Language Learning in Four Bilingual Children with Down Syndrome: A Detailed Analysis of Vocabulary and Morphosyntax

L'apprentissage du langage chez quatre enfants bilingues atteints du syndrome de Down : une analyse détaillée du vocabulaire et de la morphosyntaxe

Krista Feltmate
Elizabeth Kay-Raining Bird

Abstract
Bilingualism in children with Down syndrome (DS) is an under-studied topic. Some professionals counsel families to restrict input to a single language for children with DS because there are delays present even when only one language is being learned. The purpose of the current study was to provide more information about the ability of children with DS to learn two languages. Such evidence is important for guiding clinical decisions. The morphosyntactic and vocabulary skills in English and French of four bilingual children with DS were analyzed and compared individually to that of a typically developing bilingual child and a monolingual child with DS. The children in each triad were matched on nonverbal mental age and exposure to a second language. While language delays were evidenced in both languages for the bilingual children with DS, no consistent effect of bilingualism was seen. All four bilingual children with DS were developing functional second language skills. Current input accounted for much of the variability in English versus French language skills. These findings provide families and professionals with information that will assist them in making appropriate decisions for children with DS.

Abrégé
Le bilinguisme chez les enfants atteints du syndrome de Down a fait l'objet de très peu d'études. Compte tenu du peu de données, certains professionnels conseillent aux familles de ne parler qu'une seule langue aux enfants trisomiques parce que ces derniers accusent un retard même s'ils apprennent seulement une langue. La présente étude vise à offrir de l'information sur la capacité des enfants trisomiques à apprendre deux langues. Ce genre d'information est important pour éclairer les décisions cliniques. Cette étude a permis d'analyser les habiletés en morphosyntaxe et au plan du vocabulaire de quatre enfants bilingues atteints du syndrome de Down et de les comparer chacune à celles d'un enfant bilingue au développement typique et d'un enfant trisomique monolingue. Les enfants de chaque triade ont été jumelés selon l'âge mental non verbal et l'exposition à une langue seconde. Bien que les enfants trisomiques bilingues accusent un retard linguistique dans les deux langues, cette étude n'a relevé aucun effet conséquent du bilinguisme. Les quatre enfants trisomiques bilingues ont tous acquis des habilités fonctionnelles dans leur langue seconde. L'intrant dans le processus d'acquisition de la langue seconde semble expliquer la majeure partie de la différence entre les compétences en anglais par opposition à celles en français. Ces résultats fournissent aux familles et aux professionnels de l'information qui les aidera à prendre des décisions adaptées pour les enfants atteints du syndrome de Down.

Key words: Down syndrome, bilingual, language development, language disorders

Krista Feltmate, MSc
Community Rehab
Cambridge, Ontario Canada

Elizabeth Kay-Raining Bird, PhD
School of Human
Communication Disorders
Dalhousie University
Halifax, Nova Scotia Canada

Bilingualism in children with Down syndrome (DS) is a topic of considerable clinical interest. Some speech-language pathologists and other professionals believe that children with DS should not be exposed to two languages because they exhibit delays in their first language (Thordardottir, 2002). Evidence regarding the degree to which a child with DS can learn two languages is limited. This study contributes to the literature by providing a detailed analysis of the semantic and syntactic abilities of four bilingual children with DS, in comparison to individually matched monolingual children with DS and bilingual children with typical development (TD).

Monolingual Language Development in Children with Down Syndrome

Children with DS often have language abilities that are more delayed than would be expected given their nonverbal mental age (Chapman, 1995, 2006). Indeed, nonverbal mental age is a better indicator of language development in children with DS than chronological age. Expressive language is particularly impaired in this population (Miller, 1995). In contrast, receptive vocabulary is a strength for these individuals, often being on par or even in advance of nonverbal mental age. Hesketh and Chapman (1998) studied verb use in the narrations of individuals with DS and found that they produced fewer grammatical or lexical verbs per utterance and fewer verbs of communication of mental state, but exhibited higher verb diversity than matched TD controls. Morphosyntax is a consistently identified as a weakness for this population (Chapman, Schwartz, & Kay-Raining Bird, 1991), with expressive syntax being most delayed (Thordardottir, Chapman, & Wagner, 2002). Intelligibility is also often compromised, as a result of a variety of factors including hypotonia, oral structure differences, and phonological delays (Dodd & Thompson, 2001; Kumin, 1994, 1996, 2001; Leddy, 1999).

Bilingualism in Typically Developing Children

Although the terms are somewhat contentious in the literature, bilingual individuals have been dichotomized as simultaneous or sequential learners. In simultaneous bilingualism, the two languages are learned at the same time, usually from birth, whereas in sequential bilingualism, a person becomes proficient in one language before learning the second language (Hoff, 2001). The bilingual children participating in the present study were exposed to two languages beginning early in life so they might best be described as simultaneous bilingual learners. Regardless of the timing of exposure, it is usually the case that intensity of exposure to each language is not equivalent. Thus, one language will often be more advanced than the other (Hoff, 2001), although their relative strength can change over time.

Learning two languages is just as "normal" as learning one (Nicoladis & Genesee, 1997). In general, bilingual children learning two languages simultaneously tend to reach language milestones, such as saying their first words or attaining a productive vocabulary of 50 words, at approximately the same time as their monolingual peers. There is evidence that bilingual children learning two languages simultaneously will have smaller vocabularies in each of their languages compared to monolingual peers. However, if the vocabularies of both languages are combined, bilingual children often have as large or larger vocabularies than monolingual peers (Pearson, Fernandez, Lewedag, & Oller, 1997; Pearson, Fernandez, & Oller, 1993). For this reason, when diagnosing a language disorder in a bilingual child, it is important to consider their abilities in both languages (Pearson, 1998).

Bilingualism in Children with Down Syndrome

The research into bilingualism in children with DS is limited (Kay-Raining Bird, 2006). Two case studies (Vallar & Papagno, 1993; Woll & Grove, 1996) have been published. In 1993, Vallar and Papagno studied a 23 year old Italian woman (FF) with DS who had been exposed to English, French and Italian since childhood. At the time of testing, FF's Italian vocabulary skills were well developed. She was able to converse in all three languages as well as understand English televison shows. Her French abilities were weaker, largely because French was the language she spoke least often (Vallar & Papagno, 1993). This study demonstrated that it is possible for individuals with DS to learn a second and even a third language.

Another published example of children with DS learning two languages is the case of twins with DS born to deaf parents (Woll & Grove, 1996). The children acquired both English and British Sign Language (BSL) to the point that they could communicate in both of these languages effectively. Although they were able to learn both English and BSL, the twins, who were approximately 10 years old at the time of the study, showed impairments in both languages relative to monolingual children. Also, the children seemed to show a preference for English, which was demonstrated by the fact that they used only English when speaking with each other, even in the home where BSL was the primary language (Woll & Grove, 1996). Note that the sign language experience of these children with DS was qualitatively and quantitatively different from the therapeutic use of total communication provided to many young children with DS to support spoken language development.

Kay-Raining Bird et al. (2005) published the only study of bilingualism in children with DS that used a group design. In this study they compared the language abilities of children with DS being raised bilingually with those of children in three control groups (monolingual DS, monolingual and bilingual typically developing). Bilingual children were English dominant or balanced bilinguals (i.e., better English skills or relatively equivalent skills in both languages). Groups were matched on developmental level: chronological age for the typically developing children and nonverbal mental age for the children with DS. Assessments included both standardized and non-standardized measures of language, collected in both languages for the

bilingual children. It was found that the monolingual and bilingual children with DS did not differ significantly on any task of English language proficiency. However, both the monolingual and the bilingual children with DS displayed receptive vocabulary equivalence and expressive morphosyntactic delays relative to typically developing controls. These results suggested to the authors that there was no evidence for a detrimental effect of bilingualism on English language learning in these children with DS. Nonetheless, there was considerable variability in second language abilities among the children with DS, which suggested that some children with DS may have more difficulty than others in acquiring two languages. Analyses also revealed that chronological age, mental age and second language vocabulary comprehension were all significantly related to mean length of utterance (MLU) in the second language of the bilingual children with DS.

The purpose of the current study was to expand our understanding of the ability of children with DS to become bilingual by examining their semantic and syntactic skills using a variety of language sample measures. Four triads of children, matched on mental age, were studied. Each triad included one bilingual child with DS, one monolingual child with DS and one bilingual child with TD. The specific questions asked were:

1. Do individuals in the four triads differ on their semantic and/or morphosyntactic ability?
2. Is the pattern of differences observed within triads replicated across triads?
3. Is the pattern of differences observed in English replicated in the second language (French)?

Table 1
Subject Characteristics

	Gender	Parent Education	*CA*	*MA*
Triad 1				
DSB1	Male	22	66	34
TDB1	Female	20	36	38
DSM1	Male	14	75	36
Triad 2				
DSB2	Female	14	93	46
TDB2	Female	18	41	41.5
DSM2	Female	16	97	45
Triad 3				
DSB3	Female	22	59	29
TDB2	Male	18	29	38
DSM3	Female	14	62	30
Triad 4				
DSB4	Female	12	81	44
TDB4	Female	20	42	44.5
DSM4	Male	12	91	43.5

Notes. CA = chronological age in months; MA = mental age in months; Parent education is highest of mother or father (living in the home), expressed in years.

Methods

Participants

A total of 12 children, 8 bilingual and 4 monolingual, were selected as participants from two larger studies conducted by Kay-Raining Bird and colleagues (Kay-Raining Bird et al., 2005). Four triads were studied, each consisting of one bilingual child with DS (DSB), one typically developing bilingual child (TDB), and one monolingual child with DS (DSM). The children in each triad were individually matched on nonverbal mental age, consistent with previous work (e.g., Chapman et al., 1991, 2000; Kay-Raining Bird et al., 2005). Matching on nonverbal mental age is frequently done when studying the language abilities of individuals with DS and allowed us to compare our findings to the profile of language abilities that are typically seen in this population in the literature. Monolingual and bilingual children with DS in each triad had similar ages, differing by no more than 10 months within any triad. All parents had at least a high school education (Table 1).

An inclusion criterion for all children was that language development was in the early stages, with no less than 100 reported productive words (MacArthur Communication Development Index, Fenson et al., 1993) and an MLU no greater than a 3.5. For the bilingual children, additional inclusion criteria were: English dominance or balanced bilingualism, raised in a bilingual environment with intensive, sustained exposure to two languages over much of their life, and an ability to use both languages expressively at least at the one-word level. All bilingual children were exposed to two languages from at least 5 months of age.

TD was established through parent report and scores on standardized tests of cognition and language. All TD children scored within 1½ standard deviations of the mean on all administered standardized tests (Table 2). As well, parents reported no past or current difficulties with hearing, speech, language, reading (if applicable) or general learning.

Procedure

Data for the bilingual children with DS and TD were collected in Montreal. Data for the monolingual children with DS were collected in Nova Scotia. Data were collected as part of two larger studies, one involving the monolingual children with DS and the other involving the bilingual children with DS and TD. Both studies were designed to include comparable measures of English collected in comparable ways, with the exception that the *Peabody Picture Vocabulary Test-Revised* (PPVT-R; Dunn & Dunn, 1981) was not administered to the monolingual children

Table 2
English (PPVT-R) and French (EVIP) vocabulary comprehension abilities for bilingual children with Down Syndrome (DS) or typical development (TD)

	PPVT-R Raw / SS / AE	EVIP Raw / SS / AE	*PLS-3 Total Raw / SS / AE*	*PLS-3, R Raw / SS / AE*
Triad 1				
DSB1	22/53/34	23/68/32	51/50/33	28/56/34
TDB1	18/81/32	26/99/35	--	29/109/35
DSM1	NA	NA	51/50/33	27/50/33
Triad 2				
DSB2	33/<40/42	12/40/24	58/<50/38	31/<50/37
TDB2	52/121/54	41/113/53	83/136/57	39/121/50
DSM2	NA	NA	55/<50/35	32/<50/39
Triad 3				
DSB3	13/41/29	9/60/23	40/50/25	21/50/25
TDB2	16/99/30	18/95/36	45/110/29	21/101/25
DSM3	NA	NA	43/50/28	22/50/27
Triad 4				
DSB4	16/40/30	9/44/23	44/50/28	25/50/30
TDB4	18/81/32	17/79/27	65/106/41	32/100/39
DSM4	NA	NA	58/<50/38	35/<50/43

Notes: PPVT = Peabody Picture Vocabulary Test-Revised; EVIP = Echelle de vocabulaire en images Peabody; the PPVT-R and EVIP were not administered to the monolingual children with DS; raw = raw score, SS = standard score; AE = age-equivalent score; NA = not available because not administered; -- = not calculated because the expressive portion of the PLS was not completed.

with DS. Testing was in English for the monolingual children and in both English and French for the bilingual children. Testing in English and French was on two different days, with the order counter-balanced across the bilingual participants. In an effort to decrease the frequency of code-switching, different examiners spoke to the child in each language.

For all children, measures of cognition and English language ability were administered. These included the *Bead Memory and Pattern Analysis subtests of the Stanford-Binet Intelligence Scale* (4th edition; S-B; Thorndike, Hagan, & Sattler, 1986), the *Preschool Language Scale* (3rd edition; PLS-3; Zimmerman, Steiner, & Pond, 1992), and the collection of a language sample. The language sample was 20 minutes long and was collected using age-appropriate toy sets designed to elicit talk about either nouns or verbs. The noun samples were analysed in this study. Toys included plastic animals, a wooden structure, blankets and food troughs. The bilingual children also completed the *Peabody Picture Vocabulary Test-Revised,* Form L (PPVT-R; Dunn & Dunn, 1981), the *Echelle de vocabulaire en images Peabody, Form A* (EVIP; Dunn, Theriault-Whelan, & Dunn, 1993), and a French language sample using the same toy set as described for English (Table 2). In addition, a parent completed a language exposure and history questionnaire in which they were asked which language their child understood and produced better, and when, where, and for how long their child was exposed to both English and French. No direct measure of phonological ability was obtained for the children. However, the percentage of complete and intelligible utterances produced in the English language samples was measured and ranged from 64 to 97% suggesting that intelligibility was compromised (Table 2).

Data Analysis

Standardized tests were scored using procedures outlined in the manuals. The English samples were transcribed using *Systematic Analysis of Language Transcripts* (SALT; Miller & Chapman, 2001) conventions. French language samples were transcribed using SALT conventions modified for French (Kay-Raining Bird, Boghen, Chiasson, Cotnoir, & Trudeau, 2006). All data sets except one (DSB4, French) contained a total of 100 utterances from each child; the data sets varied in the number of complete and intelligible utterances they contained (Table 3).

The following measures of morphosyntax and semantics were calculated using both French and English conversational samples unless otherwise specified. When a measure was not completed for a language it was because not all measures were available for both languages.

a) General measures of syntax:

i. Mean length of utterance (MLU) was calculated in both morphemes and words.

ii. Index of Productive Syntax (IPSyn; Scarborough, 1990) scores were calculated. To calculate an IPSyn score, up to two exemplars of sixty different morphosyntactic structures (e.g., nouns phrases, verb phrases, articles, prepositional phrases) were identified. 0, 1 or 2 points were given for each structure identified in the language sample, to a maximum of 120. The IPSyn was developed for analysis of English morpho-syntactic structures and was therefore not applied to the French data.

Table 3
Percent complete and intelligible utterances (% C&I), mean length of utterance in words (MLU-W) and morphemes (MLU-M) and IPSyn scores.

		%C&I	MLU-W	*MLU-M*	*IPSyn*
Triad 1					
DSB1	E	65	1.62	1.85	24
	F	76	1.38	1.82	
TDB1	E	79	2.7	2.99	56
	F	74	2.36	3.28	
DSM1	E	97	3.06	3.29	59
Triad 2					
DSB2	E	84	2.33	2.58	45
	F	53	1.68	1.94	
TDB2	E	93	3.61	3.94	63
	F	84	3.2	4.75	
DSM2	E	72	1.61	1.69	26
Triad 3					
DSB3	E	76	1.36	1.36	18
	F	60	1.3	1.47	
TDB2	E	68	2.35	2.41	38
	F	61	1.8	2.43	
DSM3	E	74	1.3	1.39	19
Triad 4					
DSB4	E	64	1.61	1.64	22
	F	18	1.33	1.5	
TDB4	E	85	2.4	2.52	47
	F	57	1.86	2.4	
DSM4	E	70	1.81	2.01	43

Notes. Complete and intelligible utterances out of 100 total utterances (exception, DSB4, F); E = English; F = French; IPSyn computed for English only\

iii. Number and type of multiclausal sentences was determined using the classification system developed by Lund & Duchan (1988).

b) Noun Phrases:

i. Number of noun phrases. Proper names, pronouns and noun phrases included in calls for attention (i.e., "Look mom") were not included. Noun phrases that contained an unintelligible portion (e.g., "*the xx dog*", "*xx dog*", "*the dxx*" and "*the dog xxx*") were also excluded.

ii. The number and proportion of noun phrases with 1, 2, 3, or 4 elements. Elements of a noun phrase could be articles, determiners, modifiers or the noun. If a noun phrase contained code-mixing (e.g.,"le black dog") credit was given for only those elements produced in the target language.

c) Verbs:

i. Number of lexical and copula verbs. Lexical verbs were identified as main verbs that specified an action or state and were differentiated from copular "to be" verbs. The total number (i.e., tokens) of lexical and copula verbs were tallied.

ii. Percent lexical verbs. The percentage lexical verbs was calculated by dividing the total number of lexical verbs by the total number of main verbs.

iii. Number of different lexical verbs. The number of types of lexical verbs was tallied.

iv. Number of transitive versus intransitive verbs. Each lexical verb was classified further as transitive or intransitive.

v. Total and number of different verbs of (a) communication (e.g., "say") and (b) internal state (i.e., cognition, "know", volition,"want", sensation, "see"). These were analyzed because children with DS have been reported to have difficulty with these verb types (Chapman & Hesketh, 2000).

d) Grammatical morphology:

i. Use of English grammatical morphemes such as present progressive, regular past-*ed*, third person singular, irregular past, plural -*s*, possessive -*s*, articles *a* and *the*, auxiliary verbs, and copula verbs The percentage of correct usage in obligatory contexts was calculated for each morpheme. No analogous analysis in French was performed.

e) Vocabulary:

i. Total number of words and number of different words. Each of these was tallied using 50 consecutive complete and intelligible utterances.

Reliability

Reliability was assessed by comparing the coding for the above measures completed by three trained graduate students in speech-language pathology on one DSB and one TDB transcript. The coding of the first author was

compared to that of either a native French speaker (French measures) or a native English speaker (English measures).

Percent inter-rater agreement (agreements/ (agreements + disagreements) X 100) was computed for each of the measures separately for the two children in each language, and then averaged across children and languages. Three measures (# of transitive verbs, # of intransitive verbs, and % correct third person singular use) had low agreement (44%, 70% and 50% respectively) and were consequently dropped from further analysis. Reliability for the remaining measures varied from 75 – 100% agreement, with an average of 94.5%.

Results

For each measure, we were interested in determining whether differences existed between (a) monolingual and bilingual children with DS; (b) children with DS and TD; and (c) English and French transcripts. Because of the small number of participants, the results were analyzed qualitatively according to a set of criteria described further below. Comparisons were made within each triad. Each speaker was compared to the other two speakers in order to evaluate whether he or she differed from them according to the specified criteria. If a consistent pattern was found for three or four of the triads, it was assumed that there was a systematic, meaningful difference. The qualitative criteria were determined by the authors and were defined as follows:

- A MLU difference of 0.5 or greater
- An IPSyn difference of 10
- A percentage difference of 10% or greater.
- A number difference of 10 or greater for all such measures except total verbs for which a difference of 5 was required

Standardized Test Scores

PPVT-R and EVIP

Age-equivalent receptive vocabulary scores were higher for the TDB participants than matched DSB participants in Triad 2 only for the PPVT-R but in Triads 2 and 3 for the EVIP. Since the DSM children were not administered these measures, no comparisons were available between DSB and DSM matched participants. Performance on English (PPVT) and French (EVIP) vocabulary measures did not differ for

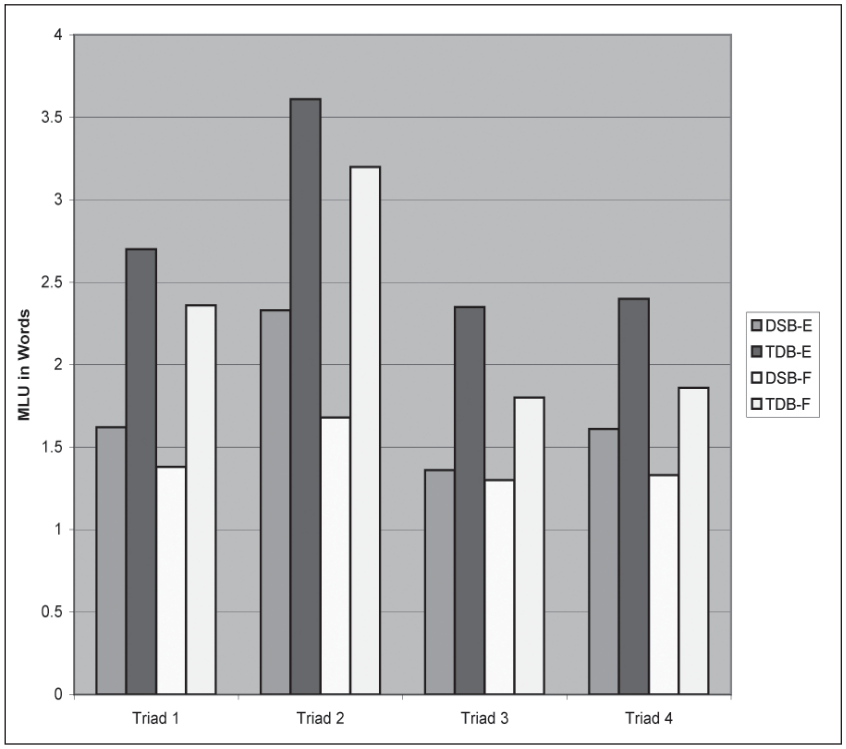

Figure 1. MLU in words in English and French for DSB, TDB, and DSM children in four triads.

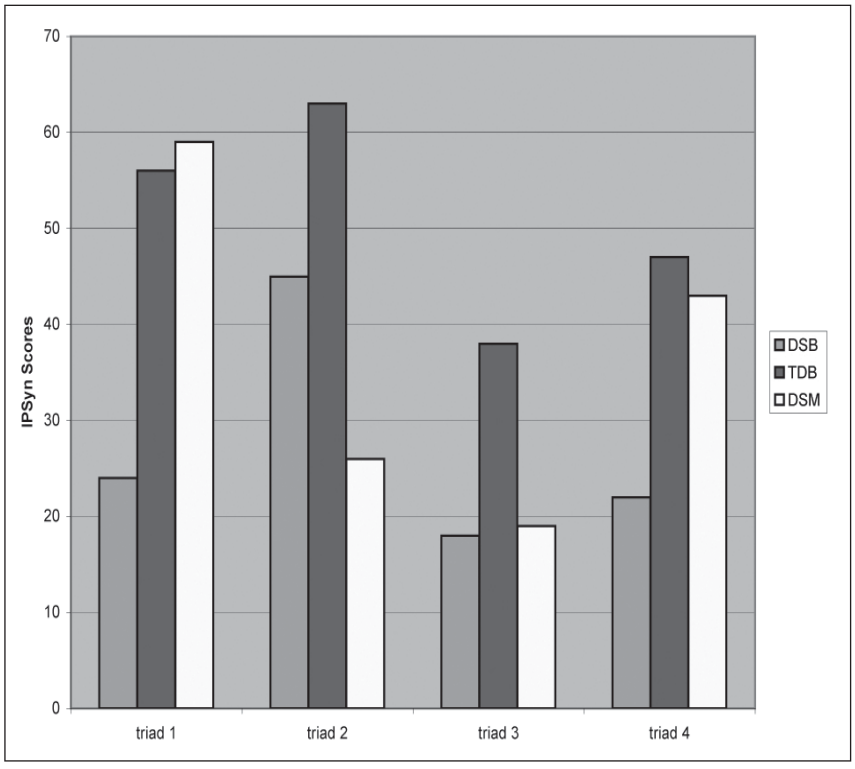

Figure 2. IPSyn scores in English for DSB, TDB, and DSM children in four triads.

any bilingual child except DSB1 who exhibited better English than French vocabulary abilities.

PLS-3

The total scores were not considered because one child with TD did not have an available score. Age-equivalent scores for the receptive part of the PLS-3 revealed no differences between DS and TD participants with the exception of Triad 2 where the TDB child scored higher than either of the matched DSB and DSM children. When DSB and DSM children in a triad were compared, there were no differences in 3 of the 4 triads.

Language Sample Measures

MLU and IPSyn

MLU in words and morphemes for English and French transcripts and IPSyn scores for English transcripts are presented in Table 3 and Figures 1 and 2 depict MLU in words in English and French for the bilingual participants and IPSyn scores respectively. As would be expected, MLU in words (range: 1.3 to 3.6) was consistently smaller than MLU in morphemes (range: 1.36 to 4.75) in both languages, indicating that all these children were producing at least some bound morphemes in their samples. IPSyn scores ranged from 18 to 63 (out of 120).

DS versus TD. In English, both monolingual and bilingual children with DS had lower MLUs in morphemes compared to their typically developing matches, with the exception of the monolingual child with DS in Triad 1 (DSM1) who had a higher MLU than the typically developing member of the triad. In French, the TDB children performed better than the DSB children in all four triads. In terms of IPSyn scores, TDB children had higher scores than both the children with DS in two triads and higher scores than the DSB children only in the two additional triads.

Monolingual versus bilingual DS. When comparing monolingual and bilingual children with DS on English MLU in morphemes, mixed results emerged. In triad 1 the DSB child had a lower MLU than the DSM child while in Triad 2 the opposite was true, and in Triads 3 and 4 differences did not reach criterion. With regard to IPSyn scores, mixed results were also evident. In Triads 1 and 4, the DSM children had higher scores, in Triad 2 the DSB child had higher scores and in Triad 3 there was no difference.

English versus French. When comparing French and English transcripts, MLU in words was no different for 3 of 4 DSB children and 2 of 4 TDB children. When MLU differed across languages, it was always higher in English.

Multiclausal Sentence Use

Multiclausal sentences were produced a total of eight times. All the TDB children and one DS child (DSM1) produced a multiclausal sentence in English, and two of the TDB children produced one in French as well. No child produced more than one type. The types of multiclausal utterances used were: object clause (2), infinitive (1), embedded question (2), compound clause (2), and adverbial (1).

Noun Phrases

Seventy-nine percent of the utterances analyzed contained a single noun phrase with a noun. TDB1 was the only child who produced any utterances that contained three noun phrases and this occurred once. Table 4 presents the number and percentage of NPs containing 1, 2, 3 and 4 elements in both languages. Figure 3 presents the percentage produced by each child in English.

DS versus TD. The percentage of NPs with one element only (i.e., bare nouns) ranged from 12 to 83% across children. In all four triads the DS children produced a higher percentage of NPs with only one element in English and French than did the TDB children. All the TDB children used two or more elements in their NPs most often. In contrast, all the children with DS used bare nouns most often in their NPs. When NPs were elaborated, they usually included two elements for all children. Only TDB2 produced a NP with four elements, once in English.

Monolingual versus bilingual DS. In two triads, monolingual and bilingual children with DS did not differ in their percentage use of one-element NPs. In Triad 2, the monolingual child produced more bare nouns while in Triad 3 the bilingual child produced more.

English versus French. In general, a higher percentage of NPs tended to be elaborated in French than English reflecting the fact that children were more likely to produce an article or determiner with nouns in French than in English. In Triads 1 and 3, the TDB and DSB children produced a higher percentage of bare nouns in English than French. In Triad 2, the TDB child did as well, but the DSB child produced comparable percentages of NPs with bare nouns in both languages. However, in Triad 4, both the TDB and DSB children produced a higher percentage of bare nouns in French.

Verb Usage

Table 5 presents the total number of copula and lexical verbs, the proportion of different to total lexical verbs, and the percentage of lexical to total verbs used by the children. Between 1 and 48 verbs were produced in these 100 utterance samples, indicating that a majority of utterances in all samples did not contain a verb. In general, lexical verbs were usually used more frequently than copulas with the percentage of lexical verb use ranging from 0 to 100%. The number of different lexical verbs ranged from 0 to 19, constituting verb type-token ratios ranging from .15 to 1.00.

DS versus TD. With the exception of DSM4 in English, TDB children produced more verbs in their samples than did the matched children with DS. In terms of the percentage of lexical verbs, DS children produced more than the TDB children in Triads 1 and

Table 4
Number of elements contained in each noun phrase

		1 element		2 element		3 element		4 element		Total
		#	%	#	%	#	%	#	%	
Triad 1										
DSB1	E	12	57%	9	43%					21
	F	10	45%	12	55%					22
TDB1	E	5	20%	10	40%	10	40%			25
	F	4	12%	26	76%	4	12%			34
DSM1	E	24	52%	12	26%	10	22%			46
Triad 2										
DSB2	E	15	54%	13	46%					28
	F	18	58%	13	42%					31
TDB2	E	17	25%	44	66%	5	7%	1	2%	67
	F	8	14%	50	83%	2	3%			60
DSM2	E	27	66%	14	34%					41
Triad 3										
DSB3	E	10	83%	1	8%	1	8%			12
	F	17	68%	8	32%					25
TDB2	E	17	45%	21	55%					38
	F	11	31%	24	67%	1	3%			36
DSM3	E	25	64%	14	36%					39
Triad 4										
DSB4	E	13	59%	8	36%	1	5%			22
	F	8	80%	1	10%	1	10%			10
TDB4	E	19	43%	20	45%	5	11%			44
	F	11	52%	10	48%					21
DSM4	E	25	62.5%	15	37.5%					40

Notes. E = English, F = French

2, but in Triad 3 the DSM child produced a smaller percentage of lexical verbs than either matched child and in Triad 4 the percentage of lexical verbs was roughly equivalent across the three children. The diversity of lexical verbs varied with more diversity displayed by the TD children in two triads and less displayed relative to both children with DS in Triad 3 and less than the DSB child only in Triad 4.

Monolingual versus bilingual DS. No consistent pattern of differences was noted when comparing monolingual and bilingual children with DS on the number of verbs produced. Once a bilingual child with DS produced more verbs in their sample, twice monolingual children did and once there was no difference. For the percent of lexical verbs in the samples, DSB children produced a higher percentage of lexical verbs than the DSM children in two triads and equivalent percentages in two triads. In terms of verb diversity, the DSM children demonstrated greater verb diversity in English than the DSB children in three triads with the opposite evident in one triad.

English versus French. In 3 of 4 triads, DSB children produced verbs with equal frequency in both languages. In contrast, TDB children in all four triads produced verbs more often in English. In terms of the percentage of lexical verb use and lexical diversity, there was no consistent pattern for the DS or the TD children.

Verbs of Communication and Internal State

The use of verbs of communication and internal state in French and English are presented in Table 6. Only three verbs of cognition and one verb each of volition, sensation and communication were used in either language by any of the children. All children except DSM2 and DSB4 produced at least one of these verbs. When the verb "know" was used, it was usually in the idiomatic construction "I don't know", and therefore was not used productively.

Grammatical Morphology

The use and mastery of nine grammatical morphemes was analyzed, in English o only. The data are presented in Table 7. Mastery of a grammatical morpheme was defined as 90% correct usage in obligatory contexts (Brown, 1973). However, mastery was not identified unless four or more obligatory contexts for a particular morpheme were present. Children produced from three to eight of the grammatical morphemes at least once in their transcripts. DS and TD children did not differ noticeably in this regard. Articles, copulas and plural –s were produced at least once by most of the children. Three TDB, one DSB and one DSM child had mastered between 1 and 3 of the 9 grammatical morphemes analyzed. Only the TD children evidenced mastery of more than one morpheme. There was no notable difference in morpheme use between DSM and DSB children.

Vocabulary

Table 8 shows the Total Words (TW) and Number of Different Words (NDW) produced in 50 consecutive complete and intelligible utterances. Total words ranged from 24 to 173 across samples and NDW ranged from 20 to 76.

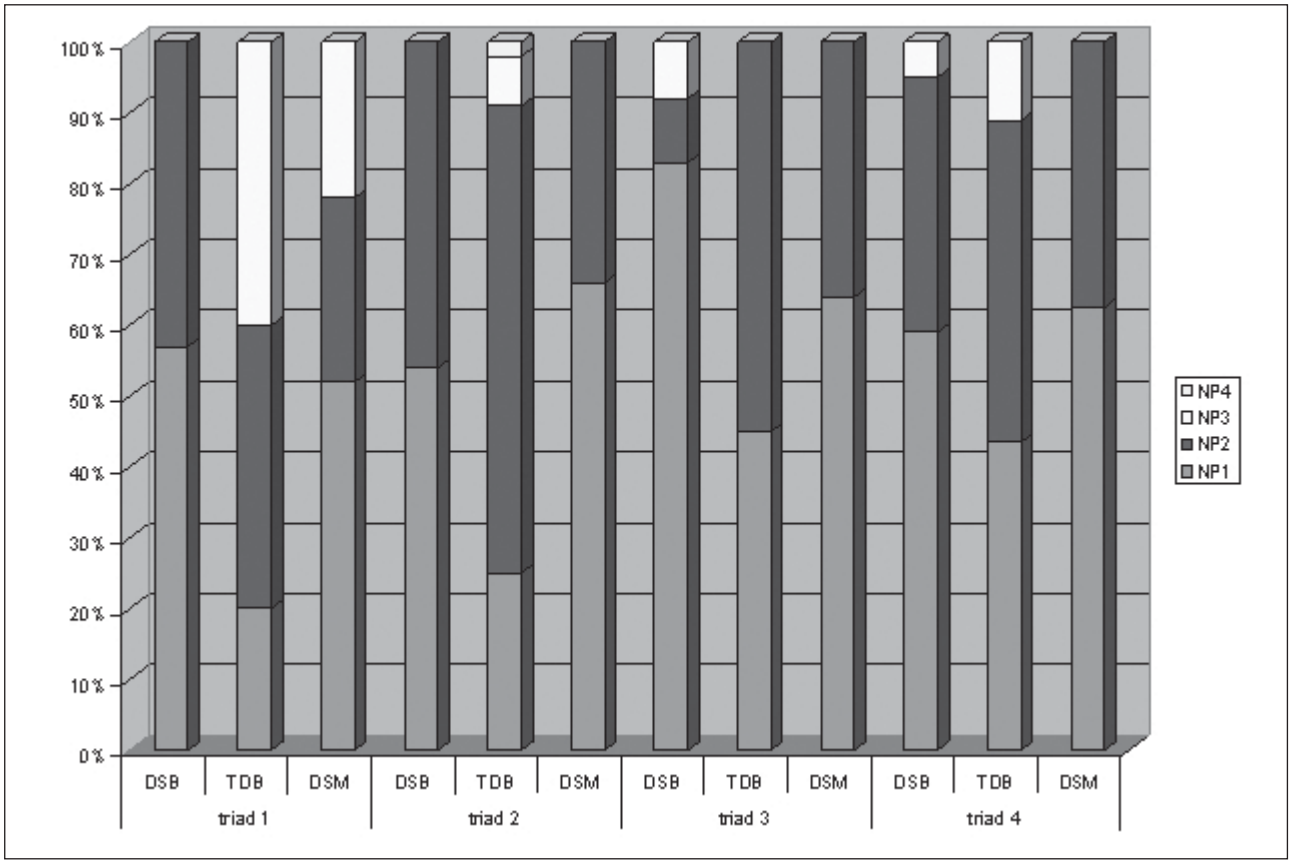

Figure 3. Percent English noun phrases with 1, 2, 3, and 4 elements for DSB, TDB and DSM children in four triads.

DS versus TD. Not surprisingly given the MLU results, the children with DS produced fewer words in 50 utterances than did the TD children in both French and English, with the exception of DSM1 in Triad 1 who produced more words than the matched TDB child in English. As well, all children with DS showed less lexical diversity (lower NDW) than did the matched TD children. These observations held in French as well as English.

Monolingual versus bilingual DS. When comparing the monolingual and bilingual children with DS, no discernible pattern of differences was evident for either TW or NDW, with the DSM child producing more TW and NDW than the DSB child in Triad 1, the opposite pattern present in Triad 2 and equivalent use of both TW and NDW by the children with DS in Triads 3 and 4.

English versus French. Two DSB children produced more total words in English than French samples while two others produced a comparable number of words in their two samples. In terms of NDW, DSB children in three triads exhibited greater vocabulary diversity in English than French. TDB children produced more words and more different words in their English than French samples with the exception of TDB3 who exhibited comparable NDW in English and French.

Summary

A summary of the results for each measure that could be compared across children is provide in in Tables 9 and 10.

Discussion

This study was designed to analyze in detail the morphosyntactic and vocabulary skills of bilingual children with DS. Children were considered bilingual for inclusion in this study if they were being raised in a bilingual environment and had had intensive and sustained exposure to two languages over most of their life. All bilingual children spoke both English and French, and their language skills were rated by parents as either English dominant or balanced between French and English. Data from four triads were examined. That is, four bilingual children with DS were each individually matched with one typically developing bilingual child and one monolingual child with DS, on the basis of non-verbal MA.

Are the language skills of the bilingual children with Down syndrome comparable to those of bilingual children with typical development matched for mental age?

No. The TDB children performed better than the

Table 5
Frequency and diversity of verb use.

		Total	# Copulas	# Lexical	% Lexical	# diff/ Total Lexical
Triad 1						
DSB1	E	14	3	11	79%	.64
	F	13	3	10	77%	.70
TDB1	E	36	13	23	64%	.70
	F	22	6	16	73%	.75
DSM1	E	28	13	15	54%	.80
Triad 2						
DSB2	E	32	9	23	72%	.43
	F	6	0	6	100%	.83
TDB2	E	48	20	28	59%	.67
	F	36	15	21	58%	.47
DSM2	E	17	4	13	76%	.15
Triad 3						
DSB3	E	4	0	4	100%	1.00
	F	3	1	2	67%	1.00
TDB2	E	25	0	25	100%	.40
	F	17	3	14	82%	.71
DSM3	E	7	4	3	43%	.67
Triad 4						
DSB4	E	7	1	6	86%	.67
	F	1	1	0	0%	0
TDB4	E	19	3	16	84%	.50
	F	14	2	12	86%	.83
DSM4	E	19	3	16	84%	.37

Notes. % Lexical = percentage of total verb use.

DSB children on all but two of the language sample measures in both French and English (Table 9). Individuals with DS were more likely than their TD controls to have lower MLUs, lower IPSyn scores,a higher use of bare nouns in expandable NPs, fewer verbs overall, fewer grammatical morphemes mastered, fewer total words and fewer different words in their language samples. These findings document expressive morphosyntactic and vocabulary difficulties in these these bilingual individuals with DS, both of which are well documented in the literature for monolingual children with DS (Chapman, 1995, 2003; Chapman & Hesketh, 2000). They also document a similar pattern of difficulty in English and French language sample measures.

Two measures revealed inconsistent differences between DSB and TDB individuals: percent of lexical to total verbs and verb diversity. It is suspected that the lack of consistent differences on these two measures was related to the fact that the children studied were in an early period of language development, producing copular forms only infrequently and exhibiting a low level of verb diversity. To illustrate, copular forms were used less than six times in all but 4 of the 20 100-utterance samples samples. As well, an average of only 8.3 different lexical verbs was produced in the English and 7.0 in the French samples of these children.

DSB and TDB children matched on nonverbal MA did not differ on either receptive measure of English language, the PPVT-R and the Receptive scale of the PLS-3. This is also consistent with the literature on language development in children with DS (e.g., Chapman et al., 1991) which evidences stronger receptive than expressive abilities with particular strengths in receptive vocabulary.

Are the English skills of the bilingual children with Down syndrome comparable to those of monolingual children with Down syndrome matched on mental age?

The answer is: perhaps. Across measures a pattern of individual differences (i.e., mixed findings) prevailed. While both the monolingual and bilingual children with DS showed similar patterns of language deficits relative to TD controls and they showed equivalent performance on the receptive PLS-3, they did not exhibit consistent similarities or differences when they were compared to each other on the language sample measures of English semantics and morphosyntax used in this study. The absence of a consistent pattern of difference on measures of expressive English vocabulary and morphosyntax when comparing monolingual and bilingual children with DS provides additional evidence that the introduction of a second language seems to have no detrimental effects on the development of the stronger language of a bilingual child with DS.

Given that these monolingual and bilingual children with DS matched on nonverbal MA did not differ systematically on language sample measures, any second language skills the bilingual children developed may serve to expand their language abilities beyond that of the monolingual children. That is, when both languages are taken into account, the total vocabulary knowledge of the DSB children, for example, may even surpass that of the DSM children in this study, as has been argued by Pearson and colleagues (Pearson, 1998; Pearson et

Table 6
Use of internal state (cognitive, volitional, sensory) and communication verbs

		Cognition	Volition	Sensory	*Communication*
Triad 1					
DSB1	E		want		
	F		veut		
TDB1	E	know			
	F	oublie			dis
DSM1	E	forget, remember, Know (2)	want (2)		
Triad 2					
DSB2	E	forgot	wanna		said, say
	F				
TDB2	E		want (2)	see	
	F				
DSM2	E				
Triad 3					
DSB3	E	know			
	F				dit
TDB2	E		wanna		says
	F				
DSM3	E			see	
Triad 4					
DSB4	E				
	F				
TDB4	E	know (4)	want		
	F		veux	voir	
DSM4	E		want		

Notes. ( ) = number of times produced when greater than 1

al., 1997). It is possible to examine this hypothesis by analysing two additional measures that were collected for this study - English and French versions of the *MacArthur and Bates Communication Development Inventory* (Fenson et al., 1996; Trudeau, Frank, & Poulin-Dubois, 1999). When the same words tested in both forms were examined, the expressive vocabulary levels reported for the bilingual children surpassed those reported for the matched monolingual children in 3 of 4 cases.

Individual differences. Pronounced individual differences are a hallmark of DS (Chapman, 1995, 2003) and the findings of this study exemplify this as well. When performance across measures is compared for matched DSB and DSM pairs, it is interesting to note that DSM1 quite consistently outperforms DSB1 in Triad 1, DSB2 quite consistently outperforms DSM2 in Triad 2, and the DSB and DSM children in the remaining two triads performed similarly on most measures, although in Triad 4, the DSM child performed better on the three measures where differences did emerge (Table 10).

Why would some children perform consistently better than their mental-age matched controls? Research suggests that a variety of factors influence expressive language development in individuals with DS. These include mental age, hearing ability, chronological age, auditory verbal memory, parent education, and receptive vocabulary skill (e.g., Chapman, Schwartz, & Kay-Raining Bird, 1991; Chapman, Seung, Schwartz, & Kay-Raining Bird, 2000; Jarrold et al., 2002; Kay-Raining Bird et al., 2005). The children in this study were matched on mental age, so this is probably not contributing strongly to the individual differences observed. Unfortunately, we do not have measures of auditory verbal memory or hearing in these children although parents reported no diagnosed hearing problems. Receptive language, as measured by the PLS-3, is very similar for matched pairs of children in Triads 1 and 2 (Table 2), so this also does not seem to be predictive of the consistent differences in expressive language ability observed. Parent education is a positive predictor of language in typically developing children (Hart & Risley, 1995). However, in Triad 1 it is the child of the less educated parents who is performing consistently higher, while in Triad 2 parental education is quite similar for the two children. Once again, this does not seem to be a predictor of the observed individual differences. Finally, while chronological age is often not a good predictor of language development in children with DS, in Triad 1 the DSM child is 14 months older than the DSB child and this may have contributed to the better performance observed in DSM1. However, CA differences exist in Triad 4 as well with no concomitant consistently better performance by the older child. Unfortunately, we have to conclude that these differences remain largely unexplained. It is interesting to note, however, that the bilingual child with the most advanced French skills was also the child in Triad 2 who consistently outperformed the monolingual control. Future studies need to address such issues.

Table 7
Grammatical morpheme use in obligatory contexts

	-ing	Past -ed	*Irreg Past*	*plural -s*
Triad 1				
DSB1	none	none	none	100% (3/3)
TDB1	100% (3/3)	none	100% (2/2)	100% (10/10)[1]
DSM1	100% (1/1)	none	100% (1/1)	
Triad 2				
DSB2	none	100% (1/1)	75% (3/4)	75% (3/4)
TDB2	100% (2/2)	none	100% (2/2)	100% (7/7)[1]
DSM2	none	none	none	100% (1/1)
Triad 3				
DSB3	none	none	none	0% (0/1)
TDB2	100% (3/3)	0% (0/1)	none	none
DSM3	none	none	none	100% (3/3)
Triad 4				
DSB4	none	none	100% (1/1)	none
TDB4	none	none	0% (0/1)	67% (2/3)
DSM4	100% (1/1)	none	none	100% (9/9)[1]
	possessive's	auxiliary	copula	article
Triad 1				
DSB1	none	100% (2/2)	43% (3/7)	44% (7/16)
TDB1	none	100% (3/3)	93% (13/14)	100% (12/12)[1]
DSM1	none	100% (1/1)	97% (33/34)	53% (16/30)
Triad 2				
DSB2	100% (2/2)	100% (9/9)[1]	91% (10/11)	36% (5/14)
TDB2	none	100% (5/5)[1]	100% (20/20)	100% (44/44)[1]
DSM2	100% (1/1)	none	75% (3/4)	25% (9/36)
Triad 3				
DSB3	none	100% (1/1)	none	50% (1/2)
TDB2	none	50% (1/2)	0% (0/2)	83% (20/24)
DSM3	none	none	57% (4/7)	36% (12/33)
Triad 4				
DSB4	none	none	100% (1/1)	31% (4/13)
TDB4	100% (1/1)	100% (4/4)[1]	50% (2/4)	54% (19/35)
DSM4	none	100% (2/2)	29% (2/7)	67% (5/15)

Notes: Percentages are of correct usage in obligatory contexts; [1] mastered as defined by 90% or more correct use in 4 or more obligatory contexts.

Evidence for Bilingualism

To examine the relative strength of English and French in these children, performance on analogous language sample and test measures were compared (Table 9). With respect to vocabulary, all of the DSB children produced more words and more different words (in 50 utterances) in English than they did in French. In contrast, only one of the DSB children had a higher age-equivalency score on the PPVT-R than on the EVIP while three had scores that did not differ at the criterion level. The vocabulary results suggest that at least 3 of the 4 DSB children in this study seemed to be English dominant in expressive but not receptive vocabulary abilities. When equivalent measures of morphosyntax were examined, English dominance was less evident: (a) Only 1 of 4 DSB children exhibited a higher than criterion MLU in words in English than French; (b) 2 of 4 DSB children produced more than the criterion number of total verbs in English than French; and (c) 2 of 4 DSB children produced a higher than criterion percentage of 1-element NPs in English than French. It is interesting to note that this latter finding suggests better development in French than English on noun phrase elaboration in two of the children. Further, the MLU and number of verbs measures identified different children as having English dominance. In part, the disparity in findings between vocabulary and morphosyntactic measures might be explained by the well established finding that children with DS have particular difficulty with the development of expressive morpho-syntax (e.g., Chapman, 1995), a finding that has been replicated in the present study for these bilingual children with DS. Given the observed delays in morphosyntax relative to vocabulary, it may be that development in morphosyntax in either language was not high enough yet for differences in ability across languages to be consistently revealed. IPSyn scores for these DSB children are low (18 to 45) as are MLU in words in both languages. It is important to note as well that morphosyntactic development across languages is not directly comparable given the language-specific nature of the structures. Thus, relative abilities in the two languages cannot be easily revealed through comparison of the present measures. A better test of how well these DSB children have developed French would require comparison to monolingual French speakers with DS, a sample which was not available in the present study. It would be useful in future studies to include both monolingual French and English controls.Regardless, it is the case that all the DSB children have developed some ability to speak

Table 8
Total words (TW) and number of different words (NDW) in 50 complete and intelligible utterances

		TW	NDW
Triad 1			
DSB1	E	73	36
	F	65	30
TDB1	E	128	69
	F	113	44
DSM1	E	147	60
Triad 2			
DSB2	E	122	61
	F	80	36
TDB2	E	173	76
	F	138	53
DSM2	E	81	28
Triad 3			
DSB3	E	71	35
	F	65	23
TDB2	E	103	45
	F	88	52
DSM3	E	70	37
Triad 4			
DSB4	E	81	41
	F	24	20[1]
TDB4	E	121	58
	F	95	39
DSM4	E	86	43

Notes. [1] DSB4 did not have 50 utterances

Table 9
Summary of observed differences across morphosyntactic measures

	Criterion	DS versus TD	*E versus F*
PPVT, EVIP; a-e	10	TD = DS, E; Ø, F	DSB & TDB:=
Rec. PLS-3, a-e	10	TD = DS	NA
MLU	0.5	TD > DS, E & F	DSB: =; TDB: Ø
IPSyn	10	TD > DS, E	NA
1 Element NPs	10%	TD > DS, E & F	DSB: E< F; TDB: Ø
Total Verbs	5	TD > DS, E & F	DSB: =; TDB: E > F
% Lexical Verbs	10%	Ø, E & F	DSB & TDB: Ø
Verb diversity	.10	Ø, E & F	DSB & TDB: Ø
Number of Words	10	TD > DS, E & F	DSB: Ø; TDB: Ø
# Different Words	10	TD > DS, E & F	DSB & TDB: E > F

Notes. < or > indicate that 3 or 4 individual comparisons reached criterion differences in the indicated direction; = indicates that 3 or 4 individual comparisons did not differ at the criterion level; Ø indicates that there was no consistent pattern; Rec. = Receptive; a-e = age-equivalent score; NP = noun phrase; F = French, E = English; NA = not applicable

and understand both languages of exposure and that this development has taken place without disadvantaging them relative to English monolingual controls.

What factors might be impacting the bilingual development of children with DS?

An obvious candidate is input. Two parents reported relatively balanced French and English input both in the home and at school, for their children (DSB1 and DSB3). As well, a strong bilingual presence was reported throughout these children's lives. Equivalent French and English language sample measures were also more similar for these two DSB children than for the other two DSB children in this study. Balanced bilingualism, then, appears to be possible for children with DS, at least at these early developmental levels, and similar input intensity across languages seems related to the achievement of balanced bilingualism.

DSB4 had the least developed French language abilities although her English language development was either better than or equivalent to two of the other DSB children. Her frequency of exposure to French and English probably accounts for much of the gap between her French and English skills and her low performance in French. DSB4 experienced English about 90% of the time in the home throughout her life. From 5 months to 5 years of age she attended a French daycare while her parents worked full time. A year and a half prior to data collection, she had entered an English school where she also attended an English afterschool program, resulting in a considerable decline in her French language exposure. This child was the second oldest child with the second highest MA of the DSB participants, so age and MA do not seem to explain her pattern of language abilities.

The child who exhibited the greatest French language ability on language sample measures was DSB2. Her English skills also exceeded those of the other DSB children. As well, her English language abilities considerably outstripped her French skills on equivalent language sample measures. DSB2 had attended a French immersion program for 2 years prior to data collection. In the home, English was usually spoken and had been throughout her life. This suggests that children with DS can develop a second language through French immersion, at least when they live in a bilingual family and are raised in a bilingual city. DSB2 was also the oldest and most cognitively advanced DSB child which could explain her advanced language skills

Table 10
Comparison of performance MA-matched pairs of bilingual (DSB) and monolingual (DSM) children with Down syndrome

Measure	Triad 1	Triad 2	Triad 3	Triad 4	Difference?
Receptive PLS-3	B = M	B = M	B = M	B < M	=
MLU	B < M	B > M	B = M	B = M	Ø
IPSyn	B < M	B > M	B = M	B < M	Ø
1 element NPs	B = M	B > M	B < M	B = M	Ø
Total verbs	B < M	B > M	B = M	B < M	Ø
% lexical verbs	B > M	B = M	B > M	B = M	Ø
Verb diversity	B < M	B > M	B < M	B < M	B < M
TW, 50 utterances	B < M	B > M	B = M	B < M	Ø
NDW, 50 utterances	B < M	B > M	B = M	B = M	Ø

Notes. NP = noun phrase; TW = total words; NDW = number of different words; B = bilingual; M = monolingual.; = indicates that 3 or 4 individual comparisons did not differ at the criterion level; Ø indicates that there was no consistent pattern

relative to the other children

Conclusions

This study conducted detailed semantic and syntactic analyses of language samples for children in four triads matched on nonverbal mental age. These detailed language sample analyses provided evidence that bilingual children with Down syndrome develop in both of their languages at the semantic and syntactic level. Many of the expressive semantic and syntactic measures revealed difficulties in the language abilities of bilingual children with DS relative to mental age matched bilingual TD children. However, no consistent differences were revealed between bilingual and monolingual children with DS on English measures, with the exception of a measure of verb diversity. Thus, findings support previous work showing that children with DS do become bilingual (Kay-Raining Bird et al., 2005; Vallar & Papagno, 1993; Woll & Grove, 1996) and that bilingual input does not disadvantage these children's acquisition of English in English dominant or balanced bilingual children. Our findings also extend such conclusions by providing support from finely detailed analyses of semantic and morphosyntactic ability. Not surprisingly, given the inclusion criteria for this study, French language abilities did not always keep pace with English language abilities on many of the language sample measures in the four bilingual children with DS. The current frequency of exposure to each language appears to be an important factor in explaining relative strengths in the two languages. Although beyond the scope of the present study, our future understanding of the French language abilities of French-English bilingual children with DS would be enhanced by comparisons with French monolinguals with DS.

The results of this study relate to our understanding of bilingualism in young children with DS (5-8 years) who are learning French and English and have nonverbal mental ages between 2 ½ and 4 years. Given the growing body of positive evidence for bilingualism in children with DS, it seems appropriate for professionals to work with families to support bilingualism in children with DS. Nonetheless, given the considerable individual variability in this population, decisions around how best to provide language learning supports must be made on an individual basis and after careful consideration of the needs and goals of the family and their child and the context in which they live.

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Correspondence should be addressed to: Elizabeth Kay-Raining Bird, School of Human Communication Disorders, Dalhousie University, 5599 Fenwick Street.

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