

Bilingual Babbling: Evidence for Language Differentiation in Dual Language Acquisition

Blagovesta Maneva and Fred Genesee
McGill University

In this study, we examined the babbling of a pre-verbal child who was learning English and French simultaneously. There were three overarching goals to the research:

- 1) To examine evidence for language differentiation during pre-lexical stages of bilingual acquisition;
- 2) To examine whether the time course of phonological development during the pre-verbal stages of bilingual acquisition is in line with that of children exposed to only one language or whether there are delays as a result of dual language exposure and learning; and
- 3) To examine evidence for babbling drift (Brown, 1958; Weir, 1966), that is, the notion that the babbling of pre-verbal children exhibits features of the target language system as the child approaches the stage of first-word productions.

We regard these results as preliminary since further analyses must be done before we can provide a comprehensive picture of this child's development and because acoustic analyses of certain features must be carried out to complement our phonological analyses. Moreover, analyses of additional children will be important to demonstrate the generalizability of these findings.

A central issue in research on bilingual acquisition is when neuro-cognitive differentiation of two languages occurs in children exposed to two languages from birth (Genesee, 1989). Early conceptualizations argued that children exposed to two languages from birth go through an initial stage when there is a single linguistic system, comprised of fused subsystems (e.g., Volterra & Taeschner, 1978). However, recent evidence in our lab and other's indicates that differentiation is evident in the one-word stage of bilingual development onward (see Deuchar & Quay, 2000; Genesee, 2001; and Meisel, 2001, for reviews). Evidence for differentiation can be found in lexical, syntactic, and pragmatic

*The authors thank Anicka Fast for her invaluable assistance with the data analyses. This research was funded by grants from the Social Sciences and Humanities Research Council, Ottawa, and the Social Sciences and Humanities Committee, McGill University.

Maneva, B., & Genesee, F. (2002). *Bilingual babbling: Evidence for language differentiation in bilingual first language acquisition*. In S. Fish & A. H-J Do (Eds), *Proceedings of the 26th Boston University Conference on Language Development*, pp. 383-392. Somerville, MA: Cascadia Press.

development. The question remains, however, whether differentiation occurs earlier -- during pre-verbal stages, before children produce recognizable words.

To investigate this issue, we examined the babbling of a bilingual infant (Bryan) longitudinally from 10 to 15 mths of age -- the child was recorded with his mother and father on separate occasions. His mother and father were native speakers of English and French respectively and, thus, it was assumed they would elicit different patterns of babbling if indeed input had shaped his babbling in language-specific ways. Oller et al. (1997) investigated age of onset and other quantitative measures of babbling in Spanish-English bilingual infants, but not language-specific features. To date, the only investigation of language-specific features of babbling in pre-verbal bilingual infants has been conducted by Poulin-Dubois & Goodz (2001). They analyzed the place and manner of articulation of consonants produced by 13 English-French bilingual children during recording sessions with their mothers and fathers, each of whom spoke either English only or French only with the child. The children, on average, were 13.6 mths of age and produced 4 words. Poulin-Dubois and Goodz found no significant difference either in manner or place of articulation in the children's consonant productions in the two language contexts.

Studies with monolingual infants exposed to different languages indicate that their babbling exhibits features that are language independent -- e.g., predominance of stops, and the predominance of open vs closed syllables (Boysson-Bardies, 1999; Vihman, 1996). These findings are generally interpreted to reflect common maturational processes that are related to the neuro-muscular mechanisms that underlie the articulation of speech sounds in all children -- in effect, some sounds are easier to produce than others and all infants produce these sounds initially (Juszyk, 1997). At the same time, monolingual infants who have been exposed to different languages exhibit certain language-specific features beginning around 10-11 months of age; these findings indicate that experience with specific languages shapes children's phonological development in the stages leading up to first-word productions (Boysson-Bardies & al., 1989, 1992; Boysson-Bardies & Vihman, 1991; Oller & Eilers, 1982). Moreover, Maneva & Konopczynski (to appear) found that there were differences in the rhythmic structuring of the babbling of infants learning two regional varieties of French (France and Quebec) demonstrating that babbling is not only language-specific but even dialect-specific.

The questions we addressed are whether the features that distinguish phonological development in the babbling of monolingual children exposed to different languages appear in children exposed to the same languages at the same time, and do they appear at the same age. For sake of brevity, we identify specific differences that have been found for English and French monolinguals (adults or children) as we present our results. We focus on such features in order to ascertain whether bilingual children demonstrate language-specific phonological features in their babbling. Specifically, our focus was on utterance and syllable structure since research indicates that suprasegmental features emerge earlier and more reliably than segmental features in monolingual children (Boysson-Bardies, Sagart, & Durand, 1984; Konopczynski, 1990).

1. The Child and His Parents

The child we examined was a first-born and only child and was developing normally; he presented no signs of hearing problems. The parents were young professionals and both were fluently bilingual. The mother is a native English-speaker and used primarily English with Bryan, and the father is a native French-speaker and used primarily French with him. During the day, Bryan was at home with his English-speaking mother and during evenings and weekends he spent a lot of time with his French-speaking father who was actively involved in his care. Bryan produced no recognizable words in either English or French during the first 4 mths of the study, but he produced what his parents identified as 4 words at 15 mths: *tati* "cat"; *bafi* "puppy"; *baba* "papa"; and *tada* "papa". Thus, when Bryan was 15 mths old, he was at approximately the same stage of production as the children studied by Poulin-Dubois and Goodz.

2. Data Collection, Transcription and Analysis

Bryan was recorded twice monthly (one session with each parent) at 10, 11, 12, 13 and 15 months of age in the home. Each session lasted approximately 45 minutes. The parents were asked to be natural in their interactions with the child, to avoid playing with noisy toys, and to not speak when Bryan was speaking. The child and his parents were video and audio taped using a Sony digital Camcorder and Sony DAT Audio Recorder (TC DD100) with a Countryman microphone.

The recordings were transcribed by the first author and retranscribed by her 5-mths later to check reliability. Only speech-like utterances that contained at least one consonant or consonant-like element (semi-consonant) and were bounded by pauses of at least 400 ms were selected for transcription and analysis. Cries and vegetative sounds were omitted from the analysis as were utterances that contained only vowel or vowel-like sounds with no consonantal element (to distinguish them from solitary babbling sounds). This yielded 567 utterances in total (289 from the sessions with the mother in English and 278 from the sessions with the father in French) and 1290 syllables (530 from the sessions with the mother and 760 from the sessions with the father). Acoustic files of each recording were made using SpeechAnalyzer software and these were checked during the transcription; they will also be used for more detailed acoustic analyses.

The results reported here focus on differences between French and English with respect to:

1. utterance structure:
 - (a) MLU
 - (b) number of monosyllabic utterances
 - (c) number of bisyllabic utterances
 - (d) number of polysyllabic utterances
2. syllable structure:
 - (a) number of sounds per syllable;

- (b) ratio of consonants to vowels per syllable;
- (c) number of V-syllables
- (d) number of CV syllables
- (e) number of stop+vowel syllables
- (f) number of approximant+vowel syllables
- (g) number of open syllables

These are features that have been shown to differ in English and French adult and in some case child monolinguals. The data have been aggregated across recording sessions for purposes of statistical analysis, but we describe the month-by-month results verbally to give an indication of the consistency of the aggregated results.. One-way analyses of variance comparing results for English versus French were carried out for variables 1(a), 2(a), and 2(b); all other data were analyzed using tests of proportions (these are reported as z scores).

3. Results

3.1. Utterance Structure

Levitt & Utman (1992:25) and Boysson-Bardies et al. (1989) have found that 11-mth old French-learning infants produced longer utterances when babbling than English infants of the same age. Accordingly, we expected that Bryan would produce longer utterances when interacting with his French-speaking father than with his English-speaking mother (see Table 1 for a summary of the utterance structure analyses). Indeed, there was a statistically significant tendency ($p=.07$) for Bryan to produce longer utterance (analyzed as syllables/utterance) when he was babbling with his French-speaking father ($M=2.7$) than when he was babbling with his English-speaking mother ($M=1.8$). There was a numerical difference in MLU in favor of French at every month, although the difference at 15 mths was minimal (Fr: 1.9; En: 1.7).

Table 1. Summary of Utterance Structure and Statistical Analyses

	ENGLISH	FRENCH	
Mean number of syllables/utterance	1.8	2.7	$F(1,9)=4.25$ $P=.07$
Monosyllabic Utterances %	46.70	37.40	$Z=2.25$ $P=.025$
Bisyllabic Utterances %	38.00	25.20	$Z=3.27$ $P<.001$
Polysyllabic Utterances %	15.2	37.4	$Z=6.02$ $P<.001$

Additional evidence for a French-English difference in utterance length comes from analyses of the frequency of Bryan's production of monosyllabic, bisyllabic, and polysyllabic utterances (utterances of 3 or more syllables); see Table 1 for a summary of these analyses. Levitt & Utman (1992) found a higher incidence of polysyllabic vs monosyllabic utterances in the babbling of their

French subject at 11 months, but their English subject who was at the same stage produced as many polysyllabic as monosyllabic utterances. Similarly, we found that Bryan he produced significantly more polysyllabic utterances with his father (M=37.4) than with his mother (M=15.3); this pattern was evident at every month. Complementary to this pattern, he produced significantly more monosyllabic utterances when babbling with his English-speaking mother (M=46.70%) than when with his French-speaking father (M=37.40%). There was a numerical difference in favor of English at every month except 15 mths. Likewise, he produced significantly more bisyllabic utterances with his mother (M=38%) than with his father (M=25.2%); this difference was also evident at every month.

Figure 1 summarizes these results graphically for ease of observation. It is evident that the overall difference in mean length of utterance between French and English, reported in the first analysis, is due primarily to the higher frequency of utterances of 3 or more syllables in the French sessions in comparison to the English sessions. As noted above, this pattern was present at every month. Complementary to this pattern, there was an overall tendency for more mono- and bi-syllable-long utterances in the English sessions in comparison to the French sessions.

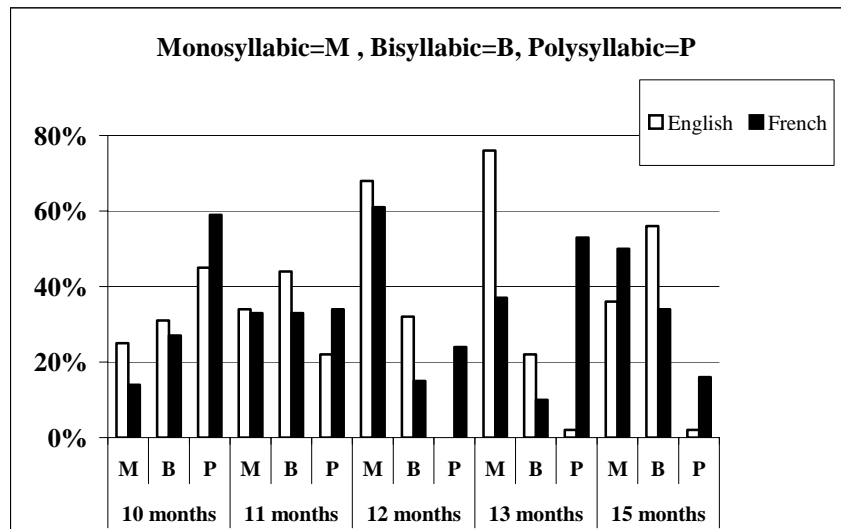


Figure 1. Frequency of Mono-, Bi- and Polysyllabic Utterances in English and French at each Month

3.2. Syllable Structure

In the following analyses, we examined differences in the syllable structure of Bryan's babbling when with his mother and his father; see Table 2 for a summary of these analyses. Delattre (1965) reports that syllable load is higher in adult English than in adult French -- specifically, he found, on average, 2.0 phonemes/syllable in adult English and 1.8 phonemes per syllable in adult French. Since Bryan was in the pre-lexical stage, we cannot speak of "phonemes" per se, so our analyses report syllable load in terms of "sounds" per syllable. There was no significant difference in syllable load when Bryan was with his English-speaking mother ($M=2.03$) in comparison to the syllable load when he was with his French-speaking father (1.84), although the difference was in the expected direction; that is, higher load in English babbling; and this difference was evident at every month, except at 15 mths.

Table 2: Summary of Syllable Structure and Statistical Analyses

	ENGLISH	FRENCH	
Sounds/syllable	2.03	1.84	$F(1,9)=2.92$ $P=.13$
Consonant:Vowel ratio	.99	.80	$F(1,9)=4.19$ $P=.07$
V-syllables %	15.3	30.3	$Z=6.19$ $p<.001$
CV syllables %	67.7	57.2	$Z=3.81$ $p<.001$
Stop+Vowel Syllables %	63.4	55.1	$Z=2.36$ $P=.02$
Approx.+V. Syllables%	8.9	21.7	$Z=4.90$ $p<.001$
Open Syllables %	86.2	90.0	$Z=2.10$ $P=.04$

Delattre (1965) has also reported that the ratio of consonants to vowels is lower in French (0.8) than in English (1.05). A higher C:V ratio in Bryan's English babbling in comparison to his French babbling would indicate relatively greater use of consonants and, thus, a higher consonant load in English relative to French. Bryan exhibited a higher C-V ratio in English (.99) than in French (.80), and this was significant at the .07 level. There was a higher C:V ratio for English at every month, except at 15 mths where there was no difference.

Turning now to syllable types, adult English has a greater variety of consonant-vowel combinations than French -- specifically, English has 14 different structures (from V to CCCVCC) and French has only 10 different structures (from V to CVCCC) (Delattre, 1965, p. 80). In babbling, the

repertoire is simpler -- the types of syllables that occur in babbling (in both English and French) are generally restricted to CV, CVC, VC and V and rarely CCVC. Delattre (1965) has claimed that owing to the differential occurrence of different syllable types in adult English and French, English sounds relatively consonantal and French relatively vocalic. Accordingly, we analyzed the relative frequency of occurrence of V-syllables in English and French.. Because of our criteria for utterance selection, V-syllables did not occur as isolated syllables, but occurred in combination with other C-V syllables. Our analysis thus captures the prevalence of these V-syllables in Bryan's English and French. In accord with Delattre's characterization of French versus English, V-syllables occurred significantly more frequently in Bryan's French babbling (M=30.3%) than in his English babbling (M=15.3). This was evident at every month.

Another way of looking at Delattre's claim concerning the "general sound" of English vs French is to analyze the occurrence of CV syllables on the expectation that there would be more CV syllables in English than in French. In fact, it has been reported that there are more CV syllables in adult English in comparison to adult French (Delattre, 1965, p. 41). First, it should be noted that CV syllables were the most prevalent syllable type in Bryan's babbling with both his mother (M=67.7%) and his father (M=57.2%) in every session. This pattern is apparent in the babbling of monolingual children as well and probably reflects ease of articulation of this syllable type (Boysson-Bardies, 1999). Bryan produced significantly more CV syllables in English (M=67.7%) than in French (M=57.2); this difference was evident at every month, except at 10 mths when there was no difference.

Differences between French and English have also been reported in the relative frequency of occurrence of stop-vowel and approximant-vowel CVs in each language, with English having more stop-vowel syllables and French more approximant-vowel syllables (Delattre, 1965). Consistent with the adult pattern, we found that stop-vowel combinations were more frequent in Bryan's English babbling (M=63.4%) than in his French babbling (M=55.1%) whereas approximant-vowel combinations were more frequent in his French babbling (M=21.7) than in his English babbling (M=8.9%); both of these differences were statistically significant. "Approximants" included semi-vowels /j, w/, the liquids /l/ and all /r/. The stop-vowel difference was evident at every month, except at 10 mths when there was no difference; and the approximant-vowel difference was evident at every month. Bryan favored stops over other consonant types in the sessions with both his mother (63.4%) and with his father (55.1%). A similar preference has been reported by Levitt and Utman (1992) for the English- and French-learning children they examined, by Locke (1982), and by Vihman et al. (1986).

Finally, it has been reported that, generally speaking, monolingual infants initially produce more open syllables than closed syllables (Boysson-Bardies, 1999), arguably because open syllables are easier to produce. Likewise, we found that open syllables were favored in both Bryan's English (open=86.2%; closed=13.8%) and his French (open=90%; closed=10%) babbling. At the same time, adult English has more closed than open syllables (60:40) while adult

French favors open syllables (76:24) (Delattre, 1965, p. 41-42). Levitt and Utman report the same differential pattern in their case study of a monolingual English- and a monolingual French-learning child (Levitt & Utman, 1992). Bryan similarly produced significantly more open syllables in his French babbling (90%) than in his English babbling (86.2%), although the difference is numerically much smaller than has been found in the case of monolingual adult speakers of these two languages. There was, in fact, considerable inconsistency in the relative proportion of open and closed syllables in Bryan's sessions with his mother and father -- there were more open syllables in French than in English at 12 and 13 mths, but the inverse at 11 mths, and no difference at 10 and 15 mths.

4. Summary and Conclusions

There is evidence in Bryan's babbling of both language-independent and language-specific patterns. Language independent patterns were evident in that:

- CV syllables were more frequent in both French and English
- Stop+Vowel syllables were the most prevalent type in both French and English
- open syllables were more frequent than closed syllables in French and English.

Language-specific patterns were evident in the following measures:

- Mean length of utterance -- monosyllabic and bisyllabic utterances were more common in English while polysyllabic utterances were more common in French
- syllable load: both the sound/syllable and C:V ratios were higher in English
- syllable types: V-syllables were more prevalent in French than in English but CVs were more common English than French;
- syllable types: stop + vowel syllables were more common in English than in French but approximant + vowel syllables were more prevalent in French than in English.

A comment about Bryan's babbling at 15 months is in order here. It will be recalled that the pattern of differences between his babbling when with his English-speaking and his French-speaking father that was found for the aggregated data was evident at most months, except in a number of cases at 15 months. While we have no definitive explanation of this finding, it is interesting to note that Bryan began to produce recognizable words at 15 months of age. The articulatory resources needed to produce meaningful strings of sounds as words may have taxed his capacity and resulted in a decalage in his babbling to the point that pre-existing differences between English and French were lost. This is purely speculative, but suggests that follow-up research that examines the link between the sounds in his first words and his babbling might be fruitful.

These results support the following conclusions:

- (1) The co-occurrence of language independent and language-specific patterns in Bryan's babbling supports an interactionist model of early phonological development; that is to say, phonological development is shaped by both

universal constraints related to early phonological production and by experiences with specific languages.

- (2) Bryan's language-specific babbling patterns reflect characteristics of the adult languages and, thus, attest to babbling drift. Follow-up research that examines the link between bilingual infants' babbling and the phonological characteristics of their parents' language to the child would be useful to establish the specificity of these effects.
- (3) The language-specific patterns also attest to language differentiation in bilingual acquisition during pre-lexical stages of development. That is to say, contrary to earlier hypotheses, bilingual children's languages are differentiated even during pre-verbal stages of acquisition. This constitutes the first evidence of such early differentiation.
- (4) Overall, Bryan was developing language-specific features within the same age range as that attested in monolingual children learning the same languages. Specifically, Bryan's variegated babbling, as reported in this study, occurred at the same time as it is reported to occur in monolingual children (Boysson-Bardies, 1999; Jusczyk, 1997).

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