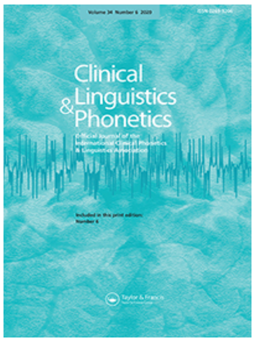

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Speech disfluencies in bilingual Yiddish-Dutch speaking children

Kurt Eggers[a,b], Sabine Van Eerdenbrugh[a], and Courtney T. Byrd[c]

[a]Department of Speech-Language Pathology, Thomas More University College, Antwerp, Belgium; [b]Department of Psychology and Speech-Language Pathology, University of Turku, Turku, Finland; [c]Department of Communication Sciences and Disorders, University of Texas at Austin, Austin, USA

ABSTRACT

In this study, we investigated the frequency and types of stuttering-like (SLD) and other (OD) disfluencies in 59 typically developing bilingual Yiddish-Dutch (YD) speaking children. Participants were divided in two age categories: 6.01–7.07 and 9.00–10.04-year-olds. All children (1) were successive, bilingual YD speaking, (2) had Yiddish as their dominant language and (3) were sufficiently intelligible in both languages. A conversation sample of at least 300 syllables was collected in each of the two languages. The main findings in this study were (a) the total amount of SLD as well as OD were significantly higher in the non-dominant language. For the SLD, this was mainly caused by the higher frequency of monosyllabic word and syllable repetitions. For the OD, almost all disfluency types seem to have contributed to this. (b) The total amount of OD was significantly higher in the older group of bilingual YD children than in the younger group. This was primarily due to higher frequencies of phrase repetitions, lexical revisions and unfinished words. (c) The monolingual diagnostic guideline of three SLD per 100 words as a means to label stuttering cannot be used in this bilingual population. The majority of the non-stuttering children scored higher than the standard 3% SLD in both languages. In the dominant Yiddish language, 27 children (46%) scored above this percentage, in the non-dominant Dutch language, 46 children (78%).

We conclude that bilingual YD-speaking children have a higher frequency of speech disfluencies in comparison to monolingual children. Consequently, monolingual stuttering guidelines cannot be used in this bilingual population.

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Speech disfluencies; typical fluent; bilingual; language dominance

Introduction

In today's world, there are more bilingual speakers than monolingual speakers (Ardila, Ramos, & Barrocas, 2010; Grosjean, 2010). Monolingual speakers, however, are still considered as the norm, both in research and in clinical practice (Romaine, 1995; Shin, 2017). Across all continents, Europe contains the highest number of bilingual speakers: 56% are functionally bilingual (Bialystok, Craik, & Luk, 2012). This high prevalence is mainly the result of globalization and immigration (e.g. Chen, Benet-Martinez, & Bond, 2008; Dumont & Lemaître, 2005). Nevertheless, given the variations in definitions for bilingualism, questions regarding prevalence data persist and will likely remain until one unified definition is accepted.

CONTACT Kurt Eggers kurt.eggers@thomasmore.be Molenstraat 8, Antwerp 2018, Belgium

Among the definitions that exist, the one proposed by Chin and Wigglesworth (2007) appears to be more widely used. They define bilingualism as a continuum of competences in two (or more) languages and suggest that only a small minority of people are located in the middle of this continuum. These individuals are considered to be 'balanced' as they are equally and highly competent in each of the two languages (Bloomfield, 1933; Poarch & Bialystok, 2015; Sorge, Toplak, & Bialystok, 2016). The competence in one language as compared to the other often depends on specific contexts (Von Hapsburg & Peña, 2002). One language is often called 'dominant' and the other 'non-dominant' (Kohnert, 2008). The dominant language is the language best acquired by the bilingual speaker. Apart from use, bilingualism also differs in description and function relative to age of acquisition. If languages are acquired at the same time and before the age of three, speakers are simultaneously bilingual (Baker, 2001). If acquired one after the other, they are sequentially bilingual.

Yet another consideration is whether or not the second language is a choice or a necessity for navigating their daily lives. Elective bilingualism refers to speakers who choose to be bilingual (Baker, 2001; Chin & Wigglesworth, 2007; Valdes & Figueroa, 1994; Von Hapsburg & Peña, 2002). Often the situations in which the second language is spoken are artificial, and the first language will remain the dominant language (Baker, 2001). Situational bilingualism refers to speakers who are bilingual because it is necessary to successfully function in society (Von Hapsburg & Peña, 2002). For those bilingual speakers, one language can become more dominant than the other if spoken more frequently for a period of time.

Disfluencies in bilingual speakers

Of particular relevance to the present study, bilingual speakers are more likely to be disfluent than monolingual speakers (see Byrd, 2018 for review). Although speech-language pathologists can identify the presence and severity of stuttering even when they do not speak the language of the person who stutters (e.g. Lee, Robb, Ormond, & Blomgren), the ability to discern when stuttering is not present in a multi-lingual speaker appears to be compromised by the high rates of disfluencies they produce (e.g. Byrd, Watson, Bedore, & Mullis, 2015).

Fiestas, Bedore, Peña, and Nagy (2005) described the presence of 'mazes' when analysing the speech of bilingual pre-school aged children. Mazes are defined as filled pauses (or interjections), connectors (repetitive use of connectors), repetitions (sound, syllable, word or phrase) and revisions (Fiestas et al., 2005; Navarro-Ruiz & Rallo-Fabra, 2001). Within the group of revisions, Fiestas et al. distinguished phonological, lexical and grammatical revisions. Phonological revisions start with the same phonemes before the word(s) is revised (e.g. a cu(p) – castle); lexical revisions suggest word retrieval difficulties (e.g., a dog instead of cat); grammatical revisions are revisions after an incorrectly chosen grammatical from (e.g., he were … was in the park).

Mazes generally appear when individuals express an idea that is abstract, complicated, or not yet fully developed. Increased use of mazes can be expected in tasks in which complex ideas are formulated, for example, with spatial, temporal or causal relationships, especially in a language that is not fully acquired. Loban (1976) considered mazes as a reflection of someone's linguistic uncertainty, and suggested to use the percentage of words in mazes divided by the total number of words as a measure for this uncertainty. It can be expected that bilingual children will have more difficulty retrieving words or expressing complex ideas in one language, are more hesitant and show more of this type of disfluency than monolingual children. Fiestas et al. (2005), however, compared monolingual children (English or Spanish) with bilingual Spanish-English children but found that the total maze use was only slightly higher in the bilingual group and was not statistically significant. It was not significantly different from the monolingual group. The bilingual group, however, used different types of mazes. They produced nearly double the number of repetitions than the monolingual group (a statistically significant difference), and more lexical and grammatical revisions than the monolingual group (not a statistically significant difference). On average, these children also produced significantly more grammatical revisions in Spanish than in English. While the bilingual group did not produce more mazes than the monolingual group, they did produce more of certain types of disfluencies like repetitions (i.e. a type of disfluency also often identified in the speech of people who stutter which may include sound, syllable or monosyllabic word repetitions), further investigation is warranted with regard to the speech disfluency of bilinguals as it relates to the types of disfluencies used to identify moments of stuttering in people who stutter.

Monolingual guidelines

The most frequently used classification for disfluencies in published studies is the one of Ambrose and Yairi (1999). They distinguish between 'Other Disfluencies' (OD; i.e. interjections, revisions of utterances, multi-syllabic repetitions and phrase repetitions) and 'Stuttering-Like Disfluencies' (SLD; i.e. part-word repetitions (syllable or sound), single word repetitions, prolongations, blocks and broken words). They compute %SLD and % OD, that is, counting one group of disfluencies (SLD or OD) as a percentage to the total number of syllables. They exclude utterances like 'yes', and 'no' in their syllable count, and they count all disfluencies that are present if more than one disfluency type occurs in a word (e.g. bu-bu-but-but yields counts of part-word and single syllable word repetitions). Ambrose and Yairi (e.g. 1999) suggest a production of 3% SLD as a clinical threshold to diagnose 'stuttering' to children.

Byrd, Bedore, and Ramos (2015) investigated whether the types of disfluencies typically used to identify stuttered speech in monolingual English speakers, can be observed in the speech of bilingual speakers who do not stutter. They included 18 Spanish-English typically fluent children between 5.6 and 6.7 years old in their study. Six children were Spanish-English balanced (using Spanish and English 40–60% of the time), six children were Spanish dominant (using Spanish 61–80% of the time) and six children were English dominant (using English 61–80% of the time). There were three boys and three girls in each of the groups. They found that language dominance did not have a significant impact on the number of SLD that were produced. The %SS ranged significantly more for Spanish than for English, with significantly more children exceeding the 3% criterion for Spanish than for English in each group (n = 5 vs n = 1 in the balanced bilingual group, n = 5 vs n = 3 in the Spanish dominant group and n = 4 vs n = 3 in the English dominant group). None of the observed repetitions in either language showed any atypicality with regard to rhythmicity or tension. From this study, one can wonder whether this 3% guideline can be applied to typically fluent speakers of other language dyads.

For various languages, including English, Dutch, Spanish, German and French, this guideline of 3% does seem to be applicable (Ambrose & Yairi, 1999; Boey, Wuyts, Van de Heyning, De Bodt, & Heylen, 2007; Carlo & Watson, 2003; Leclercq, Suaire, & Moyse, 2017; Natke, Sandrieser, Pietrowsky, & Kalveram, 2006; Pellowski & Conture, 2002; Tumanova, Conture, Lambert, & Walden, 2014). However, some of the authors (e.g. Ambrose & Yairi, 1999; Carlo & Watson, 2003) used a syllable-based metric (i.e. three stuttered disfluencies per 100 syllables), while others used a word-based metric (i.e. three stuttered disfluencies per 100 words) (e.g., Boey et al., 2007; Leclercq et al., 2017; Tumanova et al., 2014). Moreover, the group sizes of the various studies differed substantially (between n = 24 and n = 228) and some authors specified whether children needed to be monolingual while others did not. Nevertheless, taken together, it does appear that the 3% guideline can be applied to monolingual speakers of languages other than English, but, more research is needed to determine whether this guideline can apply to bilingual speakers of diverse language dyads.

Purpose of the present study

From the literature, it is clear that bilingual speakers are more disfluent than monolingual speakers and that moments of disfluency occur at the beginning of utterances and syntactic units (e.g. Gillam, Logan, & Pearson, 2009; Logan & Conture, 1995). More insight, however, needs to be gained about which types of disfluencies occur in various languages, and whether the 3% SLD guideline can be used for identification of stuttering in the speech of those languages. In the present study, we looked at the speech of Yiddish-Dutch (YD) bilingual speakers. Yiddish ('Jewish-German') is a German language, spoken globally by about three million Jewish people. It is usually written from right to left like the Hebrew alphabet but is language-wise not related to Hebrew (Jacobs, 2005). The Jewish population in Antwerp with its approximately 20,000 ultra-orthodox association, is one of the largest Jewish communities, after the one in New York, London and Jerusalem (Abicht, 2018). Given the proximity of the first two authors to this location, the study focused on this population. We aimed to systematically replicate the study completed by Byrd, Bedore et al. (2015) on Spanish-English speaking children in Yiddish-Dutch speaking children. Specifically, we asked the following research questions:

(1) Does the frequency and/or types of speech disfluencies (both SLD and OD) produced by typically developing bilingual YD children differ in their dominant language (Yiddish) compared to their non-dominant language (Dutch)?
(2) Does the frequency and/or types of speech disfluencies (both SLD and OD) produced by typically developing bilingual YD children in their dominant (Yiddish) and non-dominant language (Dutch) differ depending on age category (i.e. youngest age group vs oldest age group)?
(3) Is the guideline of 3% SLD an appropriate means for identifying stuttering in bilingual YD children?

Methods

Participants

The present study was approved by the first two authors' departmental Research Council and all parents and participating schools provided a written informed consent.

Participants were 59 typically developing bilingual YD-speaking children (12 boys and 47 girls) in two age categories: 29 children (5 boys and 24 girls) aged between 6.01 and 7.07 years of age and 30 children (7 boys and 23 girls) aged between 9.00 and 10.04 years of age. The mean ages were respectively 6.08 years (SD = 0.04) for the youngest age category and 9.09 years (SD = 0.03) for the oldest group. Because of the large proportion of females who participated in this study, it is important to mention that gender does not influence the frequency and types of disfluencies in typically developing Dutch-speaking children (Eggers & Elen, 2018). This finding is in line with earlier findings by Ambrose and Yairi (1999).

Children were recruited in the first and fourth year of elementary school of six Jewish schools located in Antwerp. All children (1) were successive, bilingual YD speaking, (2) had Yiddish as their dominant language and (3) were sufficiently intelligible in both languages. The age categories were chosen based on the Flemish educational system and more specifically on the usage of Dutch in the Jewish schools, which starts in the first year of elementary school. From the fifth year of elementary school, children are also exposed to French. Exclusion criteria were (1) the presence of reported speech, language and/or hearing problems, (2) a parental concern about the speech fluency, (3) a family predisposition for stuttering and/or cluttering and (4) the presence of intellectual and/or neurological disorders. Exclusion criteria were evaluated based on a detailed parental questionnaire combined with reports from the Centers for Student Guidance who screen each school-age child for speech, language and hearing problems. It is relevant to add that parents were found to be accurate and reliable in identifying stuttering in their own children's speech (Einarsdóttir & Ingham, 2009). Finally, the first two authors, experienced fluency specialists, independently evaluated the speech in the samples as typically developing, fluent (i.e. non-stuttered) speech.

The parental socioeconomic status was determined based on the highest educational level (1 = primary education, 2 = high school, 3 = college degree, 4 = university degree) of each parent; for each child, the parents' educational levels were added to obtain a composite score. No significant differences were found between the youngest group (M = 4.14, range 2–6) and oldest group (M = 3.93, range 2–6; $t(57) = .70$, $p = .48$).

Language dominance

The children's level of exposure to Yiddish and Dutch was determined based on a parental questionnaire, similar to Byrd, Bedore et al. (2015). Parents provided (a) a daily hour-by-hour description of their children's language input and output and (b) an overview of the languages used at home and in other environments for each year since birth. All children were Yiddish dominant, i.e. using Yiddish 60%–80% of the time. The mean Yiddish usage was 71.20% (SD = 4.34) for the youngest age group and 68.67% (SD = 5.15) for the oldest age group. A significant between-group difference showed that the youngest age group was using slightly more Yiddish than Dutch, $t(57) = 2.04$, $p < .05$. All children started speaking Yiddish before their first year of age and most children started speaking Dutch between 3 and 4 ($n = 45$), a minority between 2 and 3 ($n = 3$ in the youngest and $n = 7$ in the oldest age group) or between 4 and 5 ($n = 4$ in the oldest age group).

In order to get an indication of their level of Dutch language ability, the parental questionnaire included questions about the child's vocabulary (*'How many Dutch words does your child use?' Answering options: a few words, a limited range of words, some words, many words, extensive vocabulary*), speech intelligibility (*'How many Dutch words does your child produce intelligibly?' Answering options: a few words, a limited range of words, some words, many words, extensive vocabulary*), syntax (*'How often does your child produce grammatical correct sentences?' Answering options: never, seldom, sometimes, often, very often, always*) and language comprehension (*'How often does your child understand what is said in Dutch?' Answering options: never, seldom, sometimes, often, very often, always*). Significant differences were found between the two age groups for vocabulary (youngest group: $M = 4.31$; oldest group: $M = 4.77$; $t(57) = -2.85$, $p < .01$), speech intelligibility (youngest group: $M = 4.31$; oldest group: $M = 4.80$; $t(57) = -3.26$, $p < .005$), syntax (youngest group: $M = 3.66$; oldest group: $M = 4.47$; $t(57) = -5.01$, $p < .005$) and language comprehension (youngest group: $M = 4.31$; oldest group: $M = 4.63$; $t(57) = -2.14$, $p < .05$), indicative of the language development between both age groups. As Yiddish was always the native language and spoken most of the time, this information was only collected for the Dutch language.

Collection of the data

Parental questionnaires were distributed via the schools and collected at the moment of the session. Spontaneous conversations, one in Yiddish and one in Dutch, were video-recorded during an individual session with a YD bilingual final-year SLP-student in a quiet room at the school of the child. To avoid a confound of order, half of the participants started with the Dutch conversation and the other half with the Yiddish conversation. Each speech sample contained a minimum of 300 words and was triggered by standardized, open-ended questions (e.g. "Describe your favourite movie").

Speech samples were orthographically transcribed by two YD bilingual final-year SLP-students and double checked. Consequently, speech disfluencies were identified and coded. In line with Ambrose and Yairi (1999), isolated affirmatives and negatives were not included unless they were directly followed by a phrase (e.g. yes that is nice). Also, unintelligible utterances were not included.

Categorization of disfluencies

For categorizing the disfluencies, researchers used a similar system (see Table 1) to that of Byrd, Bedore et al. (2015) which was based on Ambrose and Yairi's (1999) system of SLD and OD. Revisions were further categorized in lexical, grammatical and phonological revisions (cf. Bedore, Fiestas, Peña, & Nagy, 2006).

Analogous to Byrd, Bedore et al. (2015), mean SLD and OD percentages were calculated based on words (and not syllables) to allow for a comparison with their findings and with frequencies reported in earlier bilingual stuttering research. In the monolingual literature it is sometimes argued that the use of words versus syllables can inflate disfluency frequencies; however, for the Dutch language, Boey et al. (2007) demonstrated

Table 1. Categorization, description and examples of the types of speech disfluencies, i.e., stuttering-like disfluencies (SLD) and other disfluencies (OD) (based on Ambrose & Yairi, 1999; Byrd et al., 2015).

Disfluency type	Description	Example Yiddish	Example Dutch
SLD			
Monosyllabic word repetition	Repetition of a monosyllabic word	ich ich ich hob es lieb gehat	ik ik ik vond het leuk
Part-word repetition			
Sound repetition	Repetition of a sound within a word	ich b b bin mied	ik b b ben moe
Syllable repetition	Repetition of a syllable within a word	ich tref main re re rensel nisht	ik vind mijn ru ru rugzak niet
Dysrhythmic phonation			
Prolongation	Prolongation of a sound resulting in an atypical duration of that sound	ich vil mmmilech	ik wil mmmelk
Block	Stopping airflow and sound during or before production of a vowel or consonant	… boim	… boom
Broken word	Stopping airflow and sound in the middle of a vowel within a word	me … ertz	maa … aart
OD			
Multi-syllable word repetition	Repetition of a multi-syllabic word	maan chavairim chavairim zennen doe	mijn vrienden vrienden zijn hier
Interjection	Filler words or non-linguistic sounds used within an utterance	ehr is doe uhm pinkt geven	hij is hier uhm net geweest
Phrase repetition	Repetition of a phrase within an utterance	a shaine a shaine hoos	een mooi een mooi huis
Revision			
Lexical revision	Correction of overt word choice errors, to add or delete lexical information	de maaze haaze zennen grois	de muizen huizen zijn groot
Grammatical revision	Correction of overt grammatical errors	ehr zitst in oif de tish	hij zit in op de tafel
Phonological revision	Correction of phonological errors	ich hob a shilem shirem	ik heb een palaplu paraplu
Unfinished word (or sentence)	Abandoned or incomplete word	ich hob a ka-	ik heb een ka-

that a word-based metric is applicable (i.e. the 3% SLD guideline, based on words, can identify stuttering with a high degree of sensitivity and specificity). For the purpose of this study, percentages were word-based in order to compare our findings in bilingual YD children to Boey et al.'s (2007) findings in monolingual Dutch speakers.

To increase the reliability of speech disfluency categorization, initially two samples were jointly transcribed and analysed by the first two authors and the two final year YD-speaking SLP students, all with experience in transcribing and analysing disfluencies. During the disfluency coding of the different speech samples, any uncertainty or discrepancy in the coding was re-examined by the first two authors and students in order to yield full agreement on all identified disfluencies. Ten percent of the speech samples (three Yiddish and three Dutch speech samples in each age group, 12 speech samples in total) were independently labelled and categorized. The inter-judge reliability for those (point-by-point for location and type, see Ambrose & Yairi, 1999) was calculated based on the 'agreement index' percentage, i.e. amount of agreements divided by the sum of agreements and disagreements (Suen & Ary, 1989). The inter-judge reliability was 0.92.

The number of total words was counted in order to calculate the percentage of disfluencies (cf. Byrd et al., 2015; Conture, 2001). Repeated words and phrases were not counted (e.g. He he went home = three words; He went to … he went to school = four words). The words in revised phrases were counted (e.g. He went home … to school = 5 words).

The mean number of repetition units for each type of repetition were based on all productions of sound, syllable and monosyllabic word repetitions. One repetition unit was defined as one extra production of a segment (e.g. he he …). These procedures were consistent with those implemented by Pellowski and Conture (2002),

Finally, the first two authors independently evaluated all repetitions for atypical rhythmic patterns and/or abnormal tension (cf. Guitar, 2013). Abnormal rhythmicity during repetitions was defined as repetition units with difference in duration and/or rapid bursts of iterations in a repetition set. Abnormal tension was scored when physical concomitants (e.g. facial grimaces and head movements) and/or pitch changes within the iterations were detected. None of the repetitions showed an atypical rhythmic pattern or abnormal tension. These are both characteristics frequently associated with moments of stuttering.

Results

The total speech sample of all participants contained 46,477 words (i.e. 23,040 Yiddish and 23,437 Dutch words). On average, participants produced 384 (SD = 64) Yiddish words and 390 (SD = 80) Dutch words. There were no significant differences between both age groups in the amount of Yiddish, $F(1, 57) = 2.78$, $p = .10$ or Dutch words produced, $F(1, 57) = 0.17$, $p = .90$.

Table 2 provides an overview of the mean percentage of SLD and OD in Yiddish and Dutch for the two age groups. An overall test of significance for the different disfluency types was performed. Differences in the disfluency type between dominant and non-dominant language and age groups were evaluated using a MANOVA. The design used was intercept + language + age group + language × age group. Both the language factor, $F(15, 100) = 5.17$, $p < .001$, $\eta_p^2 = .44$, observed power = 1.00, and the age group factor, $F(15, 100) = 8.60$, $p < .001$, $\eta_p^2 = .56$, observed power = 1.00, were significant. However, the

Table 2. Mean percentage of stuttering-like disfluencies (SLD) and other disfluencies (OD) in Yiddish and Dutch for the two age categories.

		Yiddish	Dutch
Type	Age	Mean (*SD*)	Mean (*SD*)
SLD			
Monosyllabic word repetition	6.01–7.07	2.23 (1.52)	2.96 (1.98)
	9.00–10.04	2.31 (1.42)	3.91 (2.14)
Part-word repetition			
Sound repetition	6.01–7.07	0.51 (0.64)	0.48 (0.57)
	9.00–10.04	0.20 (0.28)	0.34 (0.40)
Syllable repetition	6.01–7.07	0.36 (0.33)	0.43 (0.42)
	9.00–10.04	0.19 (0.20)	0.46 (0.44)
Dysrhythmic phonation			
Prolongation	6.01–7.07	0.11 (0.20)	0.12 (0.29)
	9.00–10.04	0.11 (0.23)	0.13 (0.21)
Block	6.01–7.07	0.11 (0.16)	0.07 (0.15)
	9.00–10.04	0.07 (0.16)	0.08 (0.15)
Broken word	6.01–7.07	0.07 (0.14)	0.17 (0.38)
	9.00–10.04	0.07 (0.11)	0.10 (0.18)
Total SLD	6.01–7.07	*3.38 (1.77)*	*4.18 (2.40)*
	9.00–10.04	*2.93 (1.51)*	*5.10 (2.14)*
OD			
Multi-syllable word repetition	6.01–7.07	0.13 (0.18)	0.07 (0.14)
	9.00–10.04	0.21 (0.37)	0.09 (0.14)
Interjection	6.01–7.07	2.67 (1.72)	3.96 (2.50)
	9.00–10.04	2.41 (1.56)	3.89 (1.96)
Phrase repetition	6.01–7.07	0.52 (0.41)	0.60 (0.56)
	9.00–10.04	0.80 (0.54)	1.01 (0.82)
Revision			
Lexical revision	6.01–7.07	0.31 (0.32)	0.71 (0.58)
	9.00–10.04	1.14 (0.66)	1.59 (0.64)
Grammatical revision	6.01–7.07	0.00 (0.00)	0.06 (0.12)
	9.00–10.04	0.04 (0.09)	0.09 (0.17)
Phonological revision	6.01–7.07	0.04 (0.10)	0.08 (0.17)
	9.00–10.04	0.06 (0.11)	0.13 (0.18)
Unfinished word (or sentence)	6.01–7.07	2.05 (0.99)	2.22 (1.27)
	9.00–10.04	4.94 (5.75)	4.01 (1.39)
Total OD	6.01–7.07	*5.71 (2.09)*	*7.54 (3.04)*
	9.00–10.04	*8.62 (2.52)*	*10.73 (3.44)*

interaction between language and age group was not significant, $F(15, 100) = 0.70$, $p = .78$, $\eta_p^2 = .09$, observed power = .42.

Frequency and types of disfluencies in the dominant versus non-dominant language

The total amount of SLD was lower for the dominant language ($M = 3.15$, $SD = 1.65$) than the non-dominant language ($M = 4.64$, $SD = 2.30$), $F(1) = 16.50$, $p < .001$ $\eta_p^2 = .13$, observed power = 0.98. This was may be due to the lower frequency of monosyllabic word repetitions (dominant: $M = 2.27$, $SD = 1.46$; non-dominant: $M = 3.44$, $SD = 2.10$) and syllable repetitions (dominant: $M = .27$, $SD = .28$; non-dominant: $M = .44$, $SD = .43$).

Also the total amount of OD was lower for the dominant language ($M = 7.19$, $SD = 2.72$) than the non-dominant language ($M = 9.16$, $SD = 3.60$), $F(1) = 14.27$, $p < .001$ $\eta_p^2 = .11$, observed power = 0.96. It is particularly interesting that while this effect may have been caused by two disfluency types in the SLD, here almost all disfluency types seem to have contributed to this difference. While interjections (dominant: $M = 2.54$, $SD = 1.64$; non-dominant: $M = 3.92$, $SD = 2.22$) and all types of revisions, i.e. lexical (dominant: $M = 0.74$,

Table 3. Results of the MANOVA with types of disfluencies as dependent variables and language and age group as fixed factors.

	By language		By age group		Language by age group	
Type	*F*	*p*	*F*	*p*	*F*	*p*
SLD						
Monosyllabic word repetition	12.35	0.00**	2.45	0.12	1.72	0.19
Part-word repetition						
Sound repetition	0.43	0.51	6.20	0.01*	0.86	0.35
Syllable repetition	6.34	0.01*	1.28	0.26	2.30	0.13
Dysrhythmic phonation						
Prolongation	0.13	0.71	0.01	0.92	0.00	0.99
Block	0.27	0,61	0.19	0,66	0.60	0.44
Broken word	2.58	0.11	1.07	0.30	0.77	0.38
Total SLD	*16.50*	*0.00***	*0.41*	*0.52*	*3.54*	*0.06*
OD						
Multi-syllable word repetition	4.14	0.04*	1.53	0.22	0.52	0.47
Interjection	14.59	0.00**	0.21	0.65	0.07	0.79
Phrase repetition	1.70	0.19	9.43	0.00**	0.32	0.57
Revision						
Lexical revision	16.16	0.00**	66.07	0.00**	0.03	0.85
Grammatical revision	6.03	0.02*	3.61	0.06	0.06	0.80
Phonological revision	4.80	0.03*	1.63	0.20	0.26	0.61
Unfinished word (or sentence)	0.43	0.51	16.92	0.00**	0.93	0.34
Total OD	*14.27*	*0.00***	*34.47*	*0.00***	*0.07*	*0.79*

*$p < .05$
**$p < .005$

Table 4. Mean number of repetition units in Yiddish and Dutch for the two age categories.

		Yiddish	Dutch
Type	Age	Mean (*SD*)	Mean (*SD*)
Monosyllabic word repetition	6.01–7.07	1.39 (0.47)	1.44 (0.44)
	9.00–10.04	1.22 (0.25)	1.17 (0.17)
Sound repetition	6.01–7.07	1.26 (0.38)	1.22 (0.48)
	9.00–10.04	1.14 (0.33)	1.04 (0.13)
Syllable repetition	6.01–7.07	1.05 (0.17)	1.10 (0.21)
	9.00–10.04	1.10 (0.29)	1.04 (0.12)

SD = 0.67; non-dominant: M = 1.16, SD = 0.75), grammatical (dominant: M = 0.02, SD = 0.07; non-dominant: M = 0.07, SD = 0.15) and phonological (dominant: M = 0.05, SD = 0.11; non-dominant: M = 0.11, SD = 0.17) were lower in the dominant language, multi-syllable word repetitions occurred more frequently in the dominant language (dominant: M = 0.17, SD = 0.30; non-dominant: M = 0.08, SD = 0.14). Table 3 includes all MANOVA results.

Finally, the number of repetition units (i.e. the number of times a child repeats a sound, syllable or monosyllabic word) were counted for both languages. While all participating children produced repetitions, they did not demonstrate any tension or atypical rhythmic pattern. The mean number of repetition units was 1.18 (SD = 0.37) for sound repetitions, 1.07 (SD = 0.19) for syllable repetitions and 1.30 (SD = 0.37) for monosyllabic word repetitions. No significant difference in mean number of repetition units was found between the dominant and non-dominant language, $F(3, 42) = .54$, $p = .65$ $\eta_p^2 = .04$, observed power = 0.15. Table 4 represents the mean number of repetitions.

Frequency and types of disfluencies in the young versus old age group

No significant difference was found for the total amount of SLD between both age groups, $F(1) = 0.41$, $p = .52$ $\eta_p^2 = .00$, observed power = .10. One disfluency type, i.e. sound repetitions, occurred more frequently in the youngest age group (young: $M = 0.49$, $SD = 0.60$; old: $M = 0.27$, $SD = 0.35$).

The total amount of OD was significantly higher in the oldest group of YD children, $F(1) = 34.47$, $p < .001$ $\eta_p^2 = .23$, observed power = 1.00. This may have been due to higher frequencies of phrase repetitions (young: $M = 0.56$, $SD = 0.49$; old: $M = 0.90$, $SD = 0.70$), lexical revisions (young: $M = 0.51$, $SD = 0.51$; old: $M = 1.36$, $SD = 0.68$) and unfinished words (young: $M = 2.14$, $SD = 1.13$; old: $M = 4.47$, $SD = 4.17$).

Finally, the number of repetition units were compared between age groups. No significant between-group difference was found, $F(3, 42) = 1.24$, $p = .31$ $\eta_p^2 = .08$, observed power = 0.31.

Applicability of monolingual guidelines

If we apply the monolingual guideline of 3% SLD for diagnosing stuttering to our participants, the majority of the children score higher than the standard 3 per 100 words SLD in both languages. In the dominant Yiddish language, 27 children (46%) score above this percentage, with mean percentages ranging between 0.62% and 7.74%. In the non-dominant Dutch language, 46 children (78%) score above this percentage, with mean percentages ranging between 0.30% and 9.12%.

Boey et al. (2007, p. 320) reported a mean frequency of SLD for typically fluent monolingual Dutch-speaking children of 0.42 ($SD = 0.98$). A *t*-test for averages was used to compare the mean total SLD in our bilingual YD children with this earlier finding. Results showed that in both in the dominant, $t(58) = 12.71$, $p < .001$, and the non-dominant language, $t(58) = 14.11$, $p < .001$, bilingual YD children produce significantly more SLD compared to monolingual children. This finding was consistent across both age groups.

In addition, the frequency of total speech disfluencies per 100 words (i.e. OD + SLD) exceeded 10 per 100 words for 29 children (49%) in the dominant language and for 46 children (78%) in the non-dominant language.

Discussion

The criteria that are currently being used as normative references to characterize stuttering or typical (dis)fluency are based on a monolingual English-speaking population. Therefore, the goal of the current study was to gain insight about the disfluencies produced by bilingual, typically developing children. In a previous study, Byrd, Bedore et al. (2015) investigated dysfluency in Spanish-English speaking children. Therefore, the present study aimed to expand the investigation of the speech disfluencies of bilingual speakers to a group of Yiddish-Dutch speaking children. The main findings in this study showed that (a) the total amount of SLD as well as OD was significantly higher in the non-dominant language, Dutch, (b) the total amount of OD was significantly higher in the older group of bilingual YD children than in the younger group and (c) bilingual YD children produce significantly more SLD in both dominant and non-dominant language compared to monolingual children. These findings suggest that the monolingual diagnostic stuttering threshold of using the categorization of disfluencies as a means to label stuttering should not be used in a bilingual population.

Frequency and types of disfluencies in the dominant versus non-dominant language

The bilingual YD children produced significantly higher frequencies in both types of disfluencies in their non-dominant language. Byrd, Bedore et al. (2015), however, did not find a difference as it related to dominance in English-Spanish speaking children. Although also studies of speakers who stutter (Ardila et al., 2010; Jankelowitz & Bortz, 1996; Lim, Lincoln, Chan, & Onslow, 2008) have shown more SLD in the non-dominant language, not all findings have been unequivocal (Bernstein Ratner & Benitez, 1985; Jayaram, 1983). Moreover, these findings may be language-specific and influenced by the linguistic and/or motoric complexity of the specific language.

The higher OD percentages in our study may have been influenced by all the sub-types except for the multi-syllable word repetitions, which occurred more in the non-dominant language. Higher SLD percentages may have been caused by the higher frequency of monosyllabic word repetitions and syllable repetitions. Fiestas et al. (2005) indicated that the higher frequency of repetitions in the non-dominant language could be the result of linguistic uncertainty at the phonological, lexical and/or semantic level. Moreover, repetitions might create a second opportunity for receiving auditive feedback and increased monitoring of the speech output. Interestingly, also in a monolingual population an increase in certain types of mazes, such as false starts, unfinished words, revisions at the beginning of an utterance, have been found to appear in periods of increased development in general language skills (Starkweather, 1987). In other words, an increased frequency of repetitions might reflect a period of rapid language growth (DeJoy & Gregory, 1985).

Due of the homogeneity of our participant group (all participants had Yiddish as the dominant language) one cannot clearly state that the reason for the higher frequency of disfluencies in non-dominant Dutch language was the consequence of language dominance or rather the result of differences in linguistic characteristics between both languages. Therefore, future research should aim to include sub-groups with different language dominance types (e.g. Yiddish dominant, Dutch dominant, and balanced).

Frequency and types of disfluencies in the young versus old age group

No difference in total amount of SLD was found between the young and old age groups; only sound syllable repetitions were more apparent in the young age group. Older bilingual YD children produced higher frequencies of OD, specifically phrase repetitions, lexical revisions and unfinished words. Their use of grammatical revisions was marginally significant. These findings were similar for both the dominant and non-dominant language. One possibility is that the older children were more focused on producing correct words and grammatical structures and as a result, engaged in more self-correction. Although self-corrections have a positive influence on the language development, they negatively affect the speech fluency. Fiestas et al. (2005) pointed out that the higher number of revisions may indicate a greater metalinguistic awareness, which may lead to an increased ability to monitor and self-correct.

Applicability of monolingual guidelines

Monolingual guidelines that are currently being used to classify speech into typically (dis) fluent and stuttered speech include producing more than 3% SLD (e.g. Ambrose & Yairi, 1999; Boey et al., 2007; Tumanova et al., 2014), producing more than 7% OD (Tumanova et al., 2014) or 10% total disfluencies (OD + SLD) per 100 words (e.g. Adams, 1977; Guitar, 2013), and a mean number of repetition units of two or higher per disfluency (e.g. Ambrose & Yairi, 1995, 1999; Pellowski & Conture, 2002).

Bilingual children of both age categories produced a significant higher number of SLD in both languages compared to their monolingual counterparts. Boey et al. (2007) reported a mean SLD of 0.42% for monolingual fluent Dutch-speaking children whereas our data show mean SLD percentages for bilinguals between 2.93 and 5.10, dependent on age group and language dominance. Moreover, when applying the 3% SLD cut-off to the dominant language (Yiddish), the speech of 46% of the YD bilinguals was classified as stuttered speech, and this increased to 78% when applied to the non-dominant language (Dutch). These findings are highly similar to Byrd, Bedore et al. (2015) who found 39% of the bilinguals scored above this cut-off for their dominant language and 78% for their non-dominant language. Both studies indicate that regardless of language, bilingual children are at risk for scoring above the standard diagnostic guidelines of 3% SLD. It is also important to note that in Ambrose and Yairi's study (1999), a few typically fluent children occasionally scored slightly above this guideline.

Tumanova et al. (2014) argued that the number of OD could be used as an augmentative measure in order to make a decision about who does and who does not stutter. Their findings showed that the criterion of 7% OD was highly specific and should, in combination with the 3% SLD criterion, increase accuracy in talker-group (i.e. stuttering or not stuttering) classification. Previously, other authors (Adams, 1977; Curlee, 1999; Guitar, 2013) also state a child is at risk for stuttering if the percentage of total disfluencies exceeds 10% of the words uttered. Applying the criterion of 7% OD to the dominant language (Yiddish) would point to stuttering in 47% of our participant group and to 69% based on the non-dominant language (Dutch). Similarly, applying the 10% OD criterion would indicate that 49% of participants stutter in their dominant language (Yiddish) while 78% stutter in their non-dominant language (Dutch). This increased OD frequency may be influenced by high maze productions. Bedore et al. (2006) stated that although bilinguals have more language knowledge, they may have an increased uncertainty because they use each language less than their monolingual peers, resulting in more mazes.

The mean number of repetition units has been indicated in several diagnostic measures of childhood stuttering as a significant factor in differentiating between children who stutter (CWS) and children who do not stutter (CWNS) (e.g. Pellowski & Conture, 2002). Not only do CWS, as a group, produce more repetition units than CWNS (e.g. Adams, 1977; Ambrose & Yairi, 1999), CWNS in general produce slightly more (Pellowski & Conture, 2002) than one repetition unit per instance and seldom produce two or more extra repetition units. Ambrose and Yairi (1995) report a mean number of repetition units of 1.16 (range 1.00–1.44) for CWNS and 1.70 (range 1.10–4.98) for CWS. This is comparable to Pellowski and Conture's data of 1.1 (range 1.0–1.6) for CWNS and 2.0 (range 1.0–5.5) for CWS. For our bilingual group, the mean number of repetition units across sound, syllable, and monosyllabic word repetitions was 1.20 (range 1.0–2.05). This is in line with previous findings in monolingual English and Dutch (Boey et al., 2007) CWNS and remarkably lower than findings by Byrd, Bedore et al. (2015). Byrd et al.'s mean number of repetition units was 5 for sound (range 4–8) and syllable repetitions (3–9) and 6 for monosyllabic word repetitions (range 4–10). It is important to note that the participants in the current study were considerably older than the participant group by Byrd, Bedore et al. (2015) and twice as old as the participants in the other studies. This, combined with the different language dyad might account for some of the differences.

The weighted SLD measure (Ambrose & Yairi, 1999) is an infrequently used measure. This measure is calculated by multiplying the number of part-word (PW) and single-syllable (SS) repetitions per 100 words (Pellowski & Conture, 2002) by the mean number of repetition units (RU) and adding the result to two times the number of dysrhythmic phonations (DP), i.e. ([PW + SS] × RU) + (2 × DP). For our bilingual group, this would result in a mean weighted SLD score of 5.01 (*SD* = 2.87) and a range between .28 and 14.98. After applying the cut-off of a score of 4 for this weighted measure (Ambrose & Yairi, 1999, p. 904), 63% of the YD bilingual children would be classified as CWS.

Since most of the previously discussed measures do not appear to be appropriate for assessing the bilingual population, clinicians may wish to focus on two other characteristics, namely physical tension and/or rhythmicity of the SLD. Boey et al. (2007) reported that the majority of the CWS scored moderate to severe on physical tension whereas the majority of the typically developing children had no physical tension, only 24% showed mild tension during repetitions. In our bilingual population, no physical tension or abnormal rhythmicity was detected. Byrd, Bedore et al. (2015) report the same finding and we agree with their argument that these characteristics are core criteria to take into consideration in the differential diagnosis of stuttering.

Conclusion

Finally, it is important to take into account that bilingualism is gradually becoming the norm (Ardila et al., 2010; Bialystok et al., 2012; Grosjean, 2010), and that most of the monolingual diagnostic guidelines for stuttering cannot be applied to a bilingual population. Moving forward, one of our major challenges for the future is to develop a new, well-defined set of diagnostic criteria for diagnosing stuttering that is based on a larger dataset of different language dyads in order to avoid the risk of false positive diagnoses.

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Declaration of interest statement

(1) All authors listed in the by-line have made considerable contributions to this manuscript, have consented to the by-line order, and have agreed to submit the manuscript in its current form.
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