nondominant language, and both languages combined.

Language	Steps	Predictors	*B*	*SE* (*B*)	Wald	*OR*	95% CI for *OR*		CWS classified	CWNS classified	Nagelkerke's *R*	Chi
							Lower	Upper				
Dominant	Step 0	Constant	–1.16**	0.24	22.43	0.31						
	Step 1	Rep_Dom	0.51***	0.14	13.54	1.66	1.27	2.18	9/22	67/70	.47	34.86***
		Constant	–3.36***	0.64	27.81	0.35						
	Step 2	Dys_Dom	0.68**	0.26	7.19	1.98	1.20	3.27	12/22	68/70	.61	13.62**
		Rep_Dom	0.47***	0.14	11.74	1.61	1.22	2.10				
		Constant	–4.57***	0.92	24.89	0.01						
	Step 3a	OD_Dom	–0.22	0.19	1.27	0.81	0.55	1.18	13/22	68/70	.63	1.41
		Dys_Dom	0.81**	0.30	7.57	2.25	1.26	4.01				
		Rep_Dom	0.55***	0.16	11.47	1.73	1.26	2.37				
		Constant	–3.79***	1.09	12.02	0.02						
Dominant ⇒ Nondominant	Step 3b (final)	Dys_Ndom	1.18**	0.38	9.65	3.24	1.54	6.80	17/22	67/70	.72	11.6**
		Dys_Dom	0.64*	0.29	4.89	1.89	1.08	3.32				
		Rep_Dom	0.54***	0.17	10.25	1.72	1.24	2.40				
		Constant	–6.48***	1.09	21.75	0.02						
Nondominant	Step 0	Constant	–1.16***	0.244	22.43	0.31						
	Step 1	Rep_NDom	0.38***	0.103	13.40	1.46	1.19	1.79	10/22	69/70	.37	26.32***
		Constant	–2.92***	0.54	29.13	0.05						
	Step 2	Dys_NDom	1.21***	0.34	12.43	3.35	1.71	6.57	15/22	67/70	.63	23.64***
		Rep_NDom	0.41***	0.12	12.11	1.51	1.20	1.91				
		Constant	–5.02***	0.99	25.87	0.01						
	Step 3a (final)	OD_NDom	–0.32+	0.18	3.01	0.73	0.51	1.04	15/22	66/70	.66	3.90*
		Dys_NDom	1.39***	0.38	13.35	4.03	1.91	8.50				
		Rep_NDom	0.57***	0.17	11.47	1.77	1.27	2.46				
		Constant	–3.94***	1.07	13.64	0.02						
Nondominant ⇒ Dominant	Step 3b (final)	Dys_Dom	0.44+	0.25	3.13	1.55	0.95	2.53	16/22	66/70	.66	3.86*
		Dys_NDom	1.14***	0.35	10.91	3.13	1.59	6.15				
		Rep_NDom	0.39**	0.12	10.04	1.48	1.16	1.88				
		Constant	–5.57***	1.12	24.80	0.00						

Note. *SE* = standard error; CI = confidence interval; *OR* = odds ratio; CWS = children who stutter; CWNS = children who do not stutter; Rep = repetitions; Dom = dominant language; Dys = dysrhythmic phonations; OD = other disfluencies; NDom = nondominant language.

*$p < .05$. **$p < .01$. ***$p < .001$. $^+p < .10$.

For the "dominant language," the forward stepwise regression showed that both Rep_Dom[1] (Step 1) and Dys_Dom[2] (Step 2) were significant predictors and significantly improved the model fit (see Table 4). OD_Dom[3] was not a significant predictor (p = .26) and failed to improve the model (see Step 3a). Instead, a predictor from the nondominant language, Dys_NDom (Step 3b), was highly significant, and adding this did improve the model. The *OR*s for the predictors in the final model indicate that an increase in repetitions in the dominant language or an increase in dysrhythmic phonations in either the dominant or the nondominant language increases the likelihood that a child is assigned to CWS rather than CWNS. The final model explained no less than 72.0% of variance (Nagelkerke's R^2) and had a positive predictive value of 77% (percentage of CWS children classified as CWS) and a negative predictive value of 96% (percentage of CWNS children classified as CWNS).

For the "nondominant language," the forward stepwise regression also showed that both Rep_NDom[4] (Step 1) and Dys_NDom[5] (Step 2) were significant predictors and significantly improved the model fit (see Table 4). The *OR*s for these predictors indicate again that an increase in repetitions or dysrhythmic phonations in the nondominant language increases the likelihood that a child is assigned to CWS rather than CWNS. OD_NDom[6] was not a fully significant predictor (p = .08) but did improve the model (see Step 3a). Note though that *OR* was below 1, implying that as the likelihood of OD rises, the probability of a child being assigned to CWS rather than CWNS decreases. A predictor from the dominant language, Dys_Dom (Step 3b), did also improve the model, be it that also here the predictor was not fully significant (p = .07). The final model explained 66.0% of variance (Nagelkerke's R^2) and had a positive predictive value of 73% and a negative predictive value of 94%.

In summary, repetitions and dysrhythmic phonations are reliable predictors in both languages with the highest *OR*s for the latter throughout all models. Second, an increase in OD is not associated with a larger likelihood to be classified as CWS. Third, considering predictors from both languages leads to better classifications. Fourth, predictive values are generally high, but higher for CWNS than for CWS.

[1]Rep_Dom = repetitions in the dominant language.
[2]Dys_Dom = dysrhythmic phonation in the dominant language.
[3]OD_Dom = other disfluencies in the dominant language.
[4]Rep_NDom = repetitions in the nondominant language.
[5]Dys_NDom = dysrhythmic phonation in the nondominant language.
[6]OD_NDom = other disfluencies in the nondominant language.

Discussion

The present study on Lebanese bilinguals builds upon two previous studies (Saad Merouwe et al., 2023a, 2023b). These studies revealed a high incidence of misidentification of stuttering in bilingual children. They also revealed that false-positives were more commonly observed among CWNS than false-negatives among CWS. The current study showed that bilingual CWNS exhibited notably fewer SLD and iterations than CWS yet exceeded clinical benchmarks for stuttering in monolinguals, while language dominance did not influence overall SLD and OD percentages. Mean number of repetitions and dysrhythmic phonation predicted CWS/CWNS categorization effectively in both languages, unlike OD. Moreover, combining predictors from both languages led to improved classification compared to relying solely on predictors from a single language. The relevance of these findings will be discussed in the subsequent sections within the context of the existing literature.

Monolingual Thresholds Cannot Be Used in Bilinguals

The aim of this study was to examine the similarities and differences in disfluency patterns between bilinguals and monolinguals and to identify any unique characteristics specific to bilinguals that may necessitate different assessment approaches for SLD. For that, we examined the applicability of established benchmarks commonly used in monolinguals to our bilingual cohort, including the 3% SLD and 4% weighted SLD thresholds (Ambrose & Yairi, 1999), as well as the attainment of at least three out of the seven diagnostic criteria proposed by Yairi and Ambrose (2005) to diagnose stuttering. Our results demonstrated that, in both their dominant and nondominant language, over 50% of bilingual CWNS exceeded the 3% SLD benchmark, leading to potential misidentifications if applied as a clinical threshold for this population. This finding aligns with previous research by Byrd, Bedore, and Ramos (2015), Eggers et al. (2019), Rojas et al. (2023), and Bakhtiar (2024), indicating a high prevalence of SLD in bilingual CWNS beyond monolingual standards. Similarly, over half of our CWNS surpassed the 4% weighted SLD threshold in both languages, which is known to effectively differentiate CWNS with a high SLD frequency from CWS with a low SLD frequency in monolinguals (Ambrose & Yairi, 1999). These results are consistent with those of Eggers et al. (2019), who reported that 63% of their bilingual children exceeded the threshold. Also, when we applied the relevance of Yairi and Ambrose's (2005) seven diagnostic criteria, over 55% of our bilingual CWNS met or exceeded three of these criteria in both languages, particularly demonstrating high frequencies of SLD, weighted SLD, monosyllabic word repetitions, and part-word repetitions. In summary, our findings highlight the prevalence of SLD beyond monolingual clinical thresholds among bilingual children, aligning closely with results from previous studies involving different language pairs (Bakhtiar, 2024; Byrd, Bedore, & Ramos, 2015; Eggers et al., 2019, 2020; Rojas et al., 2023).

The observation that monolingual benchmarks cannot apply to bilinguals thus remains valid even within the Lebanese context. The heightened occurrence of SLD in the speech of bilingual CWNS may stem from reduced language use in either language compared to monolingual counterparts (Gollan et al., 2005; Peña et al., 2016). This reduced usage can result in lexical gaps in either language and/or weaker lexical representations, particularly for low-frequency words. Additionally, Green's (1998) model suggests that bilinguals activate lexical representations in both languages simultaneously when speaking (e.g., Costa et al., 1999; Guo & Peng, 2006), necessitating inhibition of the nontarget language to ensure production in the target language. For unbalanced bilinguals, where the dominant language has a higher resting activation level than the weaker language, stronger inhibition is needed to suppress the dominant language when producing the weaker language than vice versa. In summary, bilingual competition makes word retrieval more effortful, especially in the nondominant language and especially in the context of syntactically complex sentences, resulting in more difficulties constructing sentences and ultimately more disfluencies (Gollan et al., 2005; Hartsuiker & Notebaert, 2009; Peña et al., 2016).

Differences in SLD and Iterations But Not OD Between Bilingual CWS and CWNS

The CWS group had a significantly higher SLD percentage compared to the CWNS group, in both the dominant and nondominant language. Moreover, CWS demonstrated considerably higher frequencies for all SLD subtypes. Both findings are consistent with previous research on monolinguals (e.g., Ambrose & Yairi, 1999; Boey et al., 2007; Natke et al., 2006) and with those of the pilot study conducted by Rincon et al. (2020) with six bilingual Spanish–English CWNS and CWS.

In contrast, our study showed no statistically significant differences between the two groups in terms of OD percentage, neither in the dominant nor in the nondominant language. These results align with the observations of Ambrose and Yairi (1999) within the monolingual context. However, they diverge from the findings of Tumanova et al. (2014), who found that OD significantly predicted CWNS/CWS group classification. They suggested that OD percentage could potentially enhance the classification process, although it may not replace it entirely, as the OD percentage was only 0.86% higher for CWS than for CWNS, indicating limited clinical significance. In our binary regression analyses, despite a marginal reverse effect in the nondominant language, OD did not yield a statistically significant contribution to categorize bilingual children as CWS or CWNS. Collectively, it can be concluded that OD percentage does not significantly contribute to distinguish between bilingual CWS and CWNS.

On the other hand, in terms of iterations, our bilingual CWS participants demonstrated notably higher mean iteration numbers for monosyllabic word, syllable, and sound repetitions and for all iterations together in both languages compared to CWNS. This suggests that the number of iterations is a sound criterion for distinguishing between the two groups. This aligns with the monolingual findings of Ambrose and Yairi (1999) and Pellowski and Conture (2002), who also observed substantially greater iteration numbers for CWS.

Lastly, we examined the proportion of the SLD and OD subtypes. The primary OD subtype observed in both groups was interjection, aligning with findings from Byrd, Bedore, and Ramos (2015) and Eggers et al. (2019). This subtype likely serves as interword filled pauses during language formulation, a phenomenon commonly used by speakers to gain time for formulating what they want to say next or maintaining control of the conversation (Clark & Fox Tree, 2002; Vasilescu et al., 2007). Phrase repetitions and unfinished words/sentences also emerged frequently in both groups. Most strikingly perhaps, we observed that the prevailing SLD type across both groups was monosyllabic word repetition. This contrasts with monolingual investigations, where part-word repetitions often exceed monosyllabic word repetitions (Ambrose & Yairi, 1999), yet it concurs with prior studies involving bilingual CWNS (Byrd, Bedore, & Ramos, 2015; Eggers et al., 2019; Fiestas et al., 2005; Rojas et al., 2023; Saad Merouwe et al., 2019). We presume that bilinguals use the additional word and phrase repetitions to gain time during the planning and formulation of speech, associated with difficulties they experience in retrieving lexical items, accessing their phonological representations, and/or constructing syntactic frames (Levelt, 1998; Rieger, 2003). Note though that the number of monosyllabic word repetitions is significantly higher for CWS than for CWNS, justifying the choice for including this type of repetition in SLD calculations.

The Role of Language Dominance on Disfluency Patterns in Bilinguals

Despite earlier studies reporting higher frequencies of SLD and OD in the nondominant language (e.g., Bakhtiar, 2024; Eggers et al., 2019; Lim et al., 2008; Taliancich-Klinger et al., 2013), the current study failed to find an overall influence of language dominance in both CWNS and CWS. This difference in findings might be related to the distinct characteristics of the bilingual environment in Lebanon. Although Lebanese Arabic is the primary spoken language, French and English are used frequently in both private and public settings. Children in Lebanon are exposed to multiple languages from very young age, in both their home environment and day care setting, and parents must choose an educational system that is either bilingual or trilingual (Abou, 1962; Shaaban, 1997). All of the participants in the current study were early bilinguals exposed to a second or third language before the age of 3 years, and in most cases, their bilingualism was simultaneous. Thus, despite having a dominant language, all children were quite proficient in their nondominant language. Given this context, it is not surprising that both languages exhibited equal numbers of disfluencies. In cases where one language is clearly nondominant, the effect of language dominance is more strongly felt. In their systematic review, Chaudhary et al. (2021) investigated the relationship between stuttering and bilingualism with a predominant focus on sequential bilinguals and found a higher disfluency prevalence for nondominant languages. Similarly, Eggers et al. (2019) found notably more disfluencies in the nondominant than dominant language of CWNS who were sequential bilinguals (Dutch being the nondominant language introduced during primary school education after the age of 6 years). On a general level, our results suggest that a slight imbalance in proficiency between the languages spoken by bilingual children does not lead to significant variations in the frequency of disfluencies across these languages. Disparities in disfluency counts may arise when there is a notable proficiency gap between the two languages. Next to linguistic challenges, bilingual speakers are more likely to experience an unstable speech motor system in their less proficient language compared to simultaneous bilinguals, possibly due to less practice in their second language (Chaudhary et al., 2021).

Even though we did not find an overall effect of language dominance, we did find an influence of this factor on some specific disfluency types. Most notably perhaps, our findings revealed an increased frequency of monosyllabic word repetitions in the nondominant language compared to the dominant one, while the reverse pattern was observed for part-word repetitions in CWS. In this context, we return to the explanation that monosyllabic word repetitions are more often needed in the slightly less proficient language as a strategic means to gain additional time during the process of speech production. On the other hand, the higher occurrence of part-word repetitions in the slightly more dominant language could be the result of a faster speech rate. That is, as individuals navigate their more proficient language, they may increase the pace of speech (Chakraborty et al., 2008; Oh et al., 2013), which may contribute to an increased likelihood of part-word repetitions, especially for CWS (Howell & Sackin, 2000). Further research is required to investigate if pace of speech is indeed related to this observation.

Factors Predicting Accurate Classification of Bilingual Children as CWS and CWNS

For both languages, it was shown that a high number of repetitions and dysrhythmic phonations are indicative of bilingual children being CWS. In contrast, a high number of OD does not provide such an indication. It also became evident that considering disfluencies from both languages leads to more accurate classifications. To be more specific, assessing whether there are also dysrhythmic phonations in the other language typically leads to better classifications than when considering SLD from the dominant or nondominant language alone. Our findings align with previous research on monolinguals, which demonstrated significantly higher dysrhythmic phonations in CWS compared to CWNS (Natke et al., 2006; Pellowski & Conture, 2002; Walsh et al., 2020). From a clinical standpoint, our research suggests that when the clinician is proficient in both of the languages spoken by the child, a comprehensive assessment of SLD patterns in one language and an assessment of dysrhythmic phonations in the other language is recommended to achieve the highest accuracy in identifying stuttering based on disfluencies.

In cases where the clinician is proficient solely in one of the child's languages, it is advisable to examine dysrhythmic phonations and the mean number of repetitions meticulously, as these factors have demonstrated their efficacy as prime indicators for accurately categorizing bilingual children. By utilizing these criteria, correct classifications can be achieved for 55%–68% of CWS and 96%–97% of CWNS. These outcomes are not aligned with actual assessments of bilingual CWNS versus CWS, which we investigated in our previous study (Saad Merouwe et al., 2023a). In this study, we offered speech samples in the dominant language to a relatively large number of SLPs and the percentage of misclassification was much higher for CWNS than for CWS, opposite to what the current regression analyses suggest. Regarding CWS, we assume that the physical concomitants, which were actually used as a criterion to select children for the CWS group but not included in the regression analyses, hold substantial information. This information is likely to lead to more successful real-life classification than our regression models suggest, particularly regarding children who are beyond the mild stuttering stage. The discrepancy for CWNS is more difficult to explain. Our hypothesis is that the SLPs in the study of Saad Merouwe et al. (2023a) might have been distracted by OD, which was about equal for the bilingual CWS and CWNS and do not significantly contribute to distinguishing between them. It may also be that the difference in number of repetitions between CWS and CWNS is not as salient for the SLPs as it was for the regression model. A systematic assessment of the repetitions, which was not possible in the Saad Merouwe et al. (2023a) study, could be essential. Also, assessing whether the repetitions come with more than one iteration is needed, which is more typical for CWS than CWNS.

Notably, our prior study (Saad Merouwe et al., 2023a) did not include an assessment of bilingual speakers' nondominant language by SLPs, leading to an empirical gap in evaluating their ability to categorize children as CWS or CWNS based on their nondominant language in practical settings. However, it is encouraging to note that the current study demonstrates that similar outcomes can be anticipated in the nondominant language when identical disfluency traits are considered. It is essential, however, to emphasize that high levels of proficiency in the nondominant language are crucial, as lower proficiency levels of language may lead to more frequent disfluencies and thus more frequent misdiagnoses. Therefore, in instances of uncertainty, the most prudent approach involves evaluating both languages of the child. Particularly when blocks, prolongations, and multiple iterations manifest in both languages, a confident inference can be drawn regarding the child's status as a CWS.

On a closing note, it is not clear whether the strong consensus between parents and clinicians in diagnosing stuttering (Yairi & Ambrose, 2005) and the alignment between parental concern about stuttering and SLD frequency in monolingual children (Tumanova et al., 2014) transfers to bilingual settings. Based on our clinical experience within an exclusively multilingual context, we have observed that parental concern regarding stuttering can vary depending on their linguistic and fluency expectations, as well as their understanding of the consequences of bilingualism. Parents with high linguistic and fluency expectations may express concern about typical disfluencies in their child's speech, or even choose to focus on a single language with their child for a time, while others may attribute stuttering manifestations to the bilingual context and underestimate the need for further investigation (Del Gado et al., 2022).

Earlier studies also showed that SLPs and educators often encounter challenges in distinguishing between typical bilingual language development and speech impairments in bilingual children (Dockrell et al., 2017; Dockrell & Howell, 2015), leading to a potentially disproportionate number of bilingual children being referred to services (Arkkila et al., 2013). In the context of stuttering, the accurate differentiation between speech behaviors associated with bilingualism and actual symptoms of stuttering is essential, particularly in young children. This is especially pertinent because secondary symptoms, which often contribute to a stuttering diagnosis, are less prevalent in younger children compared to older individuals (Yairi & Ambrose, 1992). It is therefore imperative to discern whether observed disfluencies are a natural part of bilingual language development or indicative of stuttering, considering the reduced occurrence of secondary symptoms in younger age groups. The current study carefully evaluated disfluency patterns of bilingual CWS and CWNS across both of their languages to gain a better understanding of the connection between stuttering and bilingualism. We aspire that the current findings will facilitate identifying stuttering in bilinguals, enhance the accuracy of diagnosis, and contribute to more favorable treatments.

Caveats and Perspectives

First, the number of CWS we were able to recruit was constrained by pandemic-related obstacles. However, within this field of study, the number of CWS can still be considered as substantial. Our study includes a diverse cohort of participants, reflecting the intricate multilingual milieu of Lebanon, thus mirroring the inherent complexity of individual bilingual language experiences. Notably, our sample comprises children speaking Lebanese Arabic and French or English, with 28% of the participants being exposed to a third language. Although this heterogeneity may pose some challenges in terms of generalizability of results, it authentically captures the unique linguistic experience of each bilingual individual. One issue that has been rising debate is whether monosyllabic word repetitions should be included in the SLD counts.

We adhered to the Illinois Disfluency Classification System (Ambrose & Yairi, 1999) since it is widely used, also in related studies (Bakhtiar, 2024; Byrd, Bedore, & Ramos, 2015; Eggers et al., 2019, 2020; Rojas et al., 2023) and for the reasons discussed by Yairi et al. (2001). Note also that for the ANOVAs, similar results were found for SLD as for weighted SLD, even though the latter downplays the role of monosyllabic repetitions and amplifies the role of iterations and dysrhythmic phonations. In other words, monosyllabic repetitions do not impact the global results of this study. Nevertheless, as both bilingual CWS and CWNS tend to produce a substantial number of monosyllabic word repetitions, inflating the overall SLD count, it is recommended to view their importance with caution. Another point of concern may be that language proficiency was assessed by a parental questionnaire and not by linguistic proficiency tests. However, the questionnaire used was a well-established normed questionnaire tapping into different aspects of language proficiency. Further studies could nevertheless assess the relation between linguistic competence and disfluency patterns in more detail. Subsequent studies could also explore the impact of mean length of utterances and syntax complexity on disfluencies in bilingual CWNS and CWS, given the established relation between these factors and disfluency rates. Finally, there is a clear need for longitudinal studies following the development of speech fluency in bilingual CWS and CWNS across a wider age range to assess how disfluency patterns progress over time. We also leave this to future studies.

Conclusions

Considering the lower incidence of secondary symptoms in young children, the need to make accurate decisions on the basis of disfluencies is pertinent. The current study shows that the application of monolingual standards to assess stuttering in bilinguals proves inappropriate as bilingual CWNS exceed many of the monolingual thresholds. Second, an assessment conducted in the dominant language will yield comparable results as an assessment in the nondominant language, when dysrhythmic phonations and repetitions are thoroughly analyzed. This is particularly evident in cases of close-to-balanced bilingualism. Third, assessing dysrhythmic phonations in both languages allows for more precise classification of CWS than considering such phonations in only one language. Fourth, our study suggests that OD do not significantly contribute to the differential diagnosis in bilingual children.

Overall, our study—with the primary focus on disfluencies—emphasizes that by systematically analyzing speech samples for repetitions and dysrhythmic phonations, preferably in both languages, clinicians can achieve considerable diagnostic accuracy. More generally, our findings highlight the importance of tailored assessment strategies that accommodate the unique linguistic demands of bilingualism. However, solely relying on these factors for accurate diagnostic decisions is not advisable (Saad Merouwe et al., 2023a). Instead, by embracing a meticulous approach that considers disfluency patterns valid in the bilingual context, along with parental concerns, physical concomitants, and emotional and cognitive reactions, clinicians can ensure precise diagnosis and the formulation of tailored intervention strategies.

Data Availability Statement

The data that have been used are confidential and thus are not publicly available.

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Appendix (p. 1 of 2)

The No Risk Index, Language Proficiency Scores, and Linguistic Richness Index of the Parents of Bilingual Children Questionnaire (PaBiQ; Tuller, 2015) for Children Who Do Not Stutter (CWNS) and Children Who Stutter (CWS)

Child	Participant group	No risk index	Language proficiency			Linguistic richness index		
			Lebanese	French	English	Lebanese	French	English
1	CWNS	23	5	14		14.75	41.25	
2	CWNS	23	15	14		20.75	37.25	
3	CWNS	22	15	11	14	29.5	16	12.5
4	CWNS	23	9	15	5	20.25	36.75	3
5	CWNS	21	14	14	8	35.5	16.5	8
6	CWNS	21	8	12		43	15	3
7	CWNS	23	15	13		38.67	16.33	2
8	CWNS	21	15	7		42.5	12.5	
9	CWNS	19	15	15	15	28.5	25	15.5
10	CWNS	23	12	11	12	23.25	13.25	21.5
11	CWNS	23	9	7	11	23.5	15	25.5
12	CWNS	23	14	14	14	29.75	19.5	10.75
13	CWNS	23	14		13	41		20
14	CWNS	23	15	6		37.5	11.5	
15	CWNS	23	11	12		36	23	1
16	CWNS	22	15	11	10	37.67	20.33	8
17	CWNS	23	15	12		39	14	
18	CWNS	23	14	14		31.5	26.5	
19	CWNS	21	15	14		39.5	16.5	7
20	CWNS	23	13	13	5	36.25	20.75	4
21	CWNS	23	13	7		38.25	19.75	2
22	CWNS	23	15	14	13	27.33	33.67	2
23	CWNS	23	15	13		35.33	18	1.67
24	CWNS	23	15	11		35.75	21	
25	CWNS	20	13	13		42.75	12.25	2
26	CWNS	23	14	15		35.5	24.5	
27	CWNS	23	9	11		42.5	17.5	
28	CWNS	23	14	15		24	30	
29	CWNS	19	10	14		31.5	25.5	1
30	CWNS	23	10	14		22.25	32.75	1
31	CWNS	19	9	9		39.5	15.5	
32	CWNS	23	14	13		35.67	16.33	
33	CWNS	23	15	15		37.67	16.33	
34	CWNS	23	13	13		37.75	18.25	
35	CWNS	23	13	9	9	32.00	24.00	9
36	CWNS	23	15	10	15	25.5	16.50	22
37	CWNS	23	12	10	14	37	10	14
38	CWNS	23	6		15	24.5	4	32.5
39	CWNS	23	15	15		34	16	2
40	CWNS	23	13	13	13	31.75	4.25	10.5
41	CWNS	23	14	12	10	39	18	3
42	CWNS	23	13	13	13	37.75	3	20.25
43	CWNS	23	14	10	9	33.25	19.75	15
44	CWNS	23	15	10	14	41.25	9.25	7.5
45	CWNS	21	15	9	11	33.25	9	15.75
46	CWNS	23	15	8	14	37.25	10.25	12.5

(*table continues*)

Appendix (p. 2 of 2)

The No Risk Index, Language Proficiency Scores, and Linguistic Richness Index of the Parents of Bilingual Children Questionnaire (PaBiQ; Tuller, 2015) for Children Who Do Not Stutter (CWNS) and Children Who Stutter (CWS)

Child	Participant group	No risk index	Language proficiency			Linguistic richness index		
			Lebanese	French	English	Lebanese	French	English
47	CWNS	22	15	13	14	32.75	16.5	9.75
48	CWNS	23	14	14	8	24.25	28.75	9
49	CWNS	21	15		13	37		20
50	CWNS	23	10	11	5	16	34.00	2.00
51	CWNS	19	9		12	29		30
52	CWNS	22	15		15	26		33
53	CWNS	21	15		7	38.75		12.25
54	CWNS	23	5	4	14	21.75	5.00	31.25
55	CWNS	23	7	5	10	35	13.33	11.67
56	CWNS	22	9	12		22	34.00	
57	CWNS	22	8	14		21.25	36.75	
58	CWNS	19	6	13		13	44	
59	CWNS	21	9	13		13	44	
60	CWNS	21	15		13	41.25	7	16.75
61	CWNS	21	13	11		26.5	32.5	2.00
62	CWNS	23	6		15	22.5	1	31.50
63	CWNS	23	14		12	30.25		26.75
64	CWNS	23	13	15	11	10.33	41.67	6
65	CWNS	23	13	14		27.25	29.5	
66	CWNS	23	9	15		19	43	4
67	CWNS	23	15	8	14	26.33	17.67	20
68	CWNS	23	7	14		30.25	29.75	
69	CWNS	22	11		12	33.5		23.5
70	CWNS	22	11		14	23.75		34.25
71	CWS	22	15		14	40.5		17.5
72	CWS	23	15	5	14	31.25	5.25	26.5
73	CWS	23	13	5	15	31.25	4	26.75
74	CWS	23	8		12	40		19
75	CWS	21	14	11		35.5	21.5	
76	CWS	23	14		11	44.75		10.25
77	CWS	22	14	15	15	27.67	29.33	11
78	CWS	19	14		8	43.75		8.25
79	CWS	20	15	8	5	43.75	9.25	3
80	CWS	23	13	15		34.67	20.33	
81	CWS	21	11	7	10	33.75	12.25	11
82	CWS	23	13	13		31.75	24.25	
83	CWS	23	9		11	39		21
84	CWS	23	14		13	43.75		9.25
85	CWS	23	6	15		20.75	34.25	8
86	CWS	23	13		12	45		7
87	CWS	23	12	14		39.75	18.25	
88	CWS	19	9	9		39.5	16.50	
89	CWS	23	11	9	14	35	8	22
90	CWS	23	12		15	22.33	2.00	34.67
91	CWS	23	15		9	38.33	1.00	13.67
92	CWS	23	10	11	14	24.67	21.67	19.67