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Université Saint-Joseph de Beyrouth
جامعة القدّيس يوسف في بيروت

SPEECH DISFLUENCIES IN BILINGUAL CHILDREN

An inquiry into the differential diagnosis of stuttering

Selma Saad Merouwe

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SARJA – SER. B OSA – TOM. 688 | HUMANIORA | TURKU 2024

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*To **Julia** and **Ram**, my cherished daughter and son, your unwavering love and the strength you infuse into my journey serve as my constant motivation to stride forward. I love you both beyond what words can express.*

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ABSTRACT

Distinguishing between normal disfluencies and stuttering in bilingual children is a crucial and compelling issue, warranting the attention of both clinicians and researchers. Despite the increasing number of bilinguals, research and clinical practice predominantly focus on monolinguals, leading to a scarcity of empirical data on the development of typical fluency patterns and the manifestation of stuttering in bilingual children. Furthermore, assessment methods that consider the unique characteristics of bilingual language and fluency development are limited, increasing the risk of misdiagnosis.

This thesis aimed to gain comprehensive insights into the manifestation of disfluencies in two groups of bilingual participants: children who stutter (CWS) and children who do not stutter (CWNS). Five main research objectives were specified: (1) to investigate the accuracy of identifying bilingual CWS and CWNS by speech-language pathologists (SLPs) in Lebanon, (2) to examine the extent to which stuttering severity ratings of SLPs to bilingual children are influenced by a child's stuttering status, (3) to chart the disfluency profiles of bilingual CWNS and CWS in both their dominant and non-dominant languages, (4) to determine which types of disfluencies are most indicative for accurate assessment of stuttering in bilingual children, and (5) to assess whether accuracy of assessment is similar between the dominant language and non-dominant language, and whether accuracy improves when both languages are considered.

The research project involved 92 bilingual Lebanese children aged between 4 and 7 years. Of these, 70 were CWNS and 22 were CWS. Bilingual profiles were determined using the Parents of Bilingual Children Questionnaire. Data collection comprised video-recordings of spontaneous conversations and narrative samples (Frog stories) in the dominant (L1) and non-dominant (L2) languages, resulting in four speech samples per child and 368 speech samples in total. All these speech samples were analyzed and coded for stuttering-like disfluencies (SLD) and other disfluencies (OD). Additionally, 32 SLPs were recruited to evaluate speech samples of eight children, including two CWS and six CWNS, to assess the accuracy of stuttering identification and the extent of misdiagnosis.

Study I revealed that bilingual children where frequently misidentified by Lebanese SLPs with CWNS more often misidentified as CWS than CWS being misidentified as CWNS. Misidentification rates varied within the CWS and CWNS

categories as well, with a larger proportion of incorrect identification of CWNS correlating with a higher amount of SLD and the misinterpretation of physical concomitants.

Study II demonstrated that SLPs assigned on average higher stuttering severity ratings to CWS compared to CWNS. However, there is great variation in severity ratings within the CWNS group, mainly depending on the number of SLD a nonstuttering child exhibits. Moreover, individual CWNS ratings occasionally match those of CWS.

Study III showed that, on average, bilingual CWNS exhibited a significantly lower percentage of SLD and iterations than CWS in both languages. Nonetheless, the SLD percentages of CWNS typically surpassed monolingual thresholds. Importantly, the study showed that there is considerable overlap between CWS and CWNS: several CWS exhibited fewer SLD than some CWNS, while, conversely, numerous CWNS displayed more SLD than a number of CWS. Language dominance did not influence the overall frequency and types of disfluencies, although there were some differences for some specific categories (e.g., monosyllabic word repetitions). Dysrhythmic phonation and number of repetitions emerged as reliable predictors for participant group classification (CWS vs. CWNS) in both the dominant and non-dominant language, but combining predictors from both languages resulted in more accurate classification than relying on predictors from just one language.

In conclusion, this research project highlighted that assessing the prevalence and the severity of stuttering among children is not the same for bilingual children as for monolingual children. Bilingual CWNS often demonstrate a relatively high number of SLD and are susceptible to being misdiagnosed as CWS, but CWS may also display a relatively small number of SLD, increasing the risk of not being diagnosed as such. By carefully examining the disfluency profiles in relation to their bilingual status, the accuracy of clinical diagnoses of stuttering in bilingual children can be markedly enhanced.

KEYWORDS: Bilingualism, Stuttering, Disfluencies, Dysrhythmic phonation, Iteration, Identification, Stuttering Severity Ratings, Differential Diagnosis

TURUN YLIOPISTO
Yhteiskuntatieteiden tiedekunta
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TIIVISTELMÄ

Erojen tekeminen normaalin puhevaikeuden ja änkytyksen välillä kaksikielisissä lapsissa on olennainen ja kiinnostava kysymys, joka vaatii sekä kliinikoiden että tutkijoiden huomiota. Vaikka kaksikielisten määrä kasvaa, tutkimus ja kliininen käytäntö keskittyvät pääasiassa yksikielisiin, mikä johtaa empiirisen datan niukkuuteen tyypillisten sujuvuusmallien kehityksestä ja änkytyksen ilmenemisestä kaksikielisissä lapsissa. Lisäksi arviointimenetelmät, jotka ottavat huomioon kaksikielisen kielen ja sujuvuuden kehityksen ainutlaatuiset ominaisuudet, ovat rajalliset, mikä lisää virheellisen diagnoosin riskiä.

Tämän väitöskirjan tavoitteena oli saada kattavia näkemyksiä disfluenssien ilmenemisestä kahden kaksikielisen osallistujaryhmän, änkyttävien lasten ja ei-äänkyttävien lasten, keskuudessa. Neljä päätutkimustavoitetta määriteltiin: (1) tutkia tarkkuutta kaksikielisten lasten tunnistamisessa änkyttäviksi ja ei-äänkyttäviksi puhevianterapeuttien Libanonissa, (2) tutkia, kuinka paljon änkyttävien lasten tunnistamiseen vaikuttaa puhevianterapeuttien määrittelemä änkyttämisen vakavuus, (3) kartoittaa ei-äänkyttävien kaksikielisten lasten disfluenssiprofiileja sekä heidän hallitsevassa että ei-hallitsevassa kielessään ja (4) selvittää, mitkä disfluenssityypit ovat tärkeimpiä änkytyksen tarkan arvioinnin kannalta kaksikielisillä lapsilla, (5) arvioida, onko arvioinnin tarkkuus samanlainen hallitsevan kielen ja ei-dominoivan kielen välillä ja paraneeko tarkkuus, kun otetaan huomioon molemmat kielet.

Tutkimusprojektiin osallistui 92 kaksikielistä libanonilaista lasta, jotka olivat iältään 4–7-vuotiaita. Näistä 70 oli ei-äänkyttäviä lapsia ja 22 änkyttäviä lapsia. Kaksikieliset profiilit määritettiin Kaksikielisten Lasten Vanhempien Kysely-lomakkeella. Aineistonkeruu sisälsi spontaanien keskusteluiden ja kertomusten (Frog-tarinoiden) videoinnit hallitsevalla ja ei-hallitsevalla kielellä, mikä johti neljään puhe-esitykseen lapselta ja yhteensä 368 puhe-esiintymään. Kaikki nämä puhe-esiintymät analysoitiin ja koodattiin änkyttämisennäköisten disfluenssien ja muiden disfluenssien osalta. Lisäksi rekrytoitiin 32 puhevianterapeuttia arvioimaan kahdeksan lapsen puhe-esitykset, mukaan lukien kaksi änkyttävää lasta ja kuusi ei-äänkyttävää lasta, änkyttämisen tunnistamisen tarkkuuden ja virheellisen diagnoosin laajuuden arvioimiseksi.

Tutkimus I paljasti, että libanonilaiset puhevianterapeutit erehtyivät usein kaksikielisistä lapsista, joista ei-äänkyttävät lapset useammin erehtyivät änkyttäviksi

lapsiksi kuin änkyttävät lapset erehtyivät ei-äänkyttäviksi lapsiksi. Virheellinen tunnistusaste vaihteli sekä änkyttävien että ei-äänkyttävien lasten luokissa, ja suurempi osuus virheellisestä tunnistuksesta ei-äänkyttävien lasten luokassa korreloi suuremman määrän änkyttämistä muistuttavien disfluenssien kanssa sekä fyysisten seuralaisten väärän tulkinnan kanssa.

Tutkimus II osoitti, että puhevianterapeutit antoivat keskimäärin korkeammat änkyttämisen vakavuusarviot änkyttäville lapsille kuin ei-äänkyttäville lapsille. Kuitenkin ei-äänkyttävien lasten ryhmässä on suurta vaihtelua vakavuusarvioissa, pääasiassa riippuen änkyttämistä muistuttavien disfluenssien määrästä, joita ei-äänkyttävä lapsi osoittaa. Lisäksi yksittäisten ei-äänkyttävien lasten arvioinnit vastaavat joskus änkyttävien lasten arviointeja.

Tutkimus III osoitti, että keskimäärin kaksikieliset lapset, joista ei-äänkyttäviä, osoittivat merkittävästi pienemmän prosenttiosuuden änkyttämistä muistuttavia disfluensseja ja toistoja kuin änkyttäviä lapsia molemmissa kielissä. Silti ei-äänkyttävien lasten änkyttämistä muistuttavien disfluenssien prosenttiosuudet ylittivät tyypilliset yksikieliset rajat. Tärkeää on, että tutkimus osoitti merkittävää päällekkäisyyttä änkyttävien lasten ja ei-äänkyttävien lasten välillä: useat änkyttävät lapset osoittivat vähemmän änkyttämistä muistuttavia disfluensseja kuin jotkut ei-äänkyttävät lapset, kun taas toisaalta lukuisat ei-äänkyttävät lapset osoittivat enemmän änkyttämistä muistuttavia disfluensseja kuin useat änkyttävät lapset. Kielen hallitsevuus ei vaikuttanut yleiseen disfluenssien esiintymistiheyteen ja -tyyppeihin, vaikka joissakin erityisissä kategorioissa (esim. yksitavuisten sanojen toistot) oli joitain eroja. Dysrhythmisten ääntämisien ja toistojen määrä osoittautui luotettaviksi ennakoijiksi osallistujaryhmän luokittelussa (änkyttävät lapset vs. ei-änkyttävät lapset) sekä hallitsevalla että ei-dominoivalla kielellä, mutta molemmista kielistä peräisin olevien ennakoijien yhdistäminen johti tarkempaan luokitteluun kuin yhden kielen ennakoijien varassa.

Lopuksi tämä tutkimusprojekti korosti, että änkyttämisen esiintyvyyden ja vakavuuden arviointi lasten keskuudessa ei ole samaa kaksikielisten lasten kuin yksikielisten lasten osalta. Kaksikieliset lapset, jotka eivät änkytä, osoittavat usein suhteellisen suuren määrän änkyttämistä muistuttavia disfluensseja ja ovat alttiita virheelliselle diagnoosille änkyttäviksi lapsiksi, mutta änkyttävät lapset voivat myös osoittaa suhteellisen pienen määrän änkyttämistä muistuttavia disfluensseja, mikä lisää riskiä olla diagnosoimatta sellaisiksi. Tarkastelemalla huolellisesti disfluenssi-profiileja suhteessa kaksikieliseen tilanteeseen kliinisen änkytyksen diagnoosin tarkkuus kaksikielisillä lapsilla voi merkittävästi parantua.

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While these past five years have certainly been arduous, taking a step back allows me to assert with confidence that my PhD journey has been remarkably enriching and enjoyable. Most importantly, it has underscored the idea that even amidst the most formidable circumstances, achievements remain attainable. This experience has greatly enhanced my ability to set and pursue objectives, grounded in realism, and to persevere step-by-step. Undoubtedly, this level of commitment would not have been sustainable without the support of numerous individuals who each, in their own unique way, left a permanent impact on me.

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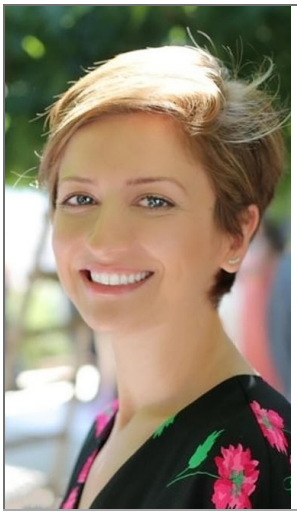
Selma Saad Merouwe



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SELMA IS A SLOVAK-LEBANESE SPEECH-LANGUAGE PATHOLOGIST. SHE IS SPECIALIZED IN STUTTERING AND CLUTTERING (CERTIFIED EUROPEAN STUTTERING SPECIALIST). SHE IS A LECTURER, GRADUATE PROGRAM COORDINATOR, AND CLINICAL SUPERVISOR AT THE HIGHER INSTITUTE OF SPEECH-LANGUAGE PATHOLOGY OF SAINT-JOSEPH UNIVERSITY OF BEIRUT. HER RESEARCH, CLINICAL PRACTICE, AND TEACHING FOCUS ON STUTTERING AND BILINGUALISM.

Table of Contents

List of Original Publications

This dissertation is based on the following original publications, which are referred to in the text by their Roman numerals:

I Saad Merouwe, S., Bertram, R., Richa, S., & Eggers, K. (2023a). Identification of Stuttering in Bilingual Lebanese Children Across Two Presentation Modes. *Journal of Fluency Disorders, 76.* Doi: https://org/10.1159/000528520

II Saad Merouwe, S., Bertram, R., Richa, S., & Eggers, K. (2023b). Stuttering Severity Judgments by Speech-Language Pathologists of Bilingual Children Who Do and Do Not Stutter. *Folia Phoniatrica et Logopaedica.* Doi: https://doi.org/10.1159/000528520

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1 General introduction

As a multilingual speech-language pathologist with 18 years of experience based in Lebanon, a country where multilingualism is the norm, I have dedicated my clinical career to examining and providing services to bilingual PWS. Over the years, I have often encountered concerned parents who inquired about the potential impact of bilingualism on their child's stuttering. Many believed that the use of multiple languages may have caused confusion and triggered stuttering in their children. Some parents have been advised by other clinicians to stick to a single language for better therapeutic outcomes or to potentially alleviate the stuttering. On the other hand, I have also encountered parents seeking clarification about their child's fluency, wanting to ensure there is no underlying disorder, as their child exhibited a high number of speech disfluencies that, after examination, were clinically perceived as typical and not indicative of stuttering. These experiences have spurred numerous questions regarding stuttering in bilingual individuals: Does bilingualism cause stuttering? Is the prevalence of stuttering equal in all spoken languages? Are there distinct speech disfluencies unique to bilingual speakers? Upon completing my *European Stuttering Specialization* in 2018, I was certain of two things: I wanted to pursue further specialization through a Ph.D. program, and I felt compelled to focus on the topic of stuttering in bilinguals. It was an instinctive choice, given the real-world implications and the need to deepen our understanding of this complex phenomenon.

As globalization and migration trends progress, the world is seeing a rising trend in bilingualism. In fact, over half of the world population now speaks more than one language (Bialystok et al., 2012; Chen et al., 2008; Dumont & Lemaître, 2005; Grosjean, 2012; Mahendra & Namazi, 2014). However, despite this demographic shift, research in the field of speech-language disorders, including stuttering, has predominantly focused on monolingual populations (Bloodstein et al., 2021). Consequently, our understanding of how stuttering manifests in bilingual children is based on a different pool of participants. This has led to considerable ambiguity regarding stuttering in bilingual individuals. It is for instance not so clear whether stuttering uniformly presents itself across all spoken languages; or whether bilingual speakers exhibit specific speech disfluencies not seen in monolinguals. Some

researchers even have raised concerns about the impact of early exposure to multiple languages on the fluency of young children. For instance, Howell et al. (2009) suggested that children exposed to multiple languages might be more susceptible to the development of stuttering. However, it remains unclear from research whether bilingualism increases the risk of stuttering or not.

Stuttering is a neurodevelopmental disorder, that typically emerges in children between the ages of 2 and 4 years, with a prevalence of 5% to 6%. It persists in 20% to 40% of cases (Yairi & Ambrose, 2013). Diagnosing stuttering is a multifaceted and intricate process, as it necessitates consideration of various dimensions, including affective, cognitive, social, linguistic, and motor aspects (Yairi & Seery, 2023). The current research project specifically focuses on the linguistic and motoric dimensions. This entails analyzing the type and frequency of disfluencies and identifying any deviations from typical speech patterns (Conture, 2001) in both the dominant and non-dominant languages.

Disfluencies are categorized as stuttering-like disfluencies (SLD), such as part-word or single-syllable word repetitions, prolongations, blocks, and broken words, and other disfluencies (OD), including multisyllable-word or phrase repetitions, interjections, and abandoned utterances (Ambrose & Yairi, 1999). While speech disfluencies are common in all children, those who stutter exhibit an excessive number of SLD. A frequency of 3% SLD or more has been found a good indicator for identifying stuttering (Ambrose & Yairi, 1999; Yairi & Seery, 2023). This criterion is commonly applied in both clinical and research contexts, as reflected in previous works (e.g., Conture, 2001; Van Riper, 1971). It's worth noting that this 3% SLD criterion, widely used internationally, primarily relies on data from monolingual English-speaking children.

Research suggests that bilingual speakers exhibit a higher frequency of word and part-word repetitions in their speech in comparison to monolingual speakers (Bedore et al., 2006; Fiestas et al., 2005). This phenomenon could be attributed to the heightened linguistic uncertainty often associated with bilingualism, as indicated by Byrd et al. (2015a). The presence of multiple languages in a bilingual's linguistic repertoire may introduce additional complexity and potential hesitations in speech production, resulting in an increased likelihood of disfluencies.

Preliminary findings from bilingual English-Spanish (Byrd et al., 2015a) and Yiddish-Dutch (Eggers et al., 2020a) children document that bilinguals often exhibit a higher frequency of SLD compared to what is typically observed in monolinguals, commonly surpassing the 3% SLD criterion. Additionally, research indicates that SLPs encounter considerable challenges in differentiating typical from abnormal disfluencies among bilingual children (Byrd et al., 2015b). Consequently, there is a risk of misidentifying CWNS as CWS in bilingual children and vice versa (Shenker, 2011; Shin, 2017). Furthermore, the lack of normative data in bilingual speakers has

led some SLPs to inaccurately consider bilingualism as a risk factor for stuttering onset or persistence (Byrd et al., 2016).

In sum, researchers and clinicians have stressed the need for empirical data on disfluencies in bilingual individuals across both of their languages (Finn & Cordes, 1997; Roberts & Shenker, 2007; Van Borsel et al., 2001; Tetnowski et al., 2012). With the global rise in bilingualism, understanding the manifestation of stuttering in this population has become increasingly critical for both scientific and clinical purposes. The current research project addresses these challenges by investigating speech disfluencies in a substantial group of bilingual CWNS and CWS living in Lebanon. Unlike most studies, which are typically conducted in monolingual societies like the United States, this research is one of the few based in a multilingual context, where early simultaneous bilingualism and high proficiency in two languages are common. This setting provides a unique opportunity to explore the relationship between stuttering and bilingualism, using a distinctive dataset that offers valuable insights particularly relevant to multilingual populations. By expanding the scope and sample size, this project aims to offer new perspectives on the manifestation of speech disfluencies and stuttering in bilingual children. Ultimately, the goal is to improve diagnostic accuracy and clinical decision-making for bilingual populations.

2 Developmental stuttering

2.1 Definition and symptomatology

The term “stuttering” is often used informally to describe any disruptions in the speech flow. However, speech-language pathologists (SLPs) and PWS do not use the term casually. Clinicians reserve the term “stuttering” for observed instances of sensorimotor disruptions in speech that differ from the typical hesitations and minor disfluencies commonly encountered in everyday conversation. Variations in speech production can sometimes lead to disfluencies being perceived as abnormal or indicative of stuttering (Yairi & Seery, 2023). Speech disfluencies are not exclusive to PWS but are common in the speech of nearly all individuals who do not stutter. They occur frequently in typically developing young children but decrease with age (Yairi, 1981). Distinguishing between PWS and people who do not stutter, particularly in young bilinguals, can be challenging. Genuine stuttering involves momentary lapses in the control or regulation of speech actions, hindering the smooth progression of subsequent sounds or syllables. Given the unique sensorimotor experience of stuttering, SLPs should thoroughly assess both the speaker’s experience and the associated speech characteristics before determining whether the term “stuttering” is appropriate for specific instances of disfluency (Yairi & Seery, 2023).

In the DSM-5, stuttering is classified as a developmental speech fluency disorder and falls under the category of communication disorders (American Psychiatric Association, 2013). It can significantly impact the rhythm and fluency of speech, leading to communication difficulties and affecting the overall quality of life. It is characterized by audible manifestations that are distinct from typical speech interruptions experienced by all speakers. The primary characteristics of stuttering involve observable speech behaviours, such as prolongations, repetitions of parts or whole words, broken words, and blocks. Repetitions can be singular or multiple; in the latter case they are referred to as iterations. In addition to overt speech characteristics, stuttering can often be accompanied by secondary components, including physical, emotional, cognitive, and behavioural aspects (e.g., American Psychiatric Association, 2013; Guitar, 2013; Shapiro, 2011). These secondary behaviours can be further categorized into overt and covert concomitants, and

introspective variables (Bloodstein & Bernstein Ratner, 2008). Overt concomitants are observable behaviours, such as eye-blinking or jaw tension, visible to the eye during moments of stuttering. Covert concomitants, such as changes in the heart rate, are not immediately observable and may be uncovered in the clinical setting indirectly through the use of questionnaires (Bloodstein & Bernstein Ratner, 2008). Introspective variables can be revealed by conversations with the SLP or questionnaires and pertain to the individual's affective and cognitive responses to stuttering, such as heightened anxiety in specific speaking situations or negative beliefs about their communication abilities (e.g., Shapiro, 2011; Yairi & Seery, 2023).

2.2 Etiology

Over the last few decades, various theoretical frameworks have surfaced in an effort to shed light on the underlying causes of stuttering. The current body of research on the etiological origins of stuttering points towards multifactorial patterns, suggesting that stuttering is not solely determined by a single cause but rather arises from the intricate interactions between various factors.

Genetics play a significant role, as evidenced by the higher prevalence of stuttering among immediate family members of PWS (e.g., Drayna & Kang, 2011). Neurobiological factors are also implicated, with studies indicating differences in brain structure and function between PWS and those who do not stutter (e.g., Benito-Aragón et al., 2019; Koenraads et al., 2019). Behavioural aspects are essential components of stuttering etiology, as individuals may develop coping mechanisms or secondary behaviours in response to their stuttering experiences. Additionally, emotional factors, such as speech-related anxiety and self-awareness related to speech, can further influence the development and manifestation of stuttering (e.g., Bloodstein & Ratner, 2008). Finally, environmental factors also contribute to the onset and course of stuttering. More specifically, factors such as family dynamics, social interactions, and exposure to stressful situations can impact the expression of stuttering (e.g., Shapiro, 2011; Yairi & Seery, 2023). The multifactorial nature of stuttering etiology underscores the complexity of this speech fluency disorder.

2.3 Stuttering assessment

Considering the multidimensional nature of stuttering, it is essential to conduct a comprehensive assessment procedure that takes into account various components. In general, parental concerns play a crucial role as they provide a reliable basis for further investigation (Glascoe, 1997; Yairi & Ambrose, 2005). To achieve a comprehensive evaluation, the clinician should conduct a detailed interview with the

parents to gain insights into the child's environment and identify relevant factors for treatment (Shapiro, 2011). Furthermore, the assessment should encompass both overt characteristics, such as speech disfluencies and physical concomitants, and covert characteristics, including affective features (e.g., emotional reactions, fear or avoidance of speaking, frustration), cognitive processes, and social dynamics. This approach aims to gain in-depth understanding of how stuttering impacts the child's daily functioning (Yairi & Seery, 2023; Yaruss & Quesal, 2006).

While the current research project focuses on the overt characteristics, particularly speech disfluencies, the following sections will explore the specific details related to this aspect of the assessment.

2.3.1 Speech examination

2.3.1.1 Speech sample size

Because of the variability of stuttering, the optimal length of a speech sample for reliable stuttering analysis is a topic of ongoing debate in the field. Various experts offer differing recommendations, highlighting the lack of consensus. For example, Riley (1994) suggests a sample size of 200 syllables per speaking mode, while Shapiro (1999) proposes 300 to 400 words. The Stuttering Severity Instrument-4 (SSI-4; Riley, 2009) recommends 2 to 3 speech samples, each with 150 to 500 syllables. In the Test of Childhood Stuttering (TOCS; Ronald et al., 2009), structured conversation and narration tasks are favored for sample analysis with a preference for samples containing 300 words, as suggested by Conture (2006), which are more likely to result in valid conclusions about the child's fluency than short speech samples are. However, Roberts et al. (2009) advocate for measuring speaking time, suggesting a range of 3 to 5 minutes for the speech sample. For pre-schoolers, Sawry and Yairi (2006) found that longer samples, exceeding 1200 syllables, were necessary to capture relevant disfluencies. This indicates that a more extensive speech sample may be required to comprehensively assess stuttering in younger children. Interestingly, some clinicians, such as Manning and DiLollo (2018), do not even specify a particular speech sample size.

In the realm of research concerning the analysis of speech samples in bilinguals who do and do not stutter, a diversity of criteria has been employed in data collection methodologies. For instance, Lim et al. (2008) and Bakhtiar (2024) adopted a 10-minute conversational speech sample format, without stipulating a minimum word count requirement. Byrd et al. (2015a) did not impose a specific minimum word count either, though the total number of words across their collected speech samples ranged from 211 to 357 in English and 172 to 232 in Spanish. Eggers et al. (2020a) gathered a 300-syllable speech sample for each spoken language when assessing

Yiddish-Dutch children. In the studies conducted by Rojas and Irani (2020) and Rojas et al. (2023), no minimum word count was specified; instead, complete narratives were included as they were. In Rojas and Irani (2020), the average number of words ranged from 179 to 350 in Spanish and 189 to 373 in English, while in Rojas et al. (2023), it varied from 230 to 316 in Spanish and 217 to 312 in English.

The lack of clear guidelines makes it challenging to determine the appropriate length of a speech sample for reliable stuttering analysis. However, it can also be argued that a definite number cannot be given, as the degree of stuttering severity can modify the appropriate size of the speech sample. That is, for individuals with severe stuttering, a relatively short sample may be sufficient to make an assessment. In case of milder stuttering, a larger sample size is often necessary to make an accurate and reliable assessment (Yairi & Seery, 2023).

In the present study, we adopted a methodology involving the collection of two speech samples per language, yielding a total of four speech samples per participant. Our decision to include full speech samples was grounded in the principle of enhancing ecological validity (Olness, 2006). Additionally, we established a minimum word count requirement for each speech sample, aligning with the criteria commonly observed in existing assessment tools. A minimum threshold of 100 words per speech sample was stipulated, resulting in a total minimum word count of 400 per participant. Participants whose speech samples did not meet the specified word count were excluded from the analysis. Speech samples that met the criterion were retained in their entirety.

2.3.1.2 Speech sample types

In collecting speech samples from children, both conversations and narratives are typically employed. These two contexts offer distinct opportunities for capturing speech samples, each with its advantages and challenges. Conversations, which involve frequent turn-taking, are valuable for obtaining representative speech samples from the home environment and daily communication. However, they may place more pressure on the child due to shifting topics and potential interruptions, leading to increased instances of stuttering events (Yairi & Seery, 2023). On the other hand, narratives provide a continuous stream of speech with longer and more complex utterances, making them ideal for assessing functional speech-language production, especially in linguistically diverse populations (Leadholm & Miller, 1995; Castilla-Earls et al., 2020; Rojas & Iglesias, 2019). They are, however, less common in family speaking contexts. They can be elicited through various tasks, including story-retelling, telling tasks, and personal narratives.

Story-retelling tasks involve children listening to a story and then retelling it, often aided by visual prompts, making them less demanding tasks compared to story

generation (Merritt & Liles, 1989; Westerveld & Gillon, 2010). Story-retelling tasks also allow researchers to control linguistic factors such as story length and complexity (Pearson, 2002). In contrast, telling tasks require children to narrate a story without an oral model, either prompted orally or based on a single picture (Lindgren, 2023). Personal narratives involve generating stories from memory, and the chosen topics can significantly impact narrative performance, with some topics eliciting longer and more complex narratives (Fiestas & Peña, 2004). Overall, while story-retelling tasks are generally considered easier than telling tasks due to the provided content, both types of narratives offer valuable insights into speech production in children (Lever & Sénéchal, 2011).

CWS commonly experience notable fluctuations in the frequency and severity of overt stuttering characteristics (Yaruss, 1997). Therefore, when stuttering appears mild or is hardly observed, it is advisable to collect two to three different types of speech samples on separate days. Additionally, home-based speech samples hold particular significance for CWS, given the anticipated variations in their speech patterns (Yairi & Seery, 2023).

Studies examining speech disfluencies in bilingual children have used various methodologies for data collection. Byrd et al. (2015a) employed both retelling and telling tasks, while Eggers et al. (2020a) exclusively gathered conversational speech samples. Rojas and Irani (2020) and Rojas et al. (2023) utilized retelling tasks, while Bakhtiar (2024) employed both conversational and retelling tasks. In the current research project, we chose to use both conversational and telling tasks for two main reasons. Firstly, we aimed to mirror typical clinical practice given the nature of the research topic and its clinical implications. Both conversational and telling speech samples are collected in assessments such as the SSI-4 (Riley, 2009) and the TOCS (Ronald et al., 2009) or employed in screening procedures. Secondly, as disfluencies are more likely to occur in linguistically complex situations (Fiestas & Peña, 2004), we opted for a telling task, which is more challenging than the retelling task (Lever & Sénéchal, 2011). In addition, a conversational task, requiring frequent turn-taking, may exert greater pressure on the child due to potential interruptions, which may lead to increased stuttering events (Yairi & Seery, 2023).

2.3.1.3 Recordings

Whether for clinical or research reasons, recording and transcribing speech samples offers quantitative data on speech disfluencies, facilitating a detailed examination of stuttering. Opting to record speech samples audiovisually rather than relying solely on audio samples has the benefit of having access to visual cues such as physical concomitants that often accompany SLD. Visual information could be particularly useful in interpreting challenging and unclear speech disfluencies that may be

difficult to classify on the basis of audio data only. A critical consideration when using video recordings though involves determining the most suitable view of the child to frame. In order to capture potential secondary behaviours, such as arm movements or upper body posturing, it is recommended to obtain a video image encompassing the upper body from the waist to the head, with enough proximity to reveal facial expressions. These comprehensive recordings may serve not only as valuable diagnostic aids but also as tools for communicating about the patient's progress over time (Yairi & Seery, 2023).

Over the past decades, researchers have explored how the presentation mode of stimuli influences listeners' perceptions of speech fluency in monolinguals (Cordes, 2000; Martin & Haroldson, 1992; Panico et al., 2005; Runyan & Adams, 1978; Runyan & Adams, 1979; Tuthill, 1940; Wendahl, 1961, Williams & Kent, 1958; Williams et al., 1963). While certain studies have found no significant difference in the identification of stuttering events between audiovisual and audio-only speech samples (e.g., Bloodstein & Bernstein Ratner, 2008; Tuthill, 1940), others have demonstrated a more accurate detection of stuttering moments through audiovisual recordings (e.g., Luper, 1956). These conflicting findings may stem from methodological variations, such as differences in participant backgrounds, the severity of stuttering in experimental samples, and the presence or absence of visible or audible physical concomitants.

In the current research project, we chose to explore how the mode of presentation affects the identification of stuttering events and the assessment of stuttering severity in our bilingual population. Our reasoning was that audiovisual speech samples offer a more authentic face-to-face listening experiences and allow for a more thorough analysis of secondary behaviors. This potentially leads to more precise judgments about fluency compared to audio recordings alone in a bilingual context.

2.3.1.4 Transcription

After recording a speech sample, the subsequent crucial step involves creating a written transcription to enable thorough analyses. When undertaking this task, it is advisable to begin by transcribing the child's words in an utterance without immediately marking the disfluencies (Yairi & Seery, 2023). Having prior knowledge of the context of the words proves beneficial in resolving any ambiguities that may arise during the transcriptions process. In clinical practice, it is customary to listen to the recorded speech sample repeatedly, as many times as necessary, to ensure the most accurate and reliable transcript, forming the foundation for subsequent analysis (Shapiro, 2011; Yairi & Seery, 2023).

2.3.1.5 Methods for measuring disfluencies

There has been ongoing debate among clinical researchers regarding whether to tally instances of stuttering or all instances of disfluency (e.g., Conture, 1990b; Cordes & Ingham, 1996a). Advocates for counting all disfluencies argue that a comprehensive range of disfluent behaviors leads to more accurate diagnostic evaluations (e.g., Campbell & Hill, 1987; Conture, 1990b), as the specific nature of all disfluencies can offer valuable diagnostic insights. Conversely, proponents of counting stuttering assert that stuttering events are easily identifiable and more pertinent to the specific speech disorder being assessed (Ingham, 1985; Teesson et al., 2003). For instance, it would be illogical to tally interjections or revisions, as they do not typify the individual's stuttering disorder. In the current research project, we explored whether diagnostic accuracy is confined to stuttering events only or whether a broader spectrum of disfluencies should be considered.

Clinical researchers employ different metrics to measure stuttering, with some preferring syllable counts (e.g., Ambrose & Yairi, 1999; Campbell & Hill, 1987; Riley, 1994) and others opting for word counts (e.g., Conture, 1990a). In young children, where monosyllabic words are prevalent, the number of words and syllables in a sample do not differ that much (Yaruss, 1997). The choice between words and syllables as the counting unit may depend on factors such as the availability of verbatim transcripts or the language in question. For instance, counting words might be more convenient when working with transcripts, while syllable counting could be simpler during real-time listening sessions, allowing clinicians to discern stressed peaks in speech flow more easily (Yaruss, 1997). Regarding language, it could be contended that in a language with significant discrepancies between the number of syllables and words, such as the highly agglutinative Finnish, a syllable-based metric would be more appropriate. This aligns with the conclusions and recommendations of Jansson-Verkasalo et al. (2020), who proposed the use of a syllable-based metric in Finnish due to the prevalence of longer words in the language and the observation that children's early vocabularies often comprise multisyllabic words.

Another approach in assessing stuttering involves examining whether stuttering occurs within specific time intervals (e.g., Ingham et al., 1993). This technique requires dividing a speech sample into intervals and determining the presence of disfluencies or stuttering within each interval. However, applying this method in clinical settings can be challenging. The duration of the intervals can influence the identification of stuttering, with variations observed between different interval lengths (Cordes & Ingham, 1994b). In fact, the clinical relevance of interval-based measures can raise questions about their utility in decision-making processes. Therefore, clinicians may find it more practical to directly count instances of disfluencies or stuttering to inform their clinical judgments effectively.

In the current research project, we adopted a comprehensive approach by counting all types of speech disfluencies, aiming to gain a deeper insight into the diverse disfluency patterns observed in bilingual individuals. We chose to measure disfluencies using a word-based metric because it is more practical when analyzing verbatim transcriptions. Additionally, employing this metric facilitates direct comparison with previous research findings, considering that the majority of studies focusing on bilingual populations have utilized word-based analysis techniques.

2.3.1.6 Classification of disfluencies

The assessment and labelling of a speech sample as stuttered speech, relies on the analysis of the type and frequency of disfluencies (e.g., Ambrose & Yairi, 1999; Conture, 2001). Speech disfluencies can be categorized into various types. Johnson (1961) developed an early classification system consisting of interjections, part-word repetitions, word repetitions, phrase repetitions, revisions, incomplete phrases, broken words, and prolonged sounds. Johnson's scheme underscored the significant overlap in disfluent behaviors between PWS and those who do not. This classification has been refined later on and revealed that PWS produce more sound, syllable, and monosyllabic word repetitions as well as blocks and (in)audible sound prolongations, whereas those who do not stutter produce primarily interjections, revisions, and phrase repetitions (e.g., DeJoy & Gregory, 1985; Yairi & Lewis, 1984).

Given that many disfluencies among PWS involve interruptions within word units, categorization systems have emerged to differentiate within-word and between-word disfluencies (e.g., Conture, 1990a, 1990b). Within-word disfluencies encompass monosyllabic whole-word repetition, sound/syllable repetition, blocks and audible and inaudible prolongation, while between-word disfluencies include phrase repetition, multisyllabic whole-word repetition, interjections, and revisions.

Various terms have been employed to describe disfluencies characteristic of PWS compared to those who do not, such as stuttering-like versus other disfluencies (e.g., Yairi & Ambrose, 1992), less typical versus more typical (e.g., Gregory & Hill, 1993), or stutter-type versus normal-type (e.g., Meyers, 1986). These classification systems generally agree on labelling part-word repetitions and dysrhythmic phonation as stuttering-like, and interjections, phrase repetitions, revisions, hesitations, and incomplete phrases as non-stuttering-like. However, there are discrepancies regarding the classification of monosyllabic whole-word repetitions. For instance, Yairi and Ambrose (1992) consider them as stuttering-like, while Meyers (1986) categorize them as normal-type disfluencies. Some researchers consider the number of iterations to determine the typicality of repetitions, with two

or fewer repetitions without tension classified as more typical, and three or more repetitions as less typical (e.g., Campbell & Hill, 1987; Gregory & Hill, 1993).

In the current research project, we adopted the Illinois disfluency classification system proposed by Ambrose and Yairi (1999), which builds upon earlier schemes by Johnson et al. (1959) and Yairi and Lewis (1984). Notably, they revised the classifications by eliminating the between-word category of tense pause and consolidating multisyllable word repetition and phrase repetition. Consequently, disfluencies are grouped into two categories: Stuttering-Like Disfluencies (SLD), including monosyllabic word repetitions, syllable and sound repetitions, and dysrhythmic phonation (i.e., prolongations, blocks, and broken words); and Other Disfluencies (OD), comprising multisyllable word/phrase repetitions, interjections, revisions, and unfinished words/sentences (Ambrose & Yairi, 1999). To specify the type of revision, especially relevant for bilinguals, we followed Bedore et al. (2006). They distinguished between phonological revisions (correction of phonological errors), lexical revisions (correction of overt choice errors by adding or deleting lexical information), and grammatical revisions (correction of overt grammatical errors). The various types of disfluencies are outlined in Table 1 below.

Table 1. Types and examples of disfluencies following Ambrose and Yairi (1999) and Bedore et al. (2006) classification.

Disfluency type	Description	Examples
Stuttering like disfluencies		
Part word repetition	Repetition of a sound/syllable within or in the beginning of a word	ta-ta-table c-c-c-car
Monosyllabic word repetition	Repetition of monosyllabic word	I I I
Prolongation	Prolongation of a sound	sssnake
Block	Stopping airflow and sound during or before the production of a vowel or consonant	…door
Broken word	Stopping airflow within a word	a…pple
Other disfluencies		
Interjection	Filler words or non-linguistic sounds	uhm
Multisyllable/phrase repetition	Repetition of a multisyllabic word or phrase	Christmas Christmas I want I want
Abandoned sentences	Uncompleted sentences	I want wow there is a rainbow
Lexical revisions	Correction of word choice errors, by adding or deleting lexical information	Give me the (pencil) pen
Grammatical revisions	Correction of grammatical errors	He is sitting (in) on the chair
Phonological revisions	Correction of phonological errors	I have (gymtastics) gymnastics

2.3.1.7 Speech-based identification of stuttering in monolinguals

Listener's judgments of disfluencies are significantly influenced by their frequency. As stuttering occurs more frequently, listeners are more likely to make increasingly negative comments about the speaker (Panico et al., 2005). However, variations in the perception of these disfluencies can make it challenging for some listeners to differentiate between typical and stuttered disfluencies (Sander, 1963). Several factors impact listener judgment, including the type, duration, intensity of disfluencies, as well as the characteristics of the listener (Kawai et al., 2007).

While most disfluency types can occur in all speakers, certain types are more likely to be perceived as stuttered by listeners, leading to behavioral classification schemes aimed at identifying those most indicative of stuttering (Ambrose & Yairi, 1999; Zebrowski & Conture, 1989). For example, although single-syllable word repetitions and syllable repetitions are present in all speakers, their frequency is significantly higher in CWS compared to CWNS (5 times for single-word repetitions and 10 times for syllable repetitions). Additionally, the speed of repetitions is 3 times faster for CWS, the mean number of iterations is higher, and the disfluencies' clustering within speech is different (Throneburg & Yairi, 1994; 2001; Ambrose & Yairi, 1995; Sawyer & Yairi, 2010). However, as noted previously by Martin and Haroldson (1981), the process of identifying stuttering among different listeners is not always straightforward. For instance, a speech interruption featuring five effortless repetitions of a single-syllable word could be perceived as stuttering by one observer but not by another one in a given situation. Moreover, these same observers may find their thresholds for identifying stuttering changing over time or in different contexts, potentially resulting in reversed identifications.

From the speaker's perspective, the underlying reasons for disfluencies are also crucial. Typical disfluencies often result from reasons such as word-finding difficulties, sentence-formulation decisions, reconsideration of message content, or distractions. When speakers recognize the reasons behind their speech disfluencies, they tend to acknowledge them as typical. However, when the words are fully decided, and the intention to say them is present, but the production becomes stuck, the speaker's experience is more likely to align with the label of stuttering (Yairi & Seery, 2023).

2.3.1.8 Monolingual clinical thresholds for stuttering

Disfluencies are a normal part of children's speech (Ambrose & Yairi, 1999; Eggers & Elen, 2018). However, CWS typically exhibit a large number of SLD, larger than average at least. To identify stuttering in children, various criteria have been proposed:

- A minimum of 3 SLD in a 100-syllable speech sample (Ambrose & Yairi, 1999) or a 100-word speech sample (Bloodstein, 1995; Conture, 2001)
- A minimum of 7% OD (Tumanova et al., 2014)
- A minimum of 10% total disfluencies (including SLD and OD) per 100 words (Guitar, 2013)
- A mean number of 2 iterations per repetition (Ambrose & Yairi, 1995, 1999; Pellowski & Conture, 2002)
- A weighted SLD measure of 4%, which reflects three dimensions, frequency, type and extent. This measure is determined by summing the frequencies of part- and single-syllable word repetitions, multiplying this sum by the average number of repetition units, and then adding twice the frequency of dysrhythmic phonation. Research has demonstrated its effectiveness in distinguishing between individuals with high SLD frequency who are typically fluent speakers and those with low frequency who stutter, due to stronger weight of dysrhythmic phonation and consideration of the mean number of iterations (Ambrose & Yairi, 1999; Yairi & Ambrose, 2005).

The 3% clinical threshold for SLD has been validated in English-speaking children (Ambrose & Yairi, 1999). Ambrose and Yairi observed significant differences in SLD between monolingual CWS and CWNS. They found that the total SLD for CWS was 10 times higher than for CWNS. Additionally, SLD constituted 66% of the overall disfluency in CWS, compared to just 24% in CWNS. The 3% SLD frequency appears to be the minimal level required to designate stuttering. This threshold is widely used internationally, and multiple studies have shown that it can accurately assess stuttering in non-English monolingual speakers, including Spanish (Carlo & Watson, 2003), French (Leclercq et al., 2017), German (Natke et al., 2006), and Dutch (Boey et al., 2007).

Moreover, Yairi and Ambrose (2005) developed a comprehensive set of seven minimal diagnostic criteria tailored specifically for children who exhibit symptoms that are on the borderline of stuttering, each criterion being measured in occurrences per 100 syllables. These diagnostic criteria include part-word repetition (1.5%), single-syllable word repetition (2.5%), dysrhythmic phonation (0.5%), total SLD (3.0%), weighted SLD (4.0%), mean repetition units (1.5) and part-word and single syllable word with 2 or more extra units (2.0). The child's performance is then compared against the predetermined threshold values. If a minimum of three out of the seven criteria meets or exceeds these threshold values, it is deemed sufficient to confirm the presence of stuttering.

2.3.2 Generalizability of the diagnostic criteria

The speech examination methods mentioned above are primarily designed for monolingual speakers. However, with the widespread prevalence of bilingualism worldwide (e.g., Bialystok et al., 2012; Grosjean, 2021; Mahendra & Namazi, 2014), researchers and clinicians have been focusing lately on studying interlinguistic characteristics to differentiate between bilingual children who stutter and their monolingual counterparts (e.g., Roberts & Shenker, 2007; Van Borsel et al., 2001). These studies underscore the crucial need for empirical data on disfluencies in bilingual children across various spoken languages (Tetnowski et al., 2012) and stress the significance of understanding stuttering manifestations in bilinguals from both scientific and clinical perspectives (Shenker, 2011; Shin, 2017). A deeper comprehension of the relationship between stuttering and bilingualism may lead to the development of improved assessment methods tailored for bilingual individuals, ultimately enhancing diagnostic accuracy (Choo & Smith, 2020). Therefore, exploring the complexities of bilingualism in the context of stuttering is of significant importance in the field of speech-language pathology. The current project is explicitly addressing these objectives.

3 Bilingualism and beyond

3.1 Defining the dual language experience

In contemporary times, bilingualism has become the norm, characterizing the linguistic daily life of over half of the world's population (Grosjean, 2021). This widespread bilingualism is a result of various phenomena, such as open borders, increased global mobility, cultural exchanges, and commercial interactions between countries. The expanding prevalence of mixed couples from different nations raising their children in multilingual environments (Bhatia & Ritchie, 2013) and the significant role of school and university in second language acquisition have further led to bilinguals now outnumbering monolinguals (Kohnert, 2010).

3.1.1 Navigating the spectrum of bilingualism

The increasing prevalence of bilingualism has motivated researchers to explore the mechanisms behind acquiring multiple languages, and research on bilingualism has grown expediently over the last decades. However, the diverse nature of bilinguals' linguistic profiles makes comparisons of bilingual studies difficult (Grosjean, 1998; 2021). Hence, it's essential to thoroughly examine the bilingual history and proficiency of bilingual participants and subsequently provide a detailed description when reporting research on this topic.

Throughout the years, various authors have defined bilingualism in different ways. Originally, a person was considered bilingual if their proficiency in the second language equalled that of a native speaker (Bloomfield, 1939). As time went on, the definition evolved and it was suggested that having basic proficiency in one of the four linguistic skills (understanding, speaking, reading, and writing) is enough to label an individual as bilingual (e.g., Hamers & Blanc, 1989). Whereas early definitions primarily emphasized linguistic proficiency, recent explanations focus more on language use. For instance, Grosjean and Li (2013) propose that bilinguals are individuals who use two or more languages daily, in various contexts and with different interlocutors, without necessarily mastering them equally.

In any case, even after numerous attempts, a universally agreed-upon definition of bilingualism remains elusive. It is evident that achieving complete mastery of two

languages is nearly unattainable (e.g., Wei, 2007). Consequently, it may be more sensible to label bilingualism as the ability to communicate in two or more languages, existing on a continuum of language skills and use, ranging from a minimum to maximum ability (Chin & Wigglesworth, 2007). In this perspective, each bilingual individual embodies their unique form of bilingualism.

3.1.2 Bilingual language diversity

3.1.2.1 Simultaneous versus sequential bilingualism

Simultaneous bilinguals acquire two languages concurrently, usually when exposed to both languages from birth or before the age of two. In contrast, sequential bilinguals begin with one language spoken at home and later incorporate a second commonly used language, often through day-care or school exposure (e.g., Bhatia & Ritchie, 2013; De Houwer & Ortega, 2019; Paradis, 2010). Simultaneous bilinguals often achieve high levels of competency in both languages (Paradis et al., 2005). However, some children with a first (minority) language can excel in learning their second (community) language, even surpassing their proficiency in their first language, influenced by factors such as need, motivation and language input quality (e.g., Genesee et al., 2004; Hoff & Shatz, 2007).

3.1.2.2 Age of acquisition in bilingualism

It's widely acknowledged that the age at which a language is acquired influences the level of proficiency attained. High levels of language proficiency are more likely to be achieved when the language is learned at an early age, though this is not always the case. Age-related decline is understood more as a continuum rather than a distinct cut-off point (Abutalebi & Clahsen, 2018). This understanding is supported by insights from neural, cognitive, and social perspectives, which highlight the complex interplay of factors involved in language learning (e.g., Birdsong, 2018). Moreover, the impact of age of acquisition on language proficiency varies across different linguistic components, with phonology often being identified as particularly challenging to acquire as one gets older (Birdsong, 2018). At any rate, it's important to approach the role of age of acquisition with nuance, recognizing the multifaced nature of language acquisition and the role of contextual factors. In our studies, the bilingual participants all acquired their both languages very early. In fact, many of them acquired both languages from birth onwards, making them simultaneous bilinguals.

3.1.2.3 Language dominance

Language dominance pertains to the varying levels of proficiency a bilingual individual possesses in each language, where the dominant language is considered the one in which proficiency is higher. It encompasses various dimensions, including linguistic proficiency and socio- and psycholinguistic factors (Snape & Kupisch, 2016). Exposure to and usage of language are pivotal in shaping language dominance, with some researchers emphasizing proficiency as a determinant while others consider factors like exposure, use, or environmental language (Argyri & Sorace, 2007).

Montrul (2016) suggests that language dominance comprises linguistic proficiency, external input, and functional context and use. Proficiency refers to the depth of knowledge in each language, while language use pertains to the frequency and distribution of language usage across different contexts (Luk & Bialystok, 2013). However, the multidimensional nature of language proficiency raises questions about the prioritizing specific components in dominance assessment (Treffers-Daller, 2019).

Language dominance can also vary across different domains of language use, leading to domain-specific dominance (Grosjean, 2016). Bilinguals may exhibit dominance in one language within a particular domain while being dominant in another domain in another language. This variability reflects the diverse contexts and purposes for which languages are utilized. Determining whether one language is dominant or whether the individual is a balanced bilingual is therefore essential. Balanced bilinguals are expected to demonstrate comparable proficiency in both languages, while dominant bilinguals excel in one language over the other (Bhatia & Ritchie, 2013; De Houwer & Ortega, 2019). Several researchers have identified the frequency of language use as a crucial factor in determining linguistic dominance (e.g., Gutiérraz-Clellen & Kreiter, 2003; Restrepo, 1998). A language is considered dominant if it is used 61% to 80% of the time, and non-dominant if it is used 20% to 40% of the time. Balanced bilinguals use both languages 41% to 60% of the time. Achieving true balanced bilingualism, where mastery of both languages is entirely equal, is rare. However, early simultaneous bilinguals may come close to this balance (Fishman, 1972).

3.1.2.4 Bilingualism in Lebanon

Lebanon is a unique case when examined from a demolinguistic perspective. The Middle Eastern and Western blend that characterizes the Lebanese population is notably evident in the unique language mixing found in various communication situations, resembling the code-switching often observed in bilingual individuals (Makki, 2007). Despite Modern Standard Arabic being the official language,

predominantly used in written form within educational institutions, Lebanese Arabic is used as a spoken language for almost 94% of the population (Leclerc, 2015). This already constitutes a particular instance of diglossia. In addition, many children experience early simultaneous bilingualism, being exposed to two or three languages from birth due to parents opting to use multiple languages at home from an early age. Additionally, around 45% consider French and 40% English as their other language (Jabbour, 2004). The bilingual upbringing and the use of one or both of these languages in day-care and educational settings fosters a multilingual environment from a very young age, contributing to widespread bilingualism across Lebanon (Abou, 1962; Shaaban, 1997). This early exposure to linguistic diversity highlights the prevalence and significance of bilingualism within the Lebanese society. As a result of this, children often are quite balanced in their language proficiency, even though the proficiency level is often a bit higher in one of the languages. In regions with lower socioeconomic status, children may not be exposed to the second language until they begin school, typically around the age of 3 or 4. In these instances, we observe a larger disparity between the two languages, where Lebanese Arabic is clearly the dominant language, while French and/or English are clearly non-dominant.

The current research project involves participants proficient in either Lebanese Arabic and French, Lebanese Arabic and English, or the three languages (qualifying as trilinguals). Thus, our study presents a diverse group of participants, reflecting Lebanon's multilingual environment and the varied language experiences of bilinguals.

3.2 Assessing bilingual language proficiency in children

The assessment of language dominance in bilingual children presents challenges due to the lack of standardized measures, as highlighted by Genesee et al. (1995), who emphasized the need for clearer measurement methods to ensure consistency across studies. Commonly used approaches are the mean length of utterances, despite the complexities in comparing it across languages or assessing language dominance through vocabulary measures (Kupisch, 2008). A more indirect way involves examining experience-based variables, such as children's exposure to both languages in their input and their own language output (Bedore et al., 2012). This indirect method offers advantages over direct measures, as it circumvents the challenge of sourcing tests in multiple languages and is particularly useful in multilingual settings lacking standardized assessments. Bedore et al. (2012) correlated direct and indirect measures, developed scores for semantic and morphosyntactic measures, and gathered detailed information on language exposure

and use through parental questionnaires. Several studies have shown correlations between indirect and direct measures of dominance, reinforcing the efficacy and efficiency of parental questionnaires as measures of language dominance (e.g., Jia et al., 2002; Unsworth, 2016).

Parental questionnaires serve as important tools for evaluating a child's linguistic dominance and language profile in bilingual environments. Various instruments like the Alberta Language and Development Questionnaire (Paradis et al., 2010), the Alberta Language Environment Questionnaire (Paradis, 2011), and the Parents of Bilingual Children Questionnaire (PaBiQ; Tuller, 2015) offer comprehensive sections probing into a child's bilingual history and current language use. In the current studies, we have used the PaBiQ (see Appendix 1) to determine language dominance among our bilingual participants. This questionnaire inquires about the age of language exposure, simultaneous or sequential acquisition, and language use frequency across different contexts. Additionally, it assesses current language skills, including proficiency and comfort levels in language use, providing valuable insights into a child's bilingual abilities.

4 Fluency and stuttering in bilinguals: Current insights

4.1 Bilingualism as a risk factor to develop stuttering

A long-standing question on the cross-section between bilingualism and stuttering has been whether bilinguals have a higher risk to develop stuttering than monolinguals. Already in the early part of the 20th century, Travis et al. (1937) stated that stuttering was more prevalent in bilingual individuals compared to monolinguals. This statement was based on their study analyzing disfluencies in spontaneous speech and reading samples of bilingual children aged 4 to 17 years. Blanton (1916), Eisenson (1984), and Karniol (1995) reached similar conclusions in their respective studies. These early studies could be criticized for being limited in scope or being methodologically unsound. More precisely, the latter three studies comprise single case studies and – as pointed out by Gahl (2020) - the study by Travis et al. (1937) contains inconsistent counts, rates, and design issues.

However, also more recent studies suggest that exposure to multiple languages increases the risk of developing stuttering in children. Also here, this contention is built on the finding that bilingual children typically exhibit more disfluencies than their monolingual counterparts (Bedore et al., 2006; Firozjaei, 2013; Van Borsel et al., 2001). Howell et al. (2009) conducted a study suggesting that delaying exposure to English until after the age of 5 may reduce the risk of stuttering onset and increase the chances of recovery compared to children who acquire both English and a minority language during this period. However, Packman et al. (2009) criticized this study and contested its conclusions, noting that the authors drew conclusions about the general population of bilingual children from a clinical cohort. They argued that establishing a relationship between stuttering and bilingualism requires an epidemiological study. Packman et al. further emphasized the necessity of more robust evidence to support such recommendations.

The view by Howell et al. (2009) is not held very widely in the clinical field. Byrd et al. (2016) investigated how many SLPs perceive bilingualism as a risk factor for stuttering. In the study, 207 SLPs in the US participated in an online survey to assess their knowledge of risk factors for stuttering, including bilingualism. The

study exposed that 22.7% of the therapists considered bilingualism to be a risk factor for the development and persistence of stuttering. In other words, the majority of SLPs did not view bilingualism as a risk factor for stuttering.

In contrast to the view that bilingualism may cause stuttering, some researchers argue for other explanations of the previous findings. Byrd et al. (2015a) and Eggers et al. (2020a) actually argue for the reverse scenario, positing that bilingual children face the risk of being misdiagnosed as stutterers due to inadequate understanding of how speech disfluencies and stuttering manifest in multiple languages. In accordance with this, a systematic review conducted by Byrd et al. (2020) examining the diagnosis criteria of multilingual participants who stutter in existing studies revealed that 57% of the studies with bilingual children utilized diagnostic descriptors based on monolingual guidelines.

4.2 Fluency patterns in bilingual children

4.2.1 Insights from typically fluent bilingual children

Identifying stuttering in bilingual children poses challenges for SLPs. To ensure accurate diagnoses in bilingual contexts, it is crucial to gain a deeper understanding of the speech disfluencies observed in bilingual CWNS. This understanding should consider the diverse linguistic profiles, richness, and exposure to different languages. It has frequently been found that typically fluent bilingual children exhibit more speech interruptions compared to their monolingual peers (Bedore et al., 2006). These interruptions include filled pauses, repetitive use of connectors, sound, syllable and word repetitions, and revisions (Fiestas et al., 2005; Navarro-Ruiz & Rallo-Fabra, 2001). This is likely a consequence of the distinct language usage patterns of bilinguals compared to monolinguals, resulting in weaker and fewer lexical representations (Grosjean, 2021). Indeed, it has been shown that bilingual children tend to have smaller lexicons (Peña et al., 2016) and weaker connections between semantic and phonological information than monolinguals (Gollan et al., 2005). Moreover, the use of multiple languages may burden their language processing system, leading to speech disfluencies (Carias & Ingram, 2006). Interruptions also serve the purpose of monitoring and self-correcting one own's speech output. It is possible that bilinguals, being linguistically more uncertain than monolinguals, utilize interruptions more frequently for this purpose, particularly when expressing intricate ideas involving spatial, temporal, or causal relationships in the less-developed language (Fiestas et al., 2005; Loban, 1976).

Studies examining which type of disfluencies bilingual CWNS exhibit, found that word and syllable repetitions are be most common (for evidence with Spanish-English bilinguals, see Bedore et al., 2006; Fiestas et al., 2005). Byrd et al. (2015a)

conducted a study with 18 Spanish-English CWNS, aged between 5;06 and 6;07 years (6 were Spanish- dominant, 6 were English-dominant, and 6 were balanced bilinguals). Narrative speech samples were collected in both spoken languages with the aim to describe the frequency and types of speech disfluencies. The participants exhibited significantly more disfluencies than what was typically considered indicative of stuttering in monolinguals – with almost 78% showing between 3% and 22% SLD, and again a predominance of syllable and monosyllabic word repetitions. Another study involving 59 Yiddish-Dutch CWNS aged between 6.01 and 10.04 (all Yiddish dominant) yielded similar findings, with 46% participants exceeding the SLD monolingual threshold in the dominant language and 78% in the non-dominant language (Eggers et al., 2020a).

In summary, bilingual CWNS demonstrate increased speech disfluencies or interruptions, distinct from those of monolinguals. Specifically, compared to monolinguals, there is a higher frequency of repetitions and revisions (Bedore et al., 2006; Fiestas et al., 2005). These findings emphasize the importance of understanding the nature of disfluencies in typically fluent bilingual children for more accurate assessments and clinical decision-making. In this project, we extract the disfluency profiles of a relatively large group of bilingual CWNS in both of their languages and compare these profiles with those of CWS.

4.2.2 Insights from bilingual children who stutter

Research on the manifestation of stuttering in bilingual children is still limited. Moreover, existing research is still inconclusive due to variability in factors such as languages of the bilingual, language exposure and proficiency in each language, age of acquisition of either language, and diagnostic methodologies. In the following, I will discuss a number of studies that have shown that the manifestation of stuttering is indeed impacted by these variables.

Howell et al. (2009) explored stuttering manifestations in 69 bilingual CWS and found that they occurred in both languages, but more frequently in the less proficient language. Similar findings were observed in subsequent studies, even with smaller sample sizes (Koushik et al., 2009; Mamdoh & Gomaa, 2015). In a similar vein, it was found that disfluencies occur more frequently in the less dominant language (Maruthy et al., 2015; Schäfer & Robb, 2012). These findings indicate that greater cognitive effort is required in case of a less proficient/dominant language, affecting the distribution, frequency, and nature of disfluencies. Another language-dominance related observation is that interjections and prolongations are more frequent in the less-dominant language, while repetitions are more prevalent in the dominant language (Carias & Ingram, 2006).

Additionally, linguistic factors such as grammatical class of words, have been explored in relation to disfluencies. Studies have shown more disfluencies on content words in the dominant language and function words in the non-dominant language (Gkalitsiou et al., 2017; Howell et al., 2004). However, due to limited participant numbers, generalization of these findings remains challenging.

In sum, given the heterogeneity of bilingual profiles, encompassing differences in language acquisition, proficiency, and dominance, it is challenging to draw definitive conclusions about the manifestation of disfluencies in bilingual CWS (Van Borsel, 2011; Werle et al., 2019). Moreover, the majority of studies on bilingual CWS are either case studies or based on limited participant samples, limiting the generalizability of the results. Therefore, a comprehensive understanding of the manifestation of stuttering in bilingual CWS has proven to be challenging. The current project seeks to advance our insights into this by evaluating disfluencies in both the dominant and non-dominant language.

4.3 Speech sample-based identification of stuttering in bilinguals

Identifying stuttering in bilingual children can present significant challenges. Previous research has shown that misdiagnosis rates with bilingual children are high, with teachers and SLPs often misidentifying CWNS as CWS; also, CWS are occasionally misidentified as CWNS (Stern & Log, 1948; Byrd et al., 2015b).

In their study, Byrd et al. (2015b) investigated the ability of 14 SLPs to accurately identify stuttering in bilingual children. The findings showed that 86% of the SLPs falsely identified a bilingual Spanish-English nonstuttering child as a stuttering child, while 29% considered a bilingual Spanish-English stuttering child as a nonstuttering child. The assessment was based on the analysis of audio recordings of the speech samples of the stuttering child and nonstuttering child. Both children were matched on age, gender, languages, and frequency of disfluencies, with the stuttering child having more SLD and the nonstuttering child having more OD. The correctness of identification was not related to SLPs' years of experience in working with bilinguals who stutter. This study also highlights the difficulty of accurately identifying stuttering in bilinguals, a challenge compounded by variations among individuals and languages (Gutierrez-Clellen & Simon-Cereijido, 2010). Bilingual children often demonstrate frequent disfluencies in their speech, such as pauses, repetitions, and interjections (Shenker & Watson, 2009). Consequently, clinicians may face difficulty distinguishing between disfluencies arising from bilingualism and those associated with stuttering.

The lack of specialized training in assessing bilingual children contributes to the potential for inaccurate diagnoses. Without this specialized training, clinicians may

struggle to understand the linguistic context of the child, leading to misdiagnoses of stuttering or incorrectly attributing disfluencies to bilingualism instead of recognizing them as indicative of a fluency disorder (Dockrell et al., 2017).

5 Aims of the thesis

Nowadays, more than half of the world's population speaks multiple languages (Grosjean, 2012; Mahendra & Namazi, 2014). However, research on speech-language disorders, like stuttering, has largely focused on monolingual populations neglecting this demographic shift. The limited research available on the intricate relationship between stuttering and bilingualism underscores the necessity for more empirical-based studies on disfluencies in bilingual CWS and CWNS. Differentiating between typical disfluencies and stuttering in bilingual children is an important matter that merits the attention of both clinicians and researchers. The current research project was designed with that specific goal in mind.

The current project was conducted in Lebanon, a Middle-Eastern country where bilingualism is the norm rather than an exception. Lebanese children are typically exposed to 2 or 3 languages, including Lebanese Arabic, French, and English, from a very early age. Despite the richness of the bilingual Lebanese context, there is a lack of studies on speech disfluencies in Lebanese bilinguals, highlighting the relevance of the current project.

There were five main objectives in this research project: first, to investigate the accuracy of identification of stuttering in speech samples of bilingual Lebanese children by bilingual Lebanese SLPs; second, to examine the extent to which stuttering severity ratings of SLPs to bilingual children are influenced by a child's stuttering status; third, to chart the disfluency profiles of bilingual CWNS and CWS, in both their dominant and non-dominant language; forth, to determine which types of disfluencies are most indicative for accurate assessment of stuttering in bilingual children; and fifth, to assess whether accuracy of assessment is similar between the dominant language and non-dominant language, and whether accuracy improves when both languages are considered.

By addressing these research objectives, the project aims to contribute to valuable insights into the understanding of stuttering in bilingual children. Moreover, it aims to shed light on the role of language dominance in the manifestation of speech disfluencies. Ultimately, this research project seeks to advance clinical practices and interventions for bilingual children with speech fluency concerns, particularly within linguistically diverse populations such as the Lebanese community.

6 Overview of the studies

6.1 Study I

Saad Merouwe, S., Bertram, R., Richa, S., & Eggers, K. (2023a). Identification of Stuttering in Bilingual Lebanese Children Across Two Presentation Modes. *Journal of Fluency Disorders, 76.* Doi: https://org/10.1159/000528520

Study I investigated the proficiency of Lebanese SLPs in accurately identifying stuttering in bilingual children. We also explored the relevance of using video-recordings compared to audio-recordings to enhance the analysis, and investigated potential factors that might influence the judgments of SLPs during the stuttering identification process.

This study was conducted in two phases. In phase 1, a group of SLP participants ($N = 32$) evaluated audio-recordings of 8 narrative speech samples. They were asked to categorize each sample as belonging to a stuttering child or a nonstuttering child, and were required to provide justifications for their decisions. Additionally, participants completed a questionnaire providing essential background information about themselves (see Appendix 3). In phase 2, which occurred 4 months later, the same 8 speech samples were presented to the SLPs again for categorization, but this time in the form of video-recordings. Also here, they were asked to pinpoint the specific speech characteristics they relied upon to make their judgments for each child.

The speech samples were Lebanese Arabic speech samples of 6 bilingual Lebanese CWNS and 2 bilingual Lebanese CWS. The Stuttering Severity Instrument-4th edition (SSI-4; Riley, 2009) was used to assess the severity of stuttering in both CWS. The child with the higher SLD frequency was rated as having severe stuttering, falling within the 89th to 95th percentile on the SSI-4. In contrast, the child with the lower frequency of SLD was rated as having moderate stuttering, falling within the 61st and 77th percentile. All 6 CWNS and 2 CWS had Lebanese Arabic as their dominant language. They were matched by age and way of elicitation, which involved narrating a story based on the picture book 'Frog goes to dinner' by Mayer (1974). The 8 speech samples were selected from a larger dataset of 92 children. To determine the language profiles of the children and identify their

language dominance, the Parents of Bilingual Children Questionnaire (PaBiQ; Tuller, 2015) was employed. In our study, the 8 bilingual CWNS and CWS included represented a diverse range of profiles with respect to the frequency and type of disfluencies. Importantly, the dominant language of these children, Lebanese Arabic, corresponded with the dominant language of the SLP participants. All recordings were uploaded to a secure, password-protected platform, and the participants were required to read and consent to the regulations regarding data protection before proceeding. During both phase 1 and 2, the SLP participants listened to the speech samples without interruption and possibility to pause or restart, as only a play button was available. Their task was to determine whether each sample was produced by a stuttering child or a nonstuttering child, resembling a screening task. Subsequently, the participants were prompted to provide detailed explanations for the speech characteristics that influenced their decisions. To collect demographic information about the SLP participants, an online questionnaire was developed. The questionnaire covered personal information, educational background, and professional experience related to stuttering and bilingualism. Participants also rated their level of confidence in diagnosing stuttering in a bilingual context and their perceived difficulties in differentiating typical and atypical disfluencies.

The results revealed significant differences in the mean percentage of misidentification between CWNS and CWS for both audio-recordings and video-recordings. SLP participants demonstrated a higher accuracy in identifying CWS compared to CWNS. There was no significant effect of presentation mode, and no interaction between presentation mode and child category.

Further examination of this first result uncovered significant differences in misidentification among the different CWNS, with a large effect size. Post-hoc analyses were conducted to explore this main effect, and they revealed significant differences in misidentification between several pairs of CWNS. The child with the lowest disfluency percentages was most often correctly identified, whereas the child with the second-lowest disfluency percentage was most often misidentified. This child had a lower language dominance score in Lebanese Arabic and was exposed to English and French as well, with relatively balanced competencies between Lebanese Arabic and English. Other factors, such as being trilingual, may have contributed to the higher percentage of misidentification for this child.

In contrast, for the two CWS, there was no significant effect of presentation mode, but there was a tendency for an interaction between presentation mode and child. Specifically, there was no difference between both CWS in the audio part of the experiment, but a significant difference was observed in the video part. The child who exhibited a higher percentage of total disfluencies with frequent and noticeable physical concomitants, elicited flawless judgments in the audiovisual mode but not in the audio-only mode. These findings suggest that the audiovisual presentation

mode may help to identify bilingual CWS with more severe symptoms, but not those with less severe symptoms.

During the investigation of predictive variables related to the correct identification of stuttering, we examined various SLP characteristics. Surprisingly, factors such as work experience, number of bilingual CWS treated, self-ratings of confidence in diagnosing stuttering in a bilingual context, self-ratings of difficulties in distinguishing typical and atypical disfluencies, and general experience did not show any significant correlation with the overall success rate of identification.

However, in the CWNS group a negative correlation was found between the success rate and the percentage of SLD. This suggests that a higher percentage of SLD in CWNS resulted in a higher rate of misidentification by SLPs. For the CWS, we were unable to conduct correlational analyses due to the limited number of data points. Nevertheless, our observation revealed that the stuttering child with a higher number of disfluencies was more accurately identified compared to the one with a lower number of disfluencies, hinting to a potential relation between the frequency of disfluencies and the accuracy of identification.

In addition to the quantitative analyses, we qualitatively explored the speech characteristics that SLP participants considered when judging the CWNS and CWS groups. In cases where children were correctly identified, the most frequently used descriptors for CWNS included the exhibition of typically fluent speech with normal disfluencies, without any indication of tension associated with the disfluencies; whereas the most frequently used descriptors for CWS included the presence of SLD and/or physical concomitants. When children were misidentified, the most frequently provided explanations for CWNS were related to the presence of SLD, such as word repetitions, part-word repetitions, prolongations, and blocks, either with or without physical concomitants; whereas the most frequently provided justifications for CWS were to the low frequency of disfluencies and physical concomitants. In general, neglecting or misinterpreting physical concomitants was a significant factor contributing to misidentification in both categories of children.

In sum, study I highlighted the challenges of identifying stuttering in bilingual children, particularly in CWNS. Misidentification occurred more in CWNS than in CWS, and even milder stuttering symptoms led to misidentification. Variations within the CWNS group suggested that characteristics such as degree of language dominance and frequency of SLD influenced the rate of misidentification. The presentation mode (audio versus audiovisual) did not affect diagnostic accuracy in CWNS, but there was some indication that visual support helps to identify CWS with severe symptoms or perhaps make SLPs more certain. Note though that the latter conclusion is based on a comparison of two CWS only and should therefore be taken with caution.

6.2 Study II

Saad Merouwe, S., Bertram, R., Richa, S., & Eggers, K. (2023b). Stuttering Severity Judgments by Speech-Language Pathologists of Bilingual Children Who Do and Do Not Stutter. *Folia Phoniatrica et Logopaedica.* Doi: https://doi.org/10.1159/000528520

Study II served as a follow-up to Study I, using the same dataset and methodology. Its goal was to examine how SLPs perceive the severity of stuttering in bilingual CWS compared to CWNS. Unlike Study I's binary judgments (i.e., stuttering or not stuttering), this study focused on obtaining stuttering severity ratings (i.e., 0 = no stuttering; 1 = very mild stuttering; 2 = mild stuttering; 3 = moderate stuttering; 4 = severe stuttering; 5 = very severe stuttering) from SLPs for both groups. The primary objectives were to gain deeper insights into the nature and extent of misjudgments in identifying CWNS as CWS and vice versa, while also examining whether presentation mode influenced severity ratings.

Study II involved the same group of SLP participants (N = 32) and utilized the same stimulus materials as described in Study I. Alongside the background information questionnaire and the identification of stuttering in the 8 speech samples in phase 1 (via audio-recordings) and phase 2 (via video-recordings), SLPs were additionally required to rate the stuttering severity for each child on a 6-point scale.

The results of Study II showed significant differences in stuttering severity ratings between bilingual CWNS and CWS, with CWNS receiving lower ratings compared to CWS. There was no effect of presentation mode, and the interaction between child category and presentation mode was not significant. However, a significant effect of child emerged, indicating variability in ratings for individual children. The stuttering child with the highest percentage of SLD received the highest ratings, while the nonstuttering child with the lowest percentage of SLD received the lowest ratings. Ratings for the other children fell somewhere in between.

Post hoc analyses indicated that CWS received significantly higher severity ratings compared to most CWNS, except for one nonstuttering child, who had the highest ratings among CWNS and also the highest misidentification rate in Study I. In line with the earlier study, this could be attributed to the unique trilingual profile of that child. Her balanced linguistic competencies between Lebanese Arabic and English, might have influenced her linguistic and speech characteristics in a way that recalibrated the evaluation of her disfluency severity, resulting in higher ratings. The nonstuttering child with the lowest stuttering severity ratings was significantly different from other CWNS and CWS. Among CWS, while average ratings were numerically higher for one stuttering child compared to the other, there was no statistical difference.

Regarding factors influencing stuttering severity ratings, a significant positive correlation was found between stuttering severity ratings and the SLD percentage for CWNS. Additionally, a positive strong correlation was observed between the mean number of iterations and perceived stuttering severity for CWNS. However, correlational analyses were not conducted for CWS due to the limited data.

In conclusion, Study II suggests that SLPs are generally perceptive of stuttering severity among bilingual children, but occasional misidentification of CWNS as CWS may occur. The study highlights the importance of considering the bilingual profile of each child and understanding that there is considerable variation in disfluencies among bilingual CWNS. It also shows that high disfluency rates as such may not be indicative of stuttering, and that more extensive evaluation may be needed to accurately identify stuttering in bilingual children.

6.3 Study III

Saad Merouwe, S., Bertram, R., & Eggers, K. (2024). Speech Disfluencies in Bilingual Lebanese Children Who Do and Do Not Stutter. *American Journal of Speech and Language Pathology. 33,* 2291-2310. Doi: https://doi.org/10.1044/2024_AJSLP-23-00311

In Study III, our primary objective was to analyze similarities and differences in speech disfluency patterns between bilingual CWS and CWNS from the same linguistic background. Additionally, we aimed to explore how language dominance impacted the manifestation of these disfluencies. In short, we aimed to enhance our understanding of stuttering in bilingual contexts and improve diagnostic approaches for this population.

Participants (N = 92) were bilingual children aged between 4;06 and 7;06 years, who spoke either Lebanese Arabic and French or Lebanese Arabic and English. Language dominance (L1 and L2) was determined for each child using the PaBiQ (Tuller, 2015). From the 92 children, 70 were classified as CWNS and 22 as CWS. Inclusion criteria for both groups required them to speak at least two languages, with one being Lebanese Arabic and the other English or French, and to demonstrate age-appropriate speech-language skills based on the PaBiQ (Tuller, 2015). Additionally, participants should have no reported intellectual, neurological, or learning disorders. For CWNS, exclusion criteria were applied, including any parental or teacher concern related to stuttering, a family history of stuttering, and previous history of speech-fluency therapy. As for CWS, additional criteria were considered, such as being diagnosed with stuttering by a certified SLP after a comprehensive assessment involving affective, cognitive, behavioral, linguistic, and motor components. The severity of stuttering was rated by parents as at least 2 on an 8-point scale. The diagnosis of stuttering for all CWS was further confirmed by the first author, who used four available speech samples per child and conducted a 20-minute phone call

with parents to gather information about the child's stuttering history, symptoms, reactionary attitudes, and parental concerns (see Appendix 2). The SSI-4 (Riley, 2009) was used to measure the severity of stuttering based on two speech samples in both languages. Among the CWS, one child was rated as mild, 11 as moderate, 5 as severe, and 5 as very severe.

The bilingual profile of all children in the study was assessed using the PaBiQ (Tuller, 2015). This standardized questionnaire consists of 27 questions divided into 5 sections, providing different scores: the No Risk Index (indicating the absence of a language disorder risk), the Language Proficiency score (reflecting the proficiency of the current linguistic skills in each language based on parental estimation), and the Linguistic Richness Index (indicating the language dominance). The assessment was conducted during a 20-minute phone call with the first author. Data collection with the children involved eliciting speech samples through spontaneous conversation and narrative tasks based on picture books, namely "Frog goes to dinner" (Mayer, 1974) and "Frog on his own" (Mayer, 1973). Both types of speech samples were video-recorded in their L1 and L2, resulting in four speech samples per child. To minimize methodological bias, counterbalancing was implemented at three levels: (1) The use of Lebanese Arabic versus French, or Lebanese Arabic versus English, in the picture book tasks was balanced across participants. (2) Half of the participants began with spontaneous speech, while the other half started with the narrative tasks. (3) Half of the participants began with the dominant language, while the other half started with their non-dominant language. Speech samples obtained from the participants were transcribed, and disfluencies were analyzed and coded using a method similar to that described in the studies of Byrd et al. (2015a) and Ambrose and Yairi (1999) (see Appendix 4). Disfluencies were categorized into two groups: SLD, which included monosyllabic word repetitions, part-word repetitions (including syllable and sound repetitions), and dysrhythmic phonation (blocks, broken words, and prolongations); and OD, which encompassed multisyllable word and phrase repetitions, interjections, unfinished words/sentences, and revisions. Mean frequencies of SLD and OD were calculated using a word-based metric to facilitate comparison with frequencies reported in previous bilingual studies.

Study III yielded several significant findings which also have clinical importance. Firstly, on average the CWNS exceeded the monolingual clinical thresholds of 3% SLD and 4% weighted SLD in both L1 and L2. Moreover, they met at least three out of the seven diagnostic criteria proposed by Yairi and Ambrose (2005) for diagnosing stuttering. In both languages, over 55% of the CWNS met or exceeded three criteria, demonstrating particularly high frequencies of SLD, weighted SLD, monosyllabic word repetitions, and part-word repetitions.

Secondly, the CWS group exhibited on average a notably higher percentage of SLD compared to the CWNS group. Furthermore, the CWS group showed significantly higher percentages in all six SLD subtypes compared to the CWNS group. However, there was considerable overlap between the CWS and CWNS group with several CWS exhibiting a relatively low amount of SLD, more typical

for CWNS and, vice versa, several CWNS exhibiting a relatively high amount of SLD, more typical for CWS. There were no differences between the two groups in terms of the percentage of OD. As for the iterations, the CWS group displayed considerably higher average iteration counts for monosyllabic word, syllable, and sound repetitions, as well as for all iterations combined in both languages compared to CWNS.

Thirdly, the percentage of SLD was not influenced by language dominance, nor was there any interaction observed between language dominance and participant group. Likewise, neither participant group nor language dominance had an effect on the frequency of OD. However, language dominance did impact specific disfluency types in CWS, with a higher incidence of monosyllabic word repetitions noted in the L1, and greater occurrence of part-word repetitions in the L2.

The final analysis, a binary logistic regression analysis was employed to determine the most influential disfluency variables in categorizing bilingual children as either CWS or CWNS. To this end, three variables for both the L1 and L2 were considered: repetitions, including monosyllabic word, sound and syllable repetitions; dysrhythmic phonations, including block, prolongations and broken words; and OD, including all other repetitions and revisions. Repetitions and dysrhythmic phonations emerged as consistent predictors, with dysrhythmic phonations showing the highest odds ratios across all models. While predictive values were generally robust, they tended to be higher for CWNS compared to CWS. Additionally, an increase in OD did not correlate with the heightened probability of being classified as CWS or CWNS. The models in the L1 looked approximately the same as in the L2 languages in terms of bilingual children correctly classified and amount of variance explained. Interestingly, incorporating predictors from both languages, specifically dysrhythmic phonations from both languages, enhanced classification accuracy and explained variance of the model.

In sum, Study III highlights that applying monolingual standards to assess stuttering in bilingual children is not adequate, as evidenced by the surpassing of many monolingual thresholds by bilingual CWNS. Moreover, assessments conducted in either the L1 or L2 yield comparable results, particularly when dysrhythmic phonations and repetitions are meticulously analyzed. Finally, findings underscore the importance of assessing dysrhythmic phonations in both languages for a more accurate classification of CWS, compared to relying solely on assessments in one language.

7 Discussion

The primary objective of this dissertation was to provide insights into the assessment of stuttering among bilingual children. By investigating disfluencies patterns of bilingual CWNS and CWS and how these patterns are interpreted by SLPs, we shed light on the complexities of identifying stuttering in the context of bilingual speech development, addressing an area of research that has been relatively understudied. The findings from this thesis can significantly contribute to advancing the field of speech fluency assessment, leading to more effective support and care for bilingual children. More specifically, they provide intricate insights into the relationship between stuttering and bilingualism, enabling improved assessment methods tailored to bilingual children.

7.1 Study I

Study I addressed the challenges faced by SLPs working in a highly multilingual environment, like Lebanon, in distinguishing between bilingual CWNS and CWS (Saad Merouwe et al., 2023a). The research specifically explored the accuracy of SLPs in identifying stuttering on the basis of audio and video recordings with speech samples of both CWS and CWNS. Conducting this study in a highly multilingual context holds significant clinical relevance as it highlights the proficiency of multilingual SLPs in distinguishing between typical and atypical disfluencies in bilingual children. The study employed a task akin to a standard screening procedure commonly performed in school settings, where SLPs are asked to identify children who require further investigation. Therefore, Study I's design makes its findings directly applicable to real-world scenarios.

Study I showed that SLPs tended to misidentify bilingual CWNS more frequently as CWS, rather than misidentify CWS as CWNS. This finding aligns with previous research by Byrd et al. (2015b). However, it is worth noting that the mean percentage of misdiagnosis of a single nonstuttering child in the Byrd et al. (2015b) study, based on audio recordings, was much higher (85.71%) than the average percentage of misidentification of the group of CWNS in the present study (44.8%). It is important to consider the potential influence of cultural factors here, as Byrd's study was conducted in a predominantly monolingual American population, which

presents a different context compared to the multilingual society of Lebanon. Beyond cultural differences, this discrepancy underscores the value of including CWNS with various disfluency profiles. The high misdiagnosis rate in the Byrd et al. (2015b) study can be attributed to the nonstuttering child having 17% disfluencies in both languages, while the CWNS group in Study I exhibited disfluency percentages ranging between 4.8% and 14.6%. The current study included 6 CWNS and 2 CWS with diverse profiles in terms of speech fluency and language proficiency. This broader variation aimed to gain deeper insights into the factors influencing the misinterpretation of disfluencies in bilingual children. Interestingly, the nonstuttering child with the lowest percentage of disfluencies was most frequently identified correctly. Conversely, the nonstuttering child with the second-lowest percentage of disfluencies was most often misidentified. This child's language dominance score in Lebanese Arabic was substantially lower than that of the other children, making it comparable to her English dominance score and indicating a more balanced competency between the two languages. Furthermore, she had significant exposure to French at school. Her linguistic profile may have led to different lexical choices due to less extensive lexicon and shorter sentences. In addition to her trilingual profile, she had a relatively high percentage of monosyllabic word repetitions (the main disfluencies exhibited) and a high number of iterations. She had the highest iteration number among the CWNS group and the second highest among the entire group of CWNS and CWS. These factors might have contributed to the higher percentage of misidentification. Although this finding warrants further investigation due to the presence of only one such case in the sample, it suggests that the linguistic profile may influence the perception of stuttering.

Our analyses indicated that the mode of presentation (audio vs. audiovisual) did not improve the identification of CWNS. From a clinical perspective, one would expect better results in the audiovisual mode, considering the possibility to assess both verbal and non-verbal cues in this mode. For CWS, there was no difference in misidentification in the audio-only mode, but a significant difference was observed in the audiovisual mode. This difference, however, was not consistent across both stuttering children. The stuttering child who exhibited a higher percentage of total disfluencies with frequent and noticeable physical concomitants, elicited flawless judgments in the audiovisual mode but not in the audio mode. In contrast, the one with fewer disfluencies and less frequent physical concomitants, was not assessed more accurately with the additional visual support. These findings are consistent with previous research showing that SLPs more easily observe atypical speech behaviors or secondary behaviors in severe cases of stuttering but may struggle to identify mild stuttering (Watson & Kayser, 1994).

In sum, in comparison to the audio-only mode, the audiovisual presentation mode only enhances the detection of severe stuttering in bilingual children, but does

not lead to better performance in detecting mild stuttering or identifying CWNS as such. These results contrasts with those of Luper (1956), who found that visual samples prompted listeners to detect more stuttering instances than auditory samples. However, it is to a great extent consistent with all subsequent studies that observed no impact of the presentation mode on listeners' identification and assessments of stuttering (Bloodstein & Bernstein Ratner, 2008; Martin & Haroldson, 1992; Panico et al., 2005). The limitations associated with video-recordings in the current study were that non-facial physical concomitants (e.g., tapping with the foot) were not visible and raters could not pause or rewind the videos. This could have influenced our findings, but the study anyway indicates that it is not straightforward to detect physical concomitants that can support fluency-based analyses.

Study I also revealed that there were no correlations between the percentage of SLD exhibited by CWNS and the success rate of SLPs. This lack of correlation can be attributed to the small amount of data points, but also in part to false positives generated by the same nonstuttering child mentioned earlier, who was often misidentified despite showing a relatively low percentage of SLD. After removing this case, a correlation emerged, showing that the identification success rate in CWNS increased with decreasing SLD percentages. This finding aligns with the results of Byrd et al. (2015b). Bilingual CWNS commonly exhibit word and part-word repetitions in their speech, as observed in previous studies (Bedore et al., 2006; Byrd et al., 2015b; Eggers et al., 2020a; Fiestas et al., 2005). Interestingly, Byrd et al. (2015b) reported that sound and syllable repetitions, along with monosyllabic word repetitions, were the most common types of SLD leading to false-positive identification of CWNS. Repetitions are typically considered stuttering-like in assessment protocols designed for monolinguals (Ambrose & Yairi, 1999), but for bilinguals, repetitions may be - more often than for monolinguals - triggered by lexical retrieval problems (e.g., Peña et al., 2016) or interference of the other language (e.g., Costa et al., 1999; Guo & Peng, 2006). This highlights the need to consider other clinical features accompanying these types of disfluencies when assessing speech fluency in bilingual children. Notably, both Byrd et al. (2015b) and Eggers et al. (2020a) found that the high rates of SLD produced by bilingual children were not associated with atypical tension or arrhythmicity. Thus, the rhythmicity of repetitions and accompanying tension, along with parental concern, should be carefully considered as clinically relevant discriminators of stuttering in bilingual populations, even more than in monolinguals. As for the two CWS, the success rate of the SLPs was higher for the CWS with a higher percentage of SLD. This finding is consistent with the conclusions of Watson and Kayser (1994), who stated that SLPs easily identify atypical speech behaviors or secondary behaviors in cases of severe stuttering, where the frequency of atypical speech behaviors is higher.

However, the identification can be more challenging in cases of mild stuttering, which require a more thorough analysis of the observed speech behavior.

Finally, SLPs provided justifications for their classification of children as either CWS or CWNS to substantiate their judgments. In CWNS, misidentifications often stemmed from typical disfluencies being mistaken for atypical ones, while overlooking the absence of physical concomitants. Conversely, accurate identifications focused on recognizing typical disfluencies or word retrieval difficulties linked to bilingualism. Regarding CWS, misidentifications occurred mostly for the child with mild stuttering. SLPs were misled by the relatively low frequency of disfluencies and attributed certain SLD incorrectly to a limited vocabulary resulting from bilingualism. Correct assessments were linked to the presence of physical concomitants accompanying disfluencies, suggesting that SLPs often did apply a valid classification criterion. Taken together, the explanations of SLPs to support their classification of children as CWS or CWNS are often correct but often go astray as well. This confirms that the identification of stuttering in bilingual children poses substantial perceptual and cognitive challenges, necessitating extensive abilities on the part of SLPs.

Study I has a few limitations, but these are grounded in scientific rationale and maintain a significant degree of ecological validity. One of the limitations of the study is the provision of only one speech sample per child in the dominant language to SLPs. This approach may not be optimal for assessing stuttering in bilingual individuals (e.g., Van Borsel et al., 2008). However, by including only one speech sample, we were able to include a broader and more varied cohort of children and SLPs, and in doing so, addressed some of the limitations of Byrd et al.'s study (2015b). Additionally, focusing on the dominant language instead of the non-dominant aligned with previous research suggesting it leads to more accurate assessments (Watson & Kayser, 1994). Moreover, it is not uncommon in screening situations or clinical practice to only assess the dominant language, giving our study ecological validity. Also, the time constraint in the study mimics the time pressure often faced in real-world clinical assessments, especially when it comes to screening tasks. Lastly, the relatively young age of the SLP participants reflects the field's profile in Lebanon, which has an overrepresentation of younger clinicians.

Future studies could address the limitation of using only one speech sample by including recordings in both the dominant and non-dominant languages. This would allow for a more comprehensive assessment of stuttering in bilingual individuals and provide insight into how fluency may vary across languages in the same speaker. Moreover, since the current study focused on one dominant language, future research could include a wider variety of language pairings to explore how different linguistic features across language dyads influence the identification of stuttering. Finally, given that the current study's SLP participants were relatively young, it could be

beneficial to include more experienced clinicians in future studies to see how experience affects the identification and diagnosis of stuttering in a multilingual context.

In sum, the present study highlights the challenge of determining stuttering in bilingual children. Misidentification is more likely to happen in bilingual CWNS compared to CWS, but it can also occur in cases of mild stuttering. Differences within the CWNS group suggest that certain characteristics may influence misidentification risk, such as high frequency of SLD in the dominant language. The presentation mode does little to improve diagnostic accuracy, underlining the fact that assessing physical concomitants is not straightforward. Given the relatively young age of the clinicians in our study, this finding may also be associated with the limited experience of our SLPs, possibly enhanced by the task constraints. At any rate, it is clear that for bilinguals, assessing rhythmicity and tension accompanying SLD to avoid misidentifications is even more crucial than for monolinguals. Educational efforts should include the implications of bilingualism on speech fluency, in order for students and clinicians to make more informed assessments, including the notion that bilinguals exhibit more SLD than monolinguals triggered by lexical retrieval problems and enhanced linguistic uncertainty resulting from competition between the bilingual's both languages.

7.2 Study II

Study II (Saad Merouwe et al., 2023b) was a follow-up investigation using the same methodology and dataset as Study I. Its focus was to examine the assessments made by SLPs regarding the severity of stuttering in bilingual CWS and CWNS, aiming to provide additional insights into the misdiagnosis observed in Study I.

To achieve this objective, the speech samples from the identical group of 6 bilingual CWNS and 2 bilingual CWS was assessed by the same SLPs (N = 32). Stuttering severity ratings (SSR) were assigned on a scale of 0 to 5, where 0 indicated no stuttering, and 5 represented very severe stuttering. These evaluations were conducted using both audio-only and audiovisual presentation formats.

The results revealed that although SLPs were not entirely accurate in discerning between bilingual CWNS and CWS in Study I, they assigned significantly higher SSR to bilingual CWS compared to bilingual CWNS in most instances, at the group level. In the singular directly comparable study, Byrd et al. (2015b) discovered no differentiation between the bilingual stuttering child and nonstuttering child. Both children were evaluated equally, with 43% of the SLPs designating them as having a "moderate stutter", and they received comparable average ratings. Byrd et al. (2015b) concluded that the reliance on disfluency frequency, often used as a guiding principle for evaluating stuttering in monolinguals, might not only lead to

misdiagnosing bilingual individuals but also influences the perceived severity of stuttering. However, the study of Byrd et al. (2015b) featured only one bilingual stuttering child and one nonstuttering child, both exhibiting a high percentage of disfluencies (17% in both languages), with actually more SLD for the nonstuttering child. This dissimilarity between our findings and those of Byrd et al. is likely linked to the diversity of profiles in terms of speech fluency, but also to the lower amount of disfluencies in general (from 4.8% to 14.6%). Of paramount significance is that all our CWNS seem to exhibit a lower percentage of SLD (2.2% to 7.3%) compared to the nonstuttering child in Byrd et al.'s study, even though all but one of our CWNS exceeded the monolingual 3% SLD threshold. Broadly, our results suggest that, bilingual CWNS are generally perceived less disfluent (i.e., a lower rating) than CWS. This aligns with studies by Susca and Healey (2001) and Panico et al. (2005), which also demonstrated that raters are sensitive to the severity of stuttering. It is important to acknowledge that the majority of bilingual CWNS in Study II were predominantly perceived as manifesting a "mild stutter".

It is essential to note that also the SSR showed variations within the group of CWNS. One nonstuttering bilingual child received the lowest average ratings, diverging significantly from all other CWNS and CWS. This observation is consistent with the findings of Study I, where we observed that this child was the least frequently misdiagnosed as a stuttering child (Saad Merouwe et al., 2023a). This child demonstrated the lowest disfluency percentage, which aligns with prior research suggesting that lower severity ratings are associated with lower disfluency frequency (Panico et al., 2005; Susca et al., 2001). Particularly noteworthy was another nonstuttering child who received ratings similar to those assigned to the two CWS. This child was also frequently identified as having a stutter in Study I. This finding aligns with the observations of Byrd et al. (2015b), indicating that misclassification of CWNS as CWS and the lack of differentiation in SSR between CWS and CWNS often occur together. Particularly interesting though is that in our study, the nonstuttering child with comparable ratings to both CWS had the second lowest percentage of SLD, which was lower than the nonstuttering child in Byrd et al.'s study (2015b).

As it is unexpected that a nonstuttering child with a relatively low percentage of SLD would be misjudged in this way, we delved deeper into this particular case. One plausible reason could be the number of iterations this child exhibited. That is, she exhibited the highest iteration count of the CWNS and the second highest among the combined CWNS and CWS cohort. Another factor we suspect may have contributed to this recurring misjudgment is linguistic in nature. More specifically, a distinguishing characteristic of this child was that her language dominance score in Lebanese Arabic was lower compared to her peers, but comparable to her language dominance in English, setting her apart from her CWNS peers. Additionally, she was

exposed to French at school. Being a balanced bilingual between Lebanese Arabic and English alongside active use of a third language may have led to atypical linguistic traits, including varied lexical choices due to a less extensive lexicon and employment of shorter sentences. These language differences might have resulted in word repetitions becoming more noticeable, impacting the interpretation and judgement of her speech by the SLPs. SLPs may also have linked the narrower linguistic repertoire with avoidance behavior, specifically in terms of sidestepping stuttering disfluencies rather than avoidance due to limited linguistic abilities. In other words, being a balanced bilingual with active use of a third language could account for the elevated misdiagnosis rate shown in Study I and the heightened SSR reported in the current study. However, given the singular presence of such a case in our sample, this outcome warrants further investigation. With respect to the two CWS, the average ratings for the first child (who had more SLD) were slightly higher than those for the second child, but this difference was not statistically significant. However, Study I showed that the second stuttering child was more often mistaken as a nonstuttering one than the first stuttering child, which matches with earlier studies suggesting that more frequent disfluencies lead to more reliable SSR (e.g., Susca & Healey, 2001).

Another finding of Study II was that there was no difference in SSR between both presentation modes. It would be logical to anticipate that assessing disfluencies solely through audio-recordings, without the visual cues of physical manifestations, might either inflate or diminish severity ratings. Nevertheless, earlier investigations involving adults (Marin & Haroldson, 1992; Panico et al., 2005; Williams et al., 1963) and children (Rousseau et al., 2008) similarly reported no variance in the ratings of overall severity between different presentation modes. In the above we already mentioned that the relative inexperience of the SLPs may have prevented them from making full use of the video support. We also noted that the video recordings themselves may have been suboptimal. That is, it's important to mention that SLPs watched the speech samples without being able to pause or go back and also that they only saw a recording of the face. As this is different from how they usually assess, this might have caused them to miss some physical signs that come with disfluencies, affecting the SSR of both CWNS and CWS.

Study II also showed that a greater occurrence of iterations corresponded to a more pronounced perception of stuttering severity. This aligns with the findings of Ambrose and Yairi (1999), who demonstrated that CWS tend to exhibit a higher average number of iterations compared to their nonstuttering counterparts.

Finally, no discernable correlations emerged between SSR and the SLD and OD percentages when the entire CWNS group was considered. However, upon exclusion of the aforementioned nonstuttering child (the outlier), a positive correlation between SSR and the SLD percentages emerged. This observation implies a connection

between SLD percentage and the general assessment of stuttering severity; specifically, a heightened SLD percentage contributes to elevated judgments of stuttering severity. This inference concurs with prior research that has highlighted positive correlations between the proportion of stuttered syllables and the assigned SSR (Susca & Healey, 2001; Hedge & Hartman, 1979a; Hedge & Hartman, 1979b; Karimi et al., 2014).

As Study II closely parallels Study I in terms of methodology and dataset, the two studies also share similar limitations. Subsequent research should thus explore whether SLPs yield comparable judgments of stuttering severity when presented with L1 and L2 samples. Furthermore, an investigation into whether bilingual children get lower SSR from SLPs sharing the same language combination compared to those with different language combinations would yield insightful perspectives.

In conclusion, Study II showed that SLPs typically assign higher SSR to bilingual CWS compared to bilingual CWNS, although they might not always be correct in labeling them as CWNS (Byrd et al., 2015b; Saad Merouwe et al., 2023a). These SSR also exhibit a positive correlation with the number of iterations and the frequency of SLD. However, Study II suggests that in the context of balanced bilingualism, even a relatively limited number of SLD can give the impression that the child is stuttering. This finding warrants further exploration, but it is plausible that SLPs may interpret certain speech behaviors differently when bilingual children have lower linguistic proficiency in one of their languages. Hence, in order to ensure precise screening and prevent misdiagnosis of stuttering in bilingual settings, it is essential to carefully consider bilingual proficiency and to recognize that the percentage of SLD does not always indicate whether a bilingual child is stuttering or not.

7.3 Study III

Study III (Saad Merouwe et al., 2024) was designed as a natural extension of Study I and II, driven by the need to untangle the factors underpinning the misclassification of bilingual CWNS as CWS. The study's primary objective was to evaluate the qualitative and quantitative differences in disfluency profiles between bilingual CWNS ($N = 70$) and bilingual CWS ($N = 22$) in both the L1 and L2. In addition, the aim was to predict classification success on the basis of these disfluency profiles.

Our first goal was to compare speech disfluency characteristics between monolingual and bilingual children, seeking insights into specific bilingual traits that might require distinct assessment methods for stuttering. We investigated whether the standard benchmarks used for monolingual evaluation apply to bilingual children. We found that a significant proportion of our bilingual CWNS exceeded the 3% SLD clinical threshold, which has been found to distinguish monolingual

CWS from CWNS (Ambrose & Yairi, 1999). Additionally, a notable number of our bilingual CWNS surpassed the 4% weighted SLD threshold. In monolinguals, the mean weighted SLD ranged from 0 to 3.87 in the CWNS group and from 4.30 to 100.54 in the CWS group, indicating its effectiveness in differentiating stuttering from normal disfluencies (Ambrose & Yairi, 1999). These findings suggest that applying these clinical thresholds to bilingual children may lead to numerous false identifications of stuttering. This is consistent with previous research showing that many bilingual CWNS exceed monolingual thresholds (Byrd et al., 2015a; Eggers et al., 2020a). Also here, and in line with previous studies (Eggers et al., 2020a), our findings showed that even when assessed against a set of seven diagnostic criteria proposed by Yairi and Ambrose (2005) to distinguish borderline cases (such as children with mild stuttering and those with high normal disfluencies; see also Yairi & Seery, 2023), over 55% of our bilingual CWNS met or exceeded three of these criteria. This suggests a level of disfluency that would indicate stuttering in monolinguals. The most common criterions exceeding the monolingual thresholds here were SLD, Weighted SLD, iterations, monosyllabic word repetitions, and part-word repetitions. These results underscore that a considerable number of Lebanese children surpass benchmarks to establish stuttering in monolinguals, consistent with findings from prior studies involving different language pairs.

To explore further, we examined the proportion of SLD relative to the total number of disfluencies in our bilingual participants and compared it to the monolingual data. According to Ambrose and Yairi (1999), monolingual CWNS exhibited 24% SLD and 76% OD, while monolingual CWS showed the reverse pattern. Our data revealed that bilingual CWNS had on average 40% SLD and 60% OD, with bilingual CWS displaying the reverse pattern. Although the overall trend is similar, our findings indicate that the proportion of SLD compared to the total amount of disfluencies is clearly higher in bilingual CWNS than in their monolingual counterparts.

It was anyway the case that, on average, CWS demonstrated significantly elevated scores for SLD, all SLD subtypes and iterations in comparison to CWNS. This implies that these counts are, to a considerable extent, reliable indicators of whether a bilingual child stutters or not, consistent with the findings of Ambrose and Yairi (1995) and Pellowski and Conture (2002) with monolinguals. However, even though there are clear differences on a group level on all these measures, there is considerable overlap between bilingual CWS and bilingual CWNS. I come back to this issue at the end of this subchapter.

Regarding OD, no substantial OD percentage differences were found between CWS and CWNS in either language. This consistency in OD rates among groups mirrors the findings of Ambrose and Yairi (1999) in their monolingual research. In addition, binary regression analyses confirmed OD's minimal contribution to

classifying bilingual CWS or CWNS, especially when considering alongside other disfluency types.

Next, Study III documented that monosyllabic word repetitions are the most common type of speech disfluency in both CWS and CWNS. This finding diverges somewhat from monolingual studies, where part-word repetitions were more frequent in CWS, followed by monosyllabic word repetitions, while monosyllabic word repetitions were slightly more common in CWNS compared to part-word repetitions (Ambrose & Yairi, 1999). However, our results align with previous research findings involving bilingual CWNS, which consistently reported a higher occurrence of monosyllabic word repetitions (Byrd et al., 2015a; Eggers et al., 2020a; Fiestas et al., 2005; Saad Merouwe et al., 2019). We hypothesize that the increased rate of monosyllabic word repetitions in bilingual speech may be due to less frequent language use compared to monolingual peers, resulting in less stable lexical representations and greater word retrieval effort (e.g., Gollan et al., 2005; Peña et al., 2016). Additionally, interference from the other language during speech may contribute to disfluency occurrences (e.g., Costa et al., 1999; Green, 1998). The predominance of monosyllabic word repetitions could also be explained by bilingual children employing this strategy to generate more time to monitor their own speech.

Study III also explored the impact of language dominance on the manifestations of disfluencies. In contrast to previous research indicating a higher occurrence of SLD and OD in the L2 (Eggers et al., 2020a; Lim et al., 2008), Study III showed that language dominance did not influence overall SLD and OD percentages for both CWNS and CWS. This may be related to the strong position of French and English in Lebanon. The bilingual landscape in Lebanon is characterized by early and simultaneous exposure to multiple languages, with children engaged in bilingual or trilingual education from an early age onwards (Abou, 1962; Shaaban, 1997). In our study, all participants were early bilinguals, so despite having a dominant primary language, their proficiency in the L2 was substantial. We argue that the bilingual proficiency being closer to balanced bilingualism than in other studies study accounts for the equal distribution of disfluencies across both languages. In other words, our findings suggest that a mild imbalance in language proficiency does not impact the overall amount of disfluencies across languages. When language dominance is more pronounced, for instance in case of sequential bilingualism, studies document a clearly higher proportion of disfluencies in L2 than in L1 (e.g., Eggers et al., 2020a).

Language dominance does have some nuanced influences on specific disfluency types though. More specifically, monosyllabic word repetitions were significantly higher in the L2 compared to the L1 for both CWS and CWNS, while part-word repetitions were slightly more frequent in the L1 compared to the L2 in CWS. The former finding suggests strategic adaptations to speech production, with

monosyllabic word repetitions in the less proficient language providing additional time for formulation and monitoring. The latter finding may indicate that CWS are slightly more optimistic about their production skills in the L1 than in the L2, leading to a faster speech rate and consequently an increased number of part-word repetitions (Chakraborty et al., 2008; Howell & Sackin, 2000).

Finally, we set out to identify predictors through binary regression analysis for accurate classification of bilingual children as CWNS and CWS. This analysis was driven by the substantial overlap in SLD percentages observed between both groups, emphasizing that SLD percentages as such do not lead to accurate assessment of all bilingual children. Given the relatively high rate of repetitions in CWNS, it would not have been unlikely that repetitions do not contribute much to distinguish between CWS and CWNS. However, the regression analyses indicated that, in addition to dysrhythmic phonations, the frequency of repetitions also serves as a reliable predictor for classifying bilingual children as CWS or CWNS in both languages. The number of OD, however, does not contribute to correctly classifying a bilingual child as a stuttering or nonstuttering child.

Integrating the regression analyses of Study III with the results of Study I leads to some interesting conclusions. Using dysrhythmic phonations and repetitions as predictors for the L1, the model accurately classified 55% of CWS and 97% of CWNS. In contrast, Study I showed that in real life, SLPs correctly classified 88 % of CWS and 55% of CWNS. Taken together, our findings suggest that SLPs are more accurate at detecting CWS in real life than the regression model based solely on speech disfluencies predicts. This discrepancy could be due to the small number of CWS cases in Study I and the SLPs' consideration of factors beyond disfluencies, such as arrhythmicity. Conversely, the model shows higher classification accuracy for CWNS than SLPs, indicating that if SLPs relied only on SLD rates, there would be fewer mis-assessments. This highlights the importance of considering additional factors, like arrhythmicity, bilingual profiles, and thorough transcription and disfluency analyses in clinical assessments.

Lastly, and essentially, evaluating dysrhythmic phonations in the L2 alongside disfluencies from the L1 significantly improved classification outcomes compared to assessing disfluencies in only one language. This underscores the importance of assessing fluency in both languages whenever possible. Our findings align with previous studies that have suggested dual-language assessment as best practice in various domains of bilingual language (e.g., Boerma et al., 2015; Caeser & Kohler, 2007; Freeman & Schroeder, 2022; Thordardottir et al., 2006). When dual-language assessment is not feasible, SLPs could collaborate with an interpreter or a professional knowledgeable about speech and language development who is proficient in the language not spoken by the SLPs. Moreover, they should combine alternative measures across languages to gain a comprehensive understanding of the

child's linguistic profile (Freeman & Schroeder, 2022). In cases where dual-fluency assessment is not possible, SLPs are advised to thoroughly evaluate dysrhythmic phonations and the mean number of repetitions in the spoken language. These strategies are particularly crucial for monolingual SLPs.

7.4 Clinical implications

In this section, we delve into the clinical implications of our findings, shedding light on their potential significance for SLP practice with regard to bilingual children. Studies I and II emphasized the challenge of identifying and rating stuttering in bilingual children solely based on audio or audiovisual samples. Building on these two studies, Study III was designed to better understand the disfluency patterns of bilingual CWNS in comparison to CWS, and through that, gain some indication of how to improve diagnostic accuracy.

While the judgement procedures described in Studies I and II are not representative of a comprehensive and multidimensional stuttering assessment, they resemble the often rapid screening processes undertaken in (Lebanese) educational and medical settings. During these screenings, SLPs or other professionals evaluate the child's speech and refer to a specialist when stuttering is suspected. In order to ascertain a high accuracy rate in these swift assessments, it is important to use evidence-based guidelines, something the current project provides. The high prevalence of bilingual children in speech therapy settings with speech fluency (or other) concerns indicate that initial screening often results in flawed assessments. Worries among parents, educators, and healthcare providers may sometimes lead to premature and extensive assessments for bilingual children who are typically fluent from a bilingual perspective. This underlines the significance of acquiring deeper insights into speech disfluency profiles of stuttering and non-stuttering bilingual children, enabling the accurate differentiation between typical and atypical speech characteristics. Insights from this project can enhance the accuracy of identifying stuttering in bilingual children, potentially reducing unnecessary referrals.

Based on the findings from Studies I, II and III, as well as insights from earlier research, the following recommendations are proposed for clinicians working with bilingual children:

1. Clinical benchmarks designed for monolingual populations should not be applied to bilingual children due to their insufficient sensitivity to the high frequency of speech disfluencies observed in bilingual contexts. This recommendation has been highlighted in previous studies on different linguistic dyads (Byrd et al., 2015a; Eggers et al., 2020a) and the current study conducted in the Lebanese multilingual context further reinforces it.

2. Given the significant variability in disfluency patterns among bilingual CWNS, and the fact that a high frequency of disfluencies does not necessarily indicate stuttering, it is important to be cautious when evaluating children with an SLD rate between 4% and 10%. Children within this range are often found in both CWS and CWNS groups. To avoid misdiagnosis, thorough and detailed assessments are essential, as recommended in earlier studies addressing this issue (Byrd et al., 2015a, 2015b; Byrd, 2018).
3. Monosyllabic word repetitions are commonly produced by bilingual children, as demonstrated by our findings and corroborated by earlier studies conducted on various bilingual populations (Byrd et al., 2015a; Eggers et al., 2020a; Rojas et al., 2023). We contend that these repetitions should not be given too much weight, as they can inflate the overall SLD rates observed in bilingual CWNS.
4. The rhythmicity of iterations and the presence of tension accompanying speech disfluencies should be carefully assessed, as previously suggested (Byrd et al., 2015a; Eggers et al., 2020a). These characteristics have been observed in bilingual CWS but not in bilingual CWNS.
5. When the clinician is proficient in both of the child's languages, (s)he should meticulously analyze dysrhythmic phonation in both L1 and L2 and repetitions in L1, as our findings suggest that this approach leads to the most accurate classification of bilingual children as CWS or CWNS.
6. When the clinician is only proficient in one of the child's languages, (s)he should thoroughly assess dysrhythmic phonation and the average number of repetitions in that language.
7. In case of small or no differences between L1 proficiency and L2 proficiency, disfluency analysis in L2 will yield reasonably reliable results. However, if there's a significant imbalance between L1 and L2 proficiency, prioritizing the assessment of stuttering in the native language (L1) is imperative.
8. Other disfluencies (e.g., revisions, interjections) should not be considered as an indicator of stuttering.
9. Clinicians should recognize that screening bilingual children for stuttering may result in more inaccurate outcomes compared to monolingual children.
10. Clinicians should be aware that parental concerns about stuttering in bilingual contexts may be influenced by factors such as linguistic expectations, fluency norms, and parental understanding of bilingualism's impact. From our clinical experience, some parents may express concern about their child's speech disfluencies stemming from bilingualism, while others might attribute genuine

fluency challenges to bilingualism, potentially underestimating the need for further assessment.

Therefore, it is evident that clinicians should adopt a thorough approach that takes into account various factors unique to bilingualism. This includes carefully examining disfluency patterns while being aware of the bilingual context, exploring parental concerns more deeply (such as encouraging them to pay attention to speech disfluency patterns of other bilingual children as well), and being particularly attentive to physical manifestations, and emotional and cognitive responses. By integrating these aspects into the diagnostic process, clinicians can achieve more accurate diagnoses and subsequently develop intervention strategies that are specifically tailored to meet the needs of bilingual CWS.

7.5 Conclusion and future perspectives

Confirming the findings from prior more exploratory investigations (Byrd et al., 2015a; 2015b; Eggers et al., 2020a), we first conclude that the application of monolingual guidelines to fluency assessments of bilingual children is unwarranted. In general, our research demonstrates both the similarities and distinctions in disfluency profiles between CWS and CWNS, but also highlights the challenge of accurately classifying bilingual CWNS and CWS within a context resembling a screening task. Given these challenges and the growing prevalence of bilingualism worldwide, it is essential to develop specialized courses for students and standardized methodologies for clinicians to enhance assessment accuracy.

Our research also underscores the complexity of comparing studies conducted with bilingual populations, which is often undermined by the substantial variability inherent to bilingual individuals. For example, our investigations diverge from previous research on bilinguals by not revealing a clear impact of language dominance on stuttering manifestations. This likely arises from the characteristics of bilingualism in the Lebanese context, where early simultaneous bilingualism and high proficiency in two languages are common. This suggests that, in general, in highly multilingual countries, where navigating between two or more languages is commonplace, children's disfluency profiles are likely to be comparable across their both languages.

Our research also indicates that, while OD do not contribute to the differential diagnosis in bilinguals, assessing dysrhythmic phonation and repetitions in either the L1 or L2 - provided that the child is proficient in the L2 as well - can yield comparable results. Analyzing dysrhythmic phonation in both languages even enhances the precision of identifying bilingual CWS and CWNS, highlighting the importance of a comprehensive assessment. In sum, these insights contribute to a

deeper understanding of bilingual contexts and underscore the importance of tailored assessment strategies to ensure accurate diagnosis and intervention.

The findings of this thesis hold significant implications for clinicians and researchers working with bilingual populations, yet they also emphasize the need for further investigation. For instance, conducting cross-sectional studies covering a wider age range (e.g., 4 to 12 years) within diverse multilingual environments is crucial for understanding the patterns of speech disfluencies that occur in bilingual children over time. Similarly, longitudinal studies tracking typically developing children over a period of time (e.g., 3 to 8 years) will provide deeper insights into the developmental trajectory of speech disfluencies in relation to language proficiency development and bilingual profile. Expanding the dataset of bilingual CWS, both in number and age-range, could help establish cut-off scores for stuttering assessment in bilinguals.

Further exploration of the impact of language dominance on disfluencies in bilingual adults is also essential to broaden our understanding of the role bilingualism plays in stuttering. We add to that investigating different forms of bilingualism (e.g., early versus late exposure), which would enrich our understanding of the relationship between fluency and bilingualism, taking into account the various possible variations in bilingual profiles.

Finally, bearing in mind that this is a non-exhaustive list of perspectives, examining linguistic factors, such as utterance length and complexity, phonological complexity, and lexical diversity can provide valuable insights for both assessment and treatment strategies. Presently, we are investigating whether there are disparities between bilingual CWS and CWNS in our dataset regarding the frequency of speech disfluencies occurring in content versus function words, as well as their occurrence at the beginning or end of sentences. In essence, any factor that could contribute to improving the distinction in diagnosing stuttering in bilingual children warrants consideration.

As we conclude this PhD journey, it's clear that much remains to be uncovered about bilingualism and stuttering. Each finding sparks new questions, emphasizing the need for further exploration. This is not the final destination, but a stepping stone toward a deeper understanding. While progress has been made, there is still more work ahead. Therefore, as we close this chapter, let us view it as the beginning rather than the end – a starting point for further insights and discoveries into speech disfluencies in bilingual children.

Abbreviations

B	Blocks
BW	Broken words
CWNS	Children Who do Not Stutter
CWS	Children Who Stutter
DSM5	Diagnostic Statistical Manual 5th Edition
Dys_Dom	Dysrhythmic phonation in the dominant language
Dys_NDom	Dysrhythmic phonation in the non-dominant language
ECSF	European Clinical Specialization in Fluency Disorders
ESS	European Stuttering Specialization
GRev	Grammatical revisions
I	Interjection
L1	Dominant language
L2	Non-dominant language
LRev	Lexical revisions
MonoWR	Monosyllabic word repetitions
MultiWR	Multisyllable word repetition
OD	Other Disfluencies
OD_Dom	Other disfluencies in the dominant language
OD_NDom	Other disfluencies in the non-dominant language
ORs	Odds Ratios
P	Prolongations
PaBiQ	Parents of Bilingual children Questionnaire
PhonRev	Phonological revisions
PhR	Phrase repetition
PWS	People Who Stutter
SLD	Stuttering-Like Disfluencies
SLP	Speech Language Pathologist
SndR	Sound repetitions
SSI-4	Stuttering Severity Instrument 4th Edition
SSR	Stuttering Severity Ratings
SylR	Syllable repetitions

Rep_Dom	Repetitions in the dominant language
Rep_NDom	Repetitions in the non-dominant language
TOCS	Test of Childhood Stuttering
UW/S	Unfinished words/sentences
US	United States

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Appendices

Appendix 1. Parents of Bilingual children Questionnaire (Tuller, 2015)

Child's name: …… Date of the interview:……..

Speech and language pathologist's name:……..... Interview with mother father ☐ ☐

Third person who has served as an intermediary with parents: YES or NO. Link with the family……..

****

PaBiQ (Questionnaire for Parents of Bilingual Children)

1. General Information about the Child

1.1 Birth Date: _____ Current age: _____ Country of birth: _____

years ; months

1.2 If place of birth is not country of residence, date of arrival in country of residence: _____

(Month/year)

1.3 What languages does your child speak now (more than isolated words)?

Lebanese	Language ……..	Other ……	Other (specify)

1.4 Which language do you think your child feels the most at home in? _____

2. Child's early history: Language, etc.

2.1How old was your child when he/she spoke his/her first word? _____months

2.2How old was your child when he/she first put words together to make short sentences?

Example: *more water*; *more milk* ; etc. _____months

2.3Before your child was three or four years old, were you ever concerned about his/her language? YES or NO

_____

2.4Has your child ever had any hearing problems or frequent ear infections? YES or NO

_____

2.5 At what age did this exposure begin? Was it through exchanges or through media?

	Age (months if possible)		Age (months if possible)
Lebanese		Other…….	
Language …….....		Other ……	

2.6 Before your child was four years old, was he/she exposed to:

	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese					
Language……..					
Other					

2.7 Before your child was four years old, was he in a significant contact with his mother, his father, etc… (yes/no).
Starting from which age (months) has this contact started for each of this languages?

	Context of contact < 4 years	**Age of contact Lebanese ……months**	**Age of contact language …… ……months**	**Age of contact language …… ……months**
a. Exchanges with mother	Yes / No			
b. Exchanges with father	Yes / No			
c. Exchanges with grand parents	Yes / No			
d. Exchanges with babysitter / child minder	Yes / No			
e. Exchanges with other adults (specify)	Yes / No			
f. Exchanges with siblings	Yes / No			
g. Nursery school/ kindergarten	Yes / No			
Total number of contexts of contact	*T*	*A*	*B*	*C*
Total per language		*A* ……/*T*……	*B* ……/*T*……	*C* ……/*T*……

3. Current Linguistic Skills

	Lebanese	**Language ……..**	**Other**
3.1 Compared to other children the same age, how do you think your child expresses him/herself in …? *0 = not very well/not as well as them; 1 = a little less well/a few differences; 2 = (generally) the same; 3 = very well, better*	0 1 2 3	0 1 2 3	0 1 2 3
3.2 Compared to other children the same age, do you think your child has difficulties making correct sentences? *0 = not very well/not as well as them; 1 = a little less well/a few differences; 2 = (generally) the same; 3 = very well, better*	0 1 2 3	0 1 2 3	0 1 2 3
3.3 Are you satisfied with your child's ability to express him/herself in …? *0 = not at all satisfied; 1 = not very satisfied; 2 = pretty satisfied/generally satisfied; 3 = very/totally satisfied*	0 1 2 3	0 1 2 3	0 1 2 3
3.4 Does your child feel frustrated when he/she can't communicate in …? *0 = very frustrated/almost always frustrated/very often frustrated ; 1 = often frustrated/yes ; 2 = sometimes frustrated, but not often; 3 = (almost) never frustrated/no*	0 1 2 3	0 1 2 3	0 1 2 3

3.5 Do you think that your child speaks like a child the same age who only speaks …..? *0 = not very well/not as well as them; 1 = a little less well/a few differences; 2 = (generally) the same; 3 = very well, better*	0 1 2 3	0 1 2 3	0 1 2 3
TOTAL by language	*/15*	*/15*	*/15*

4. Languages used at home

4.1 With parents

	Mother ↔ Child					**Father ↔ Child**				
	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always	**0** Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese										
Language …….										
Other										

4.2 Is there another adult who regularly takes care of your child? (Grandparents, babysitter, etc.) YES or No

Other adult ↔ Child					
	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese					
Language …….					
Other					

4.3 With siblings (brothers and sisters):

Brothers and sisters ↔Child					
	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese					
Language …….					
Other					

Total number of interlocutors = ……..

I- Total number of interlocutors x 4 = ……..

	Lebanese	**Language……..**	**Other**
Total usage of each language in the family	**……../I…….**	**……../I…….**	**……../I…….**

5. Language spoken in other contexts

5.1 What language activities does your child do each week and in what language(s)?

	Lebanese			**Language …….**			**Other**		
Activities	0 Never or almost never	1 At least once a week	2 Every day	0 Never or almost never	1 At least once a week	2 Every day	0 Never or almost never	1 At least once a week	2 Every day
a. Reading (books, magazines, comic books, newspapers)									
b. Television/ movies / cinema									
c. Storytelling									
Total									
Total by language	*/6*			*/6*			*/6*		

5.2 What language is spoken between your child and the friends he/she plays with regularly?

Child – Friends					
	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese					
Language …….					
Other					

5.3 What language is used by family friends who visit you regularly?

	0 Never	**1** Rarely	**2** Sometimes	**3** Usually	**4** Always
Lebanese					
Language …….					
Other					

	Lebanese	**Language…….**	**Other**
Total usage of each language in other contexts (language richness): 5.1+ 5.2+ 5.3	**/14**	**/14**	**/14**

6.Information about the mother and the father

6.1 Information about the mother

6.1.1 In which country were you born? _____

6.1.2 If you are currently working, what is the language used at work? _____

6.1.3 Education:

		Number of years	Further information
Primary school	Yes / No		
Secondary school	Yes / No		
University	Yes / No		
Other professional training	Yes / No		

6.1.4 In your opinion, how well do you speak the following languages?

	0 Only a few words	**1 Gets along, but with difficulty**	**2 Basic abilities (gets along)**	**3 Well**	**4 Very well**
Lebanese					
Language					
Other					

6.2 Information about the father

6.2.1 In which country were you born? _____

6.2.2 If you are currently working, what is the language used at work? _____

6.2.3 Education:

		Number of years	**Further information**
Primary school	Yes / No		
Secondary school	Yes / No		
University	Yes / No		
Other professional training	Yes / No		

6.1.4 In your opinion, how well do you speak the following languages?

	0 **Only a few words**	**1** **Gets along, but with difficulty**	**2** **Basic abilities (gets along)**	**3** **Well**	**4** **Very well**
Lebanese					
Language ……..					
Other					

7. Difficulties

In each cell, please indicate YES (1 point) or NO (0 point):

	Brother/sister	**Mother**	**Father**	
Difficulties mainly with reading and spelling				
Difficulties understanding others when they speak in your mother tongue				
Difficulties expressing oneself orally (pronunciation, forming sentences, finding the right word, etc.) in your mother tongue				**Total difficulties in the family**:
TOTAL	/3	/3	/3	/9

NOTES ABOUT THIS PARENTAL INTERVIEW - PABIQ

Duration of the interview: ……. minutes

Extra comments:

……
……
……
……
……
……
……

Appendix 2. Parents of children who stutter questionnaire

Parents of children who stutter questionnaire

Child's name:
Date of birth:
Age:
Date:

Description of the disorder

a. When did your child start stuttering?

……

b. Have the disorder's manifestations changed since then?

……

c. What does your child do when he/she stutters?
   - Does he/she repeat whole words?
   - Does he/she repeat part of words?
   - Does he/she stretch out sounds?
   - Does he/she get stuck on a sound and nothing comes out?
   - Does he/she do anything else with his face or body when he stutters?
   - Does he/she give up on trying to say it?

d. Is he/she aware of it? What are the signs of that?

……
……

e. Is he/she worried about it? What are the signs of that?

……
……

f. In which language you think he/she stutters more?

……

g. On a scale of 0 to 7 (where 0 is normal and 7 is extremely severe), how severe is your child's stuttering?

0	1	2	3	4	5	6	7

Family history

h. Has either of the mother or the father ever stuttered?
……
i. Do they still?
……
j. Did any blood relative on either side of the family ever stutter?
……
k. Do they still?
……

Concomitant disorders

l. Does your child have any medical problem (neurological/hearing etc.)?
……
m. Does your child have any speech/language disorder?
……
n. Does your child have any learning difficulties?
……

Therapeutic path

o. For how long has he/she been going through speech therapy sessions?
……
p. Have you seen any improvement in his/her fluency?
……

Appendix 3. SLP survey (cf. Study I and II)

Questionnaire for Lebanese Speech and Language pathologists

Section 1: Personal information

1. Sex: □ F □ M
2. Age: (21-30); (31-40); (41-50); (51-60); (60 and more)
3. Spoken languages: □ Arabic □ French □ English □ Other(s):

(Please tick your level of proficiency in each language)

Spoken:

	Weak	Average	Good	Excellent
Lebanese Arabic				
French				
English				
Other				

Written:

	Weak	Average	Good	Excellent
Lebanese Arabic				
French				
English				
Other				

4. Your highest educational degree: *(Please choose **only one** of the following)*
   - o Speech and language pathology diploma
   - o Specialization diploma
   - o Currently enrolled in a Master's degree program
   - o Master's degree
   - o Currently enrolled in a PhD program
   - o PhD

If you are currently enrolled in a Master's/PhD program or already obtained a Master's degree/PhD, please specify the title of your Master's degree/PhD (e.g. Master's in speech and language therapy, PhD in communication sciences, …):

_____

5. Please indicate when did you obtain each educational degree:
   - Diploma in speech and language therapy:
   - Master's degree:
   - Specialization diploma:
   - PhD:
   - Other:

6. Please indicate the number of years of experience in the field: _____

7. Are you currently a member of any association or professional body affiliated with speech and language pathology in Lebanon or abroad?
   - Yes
   - No

If yes, please specify:

_____

8. Are you currently working as a speech and language pathologist?
   - Yes
   - No (if the answer is no, not included in the study)

9. Are you currently engaged in a non-clinical activity related to speech and language pathology (e.g., teaching)? *(Please choose **only one** of the following)*
   - Yes
   - Non

   If yes, please choose all that apply:
   - Teaching in a speech and language pathology department at a university
   - Research in speech and language therapy
   - Teaching in a sector affiliated with speech and language pathology (linguistics, psychology, education, …)
   - Research in a sector affiliated with speech and language pathology (linguistics, psychology, education, ...)
   - Trainer
   - Internship supervisor
   - Welcoming trainees at your clinic
   - Supervising thesis
   - Other:

10. To which age-range do your patients belong? *(Please choose **all** that apply)*
    - Preschool age
    - School age
    - Adolescence
    - Adults

11. Please select the disorders that you treat in your clinic. *(Please choose **all** that apply)*
    - o Fluency disorders (stuttering, cluttering…)
    - o Language disorders
    - o Written language disorders
    - o Mathematical cognition disorders
    - o Communication disorders
    - o Voice disorders
    - o Feeding disorders
    - o Swallowing disorders
    - o Dysphagia
    - o Aphasia
    - o Mental disability
    - o Hearing impairment
    - o Visual impairment
    - o Other:

Section 2: Data related to stuttering and bilingualism

1. Do you participate in professional activities related to stuttering?
    - o Yes
    - o No

If yes, please indicate all the answers that apply:

- o Round-table discussions
- o Case studies
- o Conferences
- o Other:

2. Do you participate in professional activities related to bilingualism?
    - o Yes
    - o No

If yes, please indicate what applies:

- o Round-table discussions
- o Case studies
- o Conferences
- o Other:

3. Did you receive any additional professional training in stuttering after your graduation? *(Please select **only one** of the following)*
    - o Yes
    - o No

If yes, what are these trainings?

_____

4. Did you receive any additional professional training in bilingualism after your graduation? *(Please select **only one** of the following)*
   - o Yes
   - o No

   If yes, what are these trainings?

_____

5. Do you receive referrals of bilingual patients who stutter?
   - o Yes
   - o No
6. Do you work with bilingual patients who stutter?
   - o Yes
   - o No

   If yes, precise the type of intervention:

   - o Assessment
   - o Assessment and therapy intervention
7. What age group do your patients belong to? (Please select all that apply)
   - o Preschool age
   - o School age
   - o Adolescence
   - o Adults
8. What is the approximate number of patients who stutter you work with per week? _____
9. What is the approximate number of **bilingual** patients who stutter you work with per week? _____
10. Please specify their language dyads (eg. Leb-Fr, Leb-Eng, Leb-Armenian etc.)

    _____
11. What is the approximate number of patients who stutter you have worked with during your career? _____

Section 3: Identification of stuttering in Lebanese bilingual children

1. What criteria do you use to diagnose stuttering in Lebanese bilingual children? *(**free answer**, please indicate your own diagnostic approach)*

_____
_____
_____
_____
_____

2. If the child is bilingual, do you assess speech fluency in both languages?
   - o Yes
   - o No

If yes, why?

_____

_____

If not, in which language do you conduct your assessment, and why?

_____

_____

3. Do you feel equipped to diagnose stuttering in a Lebanese child speaking French and Lebanese Arabic?
   1: Not at all
   2: To a small extent
   3: To a moderate extent
   4: Rather much
   5: Very much

   If you don't, please specify why.

   _____

   _____

4. Do you feel equipped to diagnose stuttering in a Lebanese child speaking English and Lebanese Arabic?
   1: Not at all
   2: To a small extent
   3: To a moderate extent
   4: Rather much
   5: Very much

   If you don't, please specify why.

   _____

   _____

5. Indicate a self-rating of your confidence in your ability to accurately diagnose stuttering in Lebanese bilingual children:

   (0: not confident at all, 10: extremely confident)

0	1	2	3	4	5	6	7	8	9	10

6. Do you have difficulties in distinguishing moments of stuttering from normal speech disfluencies in Lebanese bilingual children?
   1: Not at all
   2: To a small extent

3: To a moderate extent

4: Rather much

5: Very much

If you do, why?

- Lack of assessment and diagnosis tools adapted to the Lebanese population
- Current diagnostic criteria based on monolingual speakers
- Lack of knowledge in this field
- Other:

7. Do you consider bilingualism a risk factor for the onset and/or persistence of stuttering?

1: Not at all

2: To a small extent

3: To a moderate extent

4: Rather much

5: Very much

If you do, why?

_____

If you do not, why?

_____

Section 4: Section related to the identification of stuttering in the recordings of Lebanese bilingual children

For each child, after listening to the recordings, indicate:

1. If you think the child has stuttering:
   - Yes
   - No

2. Rate the child on the following 6-point scale:

0	1	2	3	4	5

0: No stutter

1: Very mild stutter

2: Mild stutter

3: Moderate stutter

4: Sever stutter

5: Very severe stutter

3. The characteristics that you heard in their speech that affected your decisions:

_____
_____
_____
_____
_____
_____

Thank you for your participation

Appendix 4. Speech sample transcription of a hypothetical participant

Child's name: XXXX **Sample description:** *Frog on his own ENG*
Code: XXX

Once upon a time there was a boy (interviewer) and he had a frog in his basket *and he*[PhR:1] was in the garden looking and there was a butterfly with a tree and a turtle and they walked all the way [SndR:1]*a*nother frog got out (interviewer) and then the frog came to a beautiful garden he saw a butterfly *he*[MonoWR:1] ate the flower and then *he*[MonoWR:1] caught the butterfly *and*[MonoWR:1] then *he*[MonoWR:2] got out and then the frog was tired he stopped he saw a bee and then it was grandpa with his mother left eating and then the grandpa said *I*[MonoWR:1] want to go and *then the frog*[PhR:1] came into them and there was one kid looking at his boat and his mother and he saw a frog on the tree (interviewer) and then *the frog*[PhR:1] got on the little boy *a*nd[P] then he got on his boat the water and then her mom his[GRev] mom got in the water and he went in his boat and then the frog got out (interviewer) then he went toilet and then he with the baby with mother and then the tiger is on his chair he cry and his mom came (interviewer) *and then*[PhR:1] *his mom*[PhR:1] left him in chair go with tiger and then *the*[MonoWR:1] tiger want to go to frog but he didn't do anything to him (interviewer) and here he got back to his daddy (interviewer) *and*[MonoWR:1] little boy had a frog he went to the tiger but he didn't do anything to him and then the little boy went with him *the*[UW/S] and then the little boy help the frog to go with him and his turtle in his basket with the dog the end (interviewer).

Overview disfluencies			
Total number of words	**280**	**Total number of syllables**	**328**
Stuttering-like disfluencies (SLD)		**Other disfluencies (OD)**	
Monosyllabic word repetition	**7**	**Multisyllable word repetitions**	**0**
Part-word repetition		**Interjection**	**0**
Sound repetition	**1**	**Phrase repetitions**	**5**
Syllable repetition	**0**	**Revisions**	
Dysrhytmic phonation		Lexical revision	**0**
Prolongation	**1**	Grammatical revision	**1**
Block	**0**	Phonological revision	**0**
Broken words	**0**	**Unfinished word (or sentence)**	**1**
Total number of SLD	**9**	**Total number of OD**	**7**

Overview number of iterations																			
Stuttering-like disfluencies (SLD)										Other disfluencies (OD)									
Monosyllabic word repetition										Multisyllable word repetition									
1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
6	1																		
Sound repetition										Phrase repetition									
1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1										5									
Syllable repetition																			
1	2	3	4	5	6	7	8	9	10										

Overview physical concomitants			
Distracting sounds	**0**	**Facial Grimaces**	**0**
Head movements	**0**	**Movements of extremities**	**0**
Vocal pitch	**0**	*No tension observed.*	

0 = none
1 = not noticeable unless looking for it
2 = barely noticeable to casual observer
3 = distracting
4 = very distracting
5 = severe and painful looking

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