CHAPTER 12

Bimodal Bilingualism: Sign Language and Spoken Language

Ronice Müller de Quadros, Diane Lillo-Martin, *and* Deborah Chen Pichler

Abstract

Children who are exposed to a spoken language and a signed language can become bimodal bilinguals. Like adult bimodal bilinguals, children produce a variety of structures reflecting either language and, most interestingly, structures reflecting the influence of both languages. The latter include code switching and code blending, which we categorize with other bilingual phenomena as instances of what we call "language synthesis." Examining bimodal bilingual children, we conclude that they differ from adults in that they are still developing coordination of bimodal production, but otherwise they make full use of the possibilities available in bimodal bilingualism. In particular, they may combine aspects of both languages as the output of a single computation. Considering specifically bimodal bilingual children with cochlear implants, these children show development similar to that found in bimodal bilingual hearing children, provided they receive early exposure to a sign language.

Key Words: bimodal, bilingual, Coda/Koda, cochlear implant, bilingual transfer, code blending, interpreters

This chapter focuses on bimodal bilingualism, or bilingualism involving a sign language and a spoken language. This type of bilingualism shows both similarities to and differences from unimodal bilingualism (bilingualism involving two languages in the same modality, such as spoken English and spoken Portuguese) in important ways. Therefore, studying the nature of bimodal bilingualism reveals patterns that would go unnoticed if researchers limited observations to unimodal bilinguals.

A great deal of linguistic research on bilingualism is concerned with the ways that the languages of a bilingual are separated and yet interact. Proficient bilinguals frequently engage in code switching, or the use of both languages in alternating succession both across and within utterances. Although such code switching is sometimes disparaged, in linguistic research it is considered an indication of high fluency in both languages, and the linguistic positions at which switches may occur are rule governed, like other linguistic behavior (Gumperz & Toribio, 1999). Another characteristic of bilingualism is sometimes called cross-linguistic influence or transfer. This is a device by which the words of one language are produced following the structure of another language. Most research on this characteristic focuses on developing bilinguals, who might use such structures temporarily because they have not yet fully developed each language. However, there are reports of such structural combinations interacting with code switching in precisely defined ways, particularly within close-knit highly bilingual groups (e.g., González-Vilbazo & López, 2011).

As with unimodal bilinguals, most linguistic research on bimodal bilinguals considers the ways that bilinguals' languages interact. In the case of bimodal bilinguals, this research has centered on the unique code-mixing possibilities that become possible when bilingualism involves two languages articulated in different channels (i.e., oral and manual). Although bimodal bilinguals can feasibly *code-switch*, that is, start an utterance in one modality then switch to the other, researchers have repeatedly reported that this type of switching is used with far less frequency than *code blending*, or the coproduction of sign and speech content for a single proposition (Emmorey, Borinstein, Thompson, & Gollan, 2008; Petitto et al., 2001). A wide variety of spontaneously occurring sign plus speech combinations, exhibiting a range of timing, degree of congruence, influence from one language versus the other, and so on, all qualify as code blends, as will be detailed later. In addition, structural combinations of sign and speech are also observed, particularly in close-knit, highly bilingual contexts. For example, hearing adults who grew up in Deaf households may participate in the CODA organization, a group designed for such (adult, hearing) children of deaf adults (Codas). In such contexts, use of spoken words following sign language grammar is part of the unique identity of Codas, and it has come to be known as Coda-Talk (Bishop & Hicks, 2005).

This chapter will concentrate on such language interaction effects; in particular, code blending and structural combinations, drawing on previous studies of adult and child hearing bimodal bilinguals, and on the research project, *The Development of Bimodal Bilingualism* (http://bibibi.uconn.edu). This discussion focuses on data from hearing participants who were raised in Deaf families, acquiring both a spoken language and a sign language. The discussion addresses three aspects of code blending: (a) base language for code-blended utterances, (b) coordination of sign and speech during code-blended utterances, and (c) degree of congruence between signed and spoken content in code-blended utterances, as well as the type of "mixing" in which words of one language are used with grammatical structures of the other.

Bimodal bilingualism can also be observed in a number of other contexts, of which two will be included here. With the advent of cochlear implant (CI) technology, some deaf families who use sign language also choose CIs for their deaf children. As native signers, if speech is learned as well, such children can be considered bimodal bilinguals in the sense described here (those whose languages include a sign language and a spoken language). The chapter provides some information about language development by these bimodal bilingual children, along with some contrasts between native signers with CIs and CI users with only restricted access to sign language. Finally, the special context of bilingual interpreters is considered. Given their training and the requirements of their positions, language mixing sometimes takes a different form in this group. Sign language interpreters must control the output and interaction of their two languages, since they have a target language in mind as they are interpreting. Some recent findings about language mixing by interpreters are briefly summarized.

Characterization of Bimodal Bilingual Adults (Codas)

Emmorey, Borinstein, et al. (2008) analyzed different kinds of mixing produced by adult American Codas in data extracted from two tasks: natural conversation with each other and retelling the story of a cartoon they were shown. Although code switching from speech to sign, or vice versa, occurred in some instances, it was not very frequent. Only 6% of the entire dataset contained examples of code switches. The majority of these switches (65%) contained either novel American Sign Language (ASL) lexical signs or classifier constructions that do not have a close translation in English. The next most common type of code switches involved ASL signs that do have an English translation and, finally, ASL pronouns (points).

Instead of code switching, Emmorey, Borinstein, et al. (2008) reported that Coda mixing consisted primarily of *code blending*, terminology introduced by the authors to refer to simultaneous production of speech and sign. Code blending accounted for 36% of all production and 98% of all mixing in the data, with about two thirds of blends spanning multiple signs/words. Blending occurred most often at verbs (66%), followed by adjectives (18%) and nouns (7%). An example from their study is given in (1). (Following their notation, the words with which the signs are simultaneously produced are underlined.)

(1) (cartoon narrative)
"*<u>I don't think he would really live</u>*."
NOT THINK REALLY LIVE

In most cases, equivalent signed and spoken content was synchronous and semantically congruent (81%). Emmorey, Borinstein, et al. (2008) proposed that such blends are more easily processed than semantically incongruent or nonequivalent blending. They found three categories of nonequivalent code blends: (a) ASL sign(s) and English word(s) did not constitute translation equivalents (16%) (e.g., saying "Tweety" while signing BIRD); (b) timing misalignment between the production of an ASL sign and the equivalent English words (2%); and (c) sign errors in which a clearly incorrect sign was retrieved (1%).

Emmorey, Borinstein, et al. (2008) classified code blending according to which language could be considered the "Matrix" language, or the one providing the syntactic frame and the majority of morphemes (Myers-Scotton, 1997). Adult Coda code blends typically used English as the Matrix (or base) language, but examples where ASL provides the syntactic frame, and English would be considered an accompanying language, were also observed (16% of the analyzed data). Such examples include so-called Coda-Talk, as in example (2).

(2) (cartoon narrative)
"*Wonder what do.*"
WONDER DO-DO
[Sylvester] wonders what to do.

Although such Coda-Talk examples were observed, there were no examples in which ASL was the matrix language and single-word English code blends were produced, in contrast to code blends with English as the matrix language, which could include single or multiple signs. Emmorey, Borinstein, et al. (2008) conjectured that this pattern is attributable to English being the dominant language for these (hearing) adult bimodal bilinguals at this stage of their lives (according to their self-report), since studies of unimodal bilinguals have observed that it is harder for bilinguals to switch from the less dominant language to their more dominant language than the reverse. Emmorey, Petrich, and Gollan (2013) reported experimental psycholinguistic results that also support the idea that English is the dominant language for most hearing, adult bimodal bilinguals, finding slowed lexical retrieval in ASL compared to English.

Dominance in English, however, does not preclude other types of consistent language combination effects in the direction of ASL to English. Pyers and Emmorey (2008) examined the use of ASL grammatical nonmanuals that "leaked" into spoken English by adult Codas. In particular, these Codas made frequent use of brow raise (a component of the ASL conditional nonmanual marker) while expressing conditional structures in English, without any accompanying ASL, to hearing, nonsigning interlocutors. The authors argued that such integration of distinct morphosyntactic elements from two languages into a single syntactic representation occurs because shared syntax makes full inhibition of the nonselected language (in this case, ASL) difficult. The "leaked" nonmanuals are evidence that ASL grammar remains at least partially activated. However, the same Coda participants refrained from using brow furrow (a component of the ASL WH-question marker) when asking English WH-questions to nonsigning interlocutors, suggesting that Codas can modify the degree to which ASL is inhibited. Pyers and Emmorey (2008) speculated that Codas' avoidance of brow furrow is rooted in their awareness that this nonmanual expression has negative connotations in American hearing culture and might be misinterpreted by nonsigning interlocutors.

To the extent that frequent code blending and "leaking" of ASL nonmanual information while speaking English are typical patterns for Codas, this may indicate that language suppression is less frequent and less complete for this group than for unimodal bilinguals. Emmorey, Luk, Pyers, and Bialystok (2008) concluded that the relative decrease of language suppression is responsible for the fact that bimodal bilinguals do not appear to manifest a "bilingual advantage" of enhanced executive function performance previously noted for unimodal speech bilinguals (Bialystok, Craik, Klein, & Viswanathan, 2004). Emmorey, Luk, et al. (2008) reported that adult bimodal bilinguals performed on par with monolinguals on an experimental task targeting executive function, with both groups scoring below unimodal speech bilinguals. These results are consistent with the view that the bilingual advantage arises from long-term acquisition of two languages in the same modality, necessitating constant inhibition of one language in order to produce the other.

Kodas (Coda Children) in Previous Literature

There is a small but growing number of studies on bimodal bilingual development among Kodas learning a variety of language pairs. Petitto et al. (2001) studied hearing bimodal bilingual children acquiring Quebec Sign Language (LSQ) and spoken French and concluded that they displayed separate and parallel development in both their languages, as do hearing unimodal bilingual children acquiring spoken English and spoken French. Consistent with language acquisition milestones for general L1 acquisition, both groups of bilinguals observed by Petitto et al. (2001) produced their first words around 0;10–1;02, their first two-word combinations around 1;05–1;08, and their first 50 words around 1;05–1;09. Word and sign development for LSQ/French bilinguals paralleled each other. Also, both unimodal and bimodal bilinguals produced 36% to 51% of their vocabularies as translation equivalents (TEs), important evidence that lexical learning progresses for both languages independently, unaffected by the principle of mutual exclusivity that normally restricts children's early acceptance of two labels for the same referent (Markman, 1990). Thus, contrary to earlier proposals that bilingual children begin with a fused grammar and lexicon for their two languages (Volterra & Taeschner, 1978), linguistic development in the bilingual mind leads to two distinct but interacting grammars.

Further evidence that Kodas develop distinct but interacting bilingual grammars comes from child code-mixing data. Code blending is common between deaf parents and their hearing or deaf children (Kanto, Huttunen, & Laasko, 2013; Mallory, Zingle, & Schein, 1993). Van den Bogaerde (2000), in her study of code blending in the Netherlands involving Sign Language of the Netherlands (NGT) and Dutch, found that deaf parents code-blended more often with their Koda children than with their deaf children, although individual rates of code blending varied across parents. Like the adult Codas observed by Emmorey, Borinstein, et al. (2008), Van den Bogaerde, and Baker (2005) reported that Dutch Kodas produced many more code blends (90% of the data sample) than code switches (<10% of the sample); likewise, the majority (>80%) of Koda blends were lexically congruent and involved content words. Similar patterns have been reported by Petitto et al. (2001) for LSQ/French Kodas. However, Petitto et al. focused their analysis primarily on the semantic contributions of blended speech and sign, categorizing code-blended utterances as semantically congruent or incongruent, similarly to Emmory, Borinstein, et al. (2008). LSQ-French code blends of both types are given in examples (3) and (4). (English glosses are provided below all non-ASL signs and non-English speech.[1])

(3) Semantically congruent blend
LSQ: CANARDS
DUCKS
French: des canards
ducks
some ducks

(4) Semantically incongruent blend
a. LSQ: BOIS JUS
DRINK JUICE
French: tiens puis du jus
here and some juice
Here, and then drink some juice.
b. LSQ: AMI MON LÀ
FRIEND MY THERE
French: mon ami Marcel
my friend Marcel
My friend Marcel

Petitto et al. (2001) placed great emphasis on the semantically incongruent blends produced by their bimodal bilingual children (11% of all code-switched or code-blended utterances), noting that they combined signs and speech in semantically appropriate ways to create a cohesive single proposition. Furthermore, in code blends such as (4b), when the children produced equivalent strings of signs and speech in different word orders, they chose word orders appropriate for each language. Petitto et al. cited such examples as strong evidence that bimodal language mixing is "systematic and principled" (2001, p. 488) from children's earliest utterances, indicating that they differentiate between their two grammars, and refuting popular concerns of language mixing as a sign of language confusion.

Within the category of code blends, child language researchers also distinguish between multiple subcategories or subtypes, although the terminology for these subcategories varies somewhat across the literature. In their more recent work, Van den Bogaerde and Baker (2005, 2008; Baker & Van den Bogaerde, 2008, 2014) identify four types of code-blended utterances (labeled as SC or Simultaneous Communication in Van den Bogaerde, 2000). Examples of the code-blend types proposed by Van den Bogaerde and Baker (2008) appear in examples (5)–(8). Adopting the notion of Matrix or base language from the unimodal code-mixing literature (Myers-Scotton, 1997), Van den Bogaerde and Baker subcategorized code-blended utterances according to whether the full proposition was expressed in the spoken language (*Dutch base*), the sign language (*NGT base*), nonredundantly across both (*Mixed*; i.e., the full proposition can only be understood by attending to both languages), or redundantly in both (*Full*). In Mixed code blends, simultaneously uttered words and signs need not be exact translation equivalents and may even belong to different word classes, as illustrated in examples (7a) and (7b). Also, code-blended utterances may omit certain grammatical elements and still be classified as Full code

blends (e.g., the code-blended Dutch in (8) omits the subject, normally a grammatically obligatory element in Dutch). (In these examples and the ones that follow, relative spacing of signs and words represents their timing and overlap.)

(5) Dutch base language
NGT: VALLEN
FALL
Dutch: die gaat vallen
that goes fall
That [doll] is going to fall.

(6) NGT base language
NGT: INDEX$_{hij}$ JAS BLAUW
INDEX$_{he}$ COAT BLUE
Dutch: blauw
blue
He has a blue coat.

(7) Mixed
a. NGT: POLITIE ANDER MENSEN SCHIETEN
POLICE OTHER PEOPLE SHOOT
Dutch: politie andere mensen doodmaken
police other people kill
The police shot the other people.
b. NGT: DAN HARD GENOEG
THEN HARD ENOUGH
Dutch: dan als genoeg
then when enough
Then, when [the fish] is hard, it is enough (the fish is cooked).

(8) Full
NGT: BOEK PAKKEN
BOOK FETCH
Dutch: boek pakken
book fetch
[I will] fetch the book.

Note that Van den Bogaerde and Baker do not consider phonation to be a criterion for code blending. Thus, signed utterances accompanied by mouthing of Dutch words, even in the complete absence of any voicing or whispering, are counted as code blending in their data, a practice that differs from that adopted by other researchers[2] (e.g., Bishop, 2010; Donati & Branchini, 2013; Emmorey, Borinstein, et al., 2008, Lillo-Martin et al., 2014; Petitto et al., 2001; but see also Fung, 2012, who follows Van den Bogaerde and Baker's inclusion of mouthing plus signing as code blending).

The categories proposed by Van den Bogaerde and Baker overlap to some extent with those employed by other researchers of child code blending. Petitto et al. (2001) also mentioned the Matrix language (or *host language*) in some of their code-blended data and noted that children generally tended to match their matrix language to the language used by their interlocutor. Van den Bogaerde and Baker observed that regardless of the matrix language, code-blended structures in their data usually conformed to the grammar of both languages involved, leading the authors to conclude that Koda language mixing does not indicate confusion or weak language abilities, but rather strong language abilities, since children must be skilled enough in both languages to select compatible sign and speech output that follows their respective grammars.

More recent reports of Kodas acquiring Italian Sign Language (LIS) and spoken Italian (Donati & Branchini, 2013) offer a unique perspective for investigating the degree of autonomy between code-blended sign and speech. Spoken Italian is an SVO language (harmonic head-initial) while LIS is an SOV language (harmonic head-final). Donati and Branchini (2013) analyzed data from six Italian Kodas between the ages of 6 and 8 years of age. They confirmed previous observations that code switching is relatively uncommon among bimodal bilinguals, while blending is very productive. They also confirmed the presence in some LIS/Italian code blends of autonomous, complete utterances in one modality, accompanied by just a few words or signs in the other modality. However, Donati and Branchini (2013) also observed cases of what they considered independent blending, that is, simultaneous production of two independent monolingual utterances, including instances of congruent lexicalization, and syntactic calques. Most intriguing are the cases they describe as "two word orders" (example 9), where the sign and the speech follow opposite word orders, each appropriate to the target language, and "blended blending" (example 10), where each modality contributes part of the message. In the following examples, 1SG stands for agreement with first-person singular, 3SG stands for agreement with third-person singular, PRS stands for present tense, PTC stands for particles, and NEG stands for negation.

(9) LIS/Italian blends with two word orders
Italian: Chi ha chiamato?
who have.3SG call.PTC
LIS: CALL WHO?
Who has called?

Italian: Eh? Non ho capito
Uh? NEG have1SG understand.PTC
LIS: I UNDERSTAND NOT
I haven't understood.

(10) LIS/Italian blended blending
Italian: Parla con Biancaneve
talk.PRS.3SG with Snow White
LIS: TALK HUNTER
The hunter talks to Snow White.

These strikingly incongruous blends reported by Donati and Branchini (2013) raise important questions for the appropriate theoretical model to account for bimodal bilingual production, a topic to which we turn next.

Theoretical Models

The observation that the vast majority of both adult and child Coda code blends display congruence and temporal coordination between equivalent signed and spoken content calls to mind similar coordination between speech and co-speech gestures. Like co-speech gesture, signing in code blending tends to convey meaning that is equivalent to or closely related to accompanying spoken content. Considering this parallel, Emmorey, Borinstein, et al. (2008) and Casey and Emmorey (2009) proposed a model of bimodal production inspired by an existing model for co-speech gesture (Kita & Özyürk, 2003). Emmorey and her colleagues argued that bimodal bilinguals are exempt from the articulatory restrictions that limit unimodal bilinguals to production in one language or the other. Under these circumstances, inhibition of one language is cognitively more costly (effortful) than code blending. Thus, Emmorey and her colleagues take simultaneous ASL-English code blends as support for separate but linked production mechanisms for sign and speech in their model, shown in Figure 12.1.

This model has important implications for production. First, the architecture of this language production system does not require that a single lexical representation be selected at the preverbal message level or at the lemma level. Moreover, lexical selection is computationally inexpensive relative to lexical suppression, and both languages are active all the way to the level of phonology for bilingual speakers, permitting a single computation to be articulated using both speech and sign right up to the last moment.

Emmorey, Borinstein, et al. (2008) and Casey and Emmorey (2009) noted that the primary function of code blending is not to convey distinct information in two languages, but rather to construct a single message (proposition) from content in two modalities. The choice of a matrix language is likely made at relatively early stages in production (labeled ASL Formulator and English Formulator in Figure 12.1), because one language must provide the syntactic frame. Salience or importance of a concept to the discourse may be one factor that determines lexical selection. Verbs were most frequently produced in single-sign code blends, since verbs express critical event-related information within a narrative. However, the inflectional morphology of ASL and English does not have to be integrated during a code blend. Also, switches from speaking to signing often occur when ASL is able to convey information in a unique manner, one that is not captured by English.

Donati and Branchini (2013) discussed several alternative conceptions of the language architecture in attempting to account for the "two-word order" and "blended blending" data of the sort represented

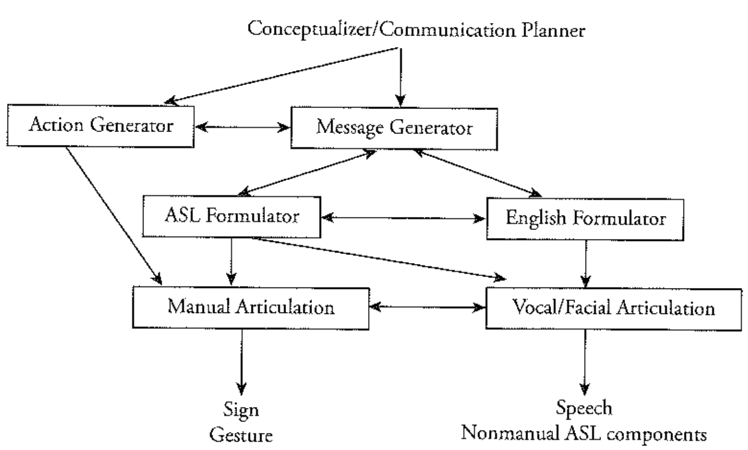

Figure 12.1 Model from Emmorey, Borinstein, et al. (2008).

in (9) and (10). According to one approach, the syntactic derivation has hierarchical relations, but linear order is only achieved after syntax, in the mapping to the phonological component (PF; Chomsky, 1995). Donati and Branchini suggested that during code-blended utterances, only one structure is derived, but two linearizations take place. Typically, linearization forces every word to be uttered in sequence because of the availability of a single articulatory channel. However, for bimodal bilinguals, the exceptional availability of two channels allows linearization to take place separately for speech and sign. The LIS-Italian code-blended utterances illustrated earlier thus require simultaneous activation of two PF channels by the Koda children.

Building on previous models for code blending and code switching, the Language Synthesis model was proposed (Koulidobrova, 2013; Lillo-Martin, Koulidobrova, Quadros, & Chen Pichler, 2012; Lillo-Martin, Quadros, Koulidobrova, & Chen Pichler, 2010; Quadros, Lillo-Martin, & Chen Pichler, 2013), adopting the minimalist perspective argued by MacSwan (2000, 2005) that bilingual code-mixing phenomena should be accounted for by a universal computational system (see Fig. 12.2). Despite the fact that code blending involves output in two distinct modalities, these outputs should still be generated by a single computational system that functions in the same manner for both monolinguals and bilinguals. Such a model offers an account for both code switching (unimodal and bimodal) and code blending. Additionally, the Language Synthesis model addresses the observation that lexical selection (for all bilingual mixing) arises relatively late, resulting in a variety of code-blended and code-mixed outputs, including use of the words from one language following the grammar of the other. This model captures relatively late lexical selection by applying aspects of distributed morphology (Halle & Marantz, 1993) to bilingual code-switching phenomena, as has been proposed earlier by Den Dikken (2011, p. 1): "(W)hen it comes to Vocabulary Insertion, bilinguals obviously differ from monolinguals in having a larger pool of V[ocabulary] I[tems]s to pick and choose from—so there will be occasions on which a particular terminal morpheme will have a better fit for an L1/L2 bilingual than it would have for a monolingual speaker of L1."

Language synthesis effects, commonly known as transfer or crosslinguistic influence, occur through the same mechanisms as code switching and code blending. At Vocabulary Insertion, elements from either language can be introduced into the derivation, as long as all featural requirements are satisfied. Consequently, roots and morphemes from both languages can contribute to a single output. In the case of bimodal bilinguals, who possess two independent sets of articulators for sign and speech, a morphological feature from the sign language that is selected early in the derivation may subsequently be satisfied by insertion of a spoken language Vocabulary Item (resulting in spoken language words in the order of the signed language, either as a fully spoken or a code-switched utterance), a sign language Vocabulary Item (resulting in a signed utterance), or both (resulting in a code-blended utterance). In the following section, we survey some of the studies carried out in the BiBiBi project that demonstrate how the Language Synthesis model

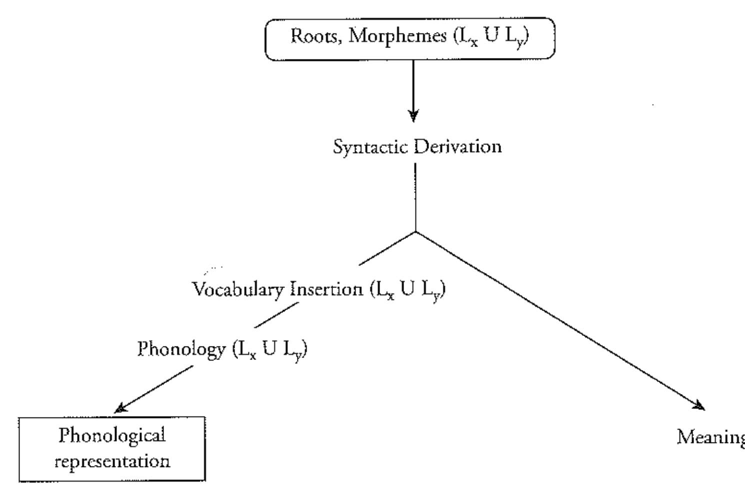

Figure 12.2 Language Synthesis model.

applies to code blending and cross-linguistic transfer observed in child bimodal bilingual participants.

BiBiBi Studies of Bimodal Bilingual Children

In the Binational Bimodal Bilingual (BiBiBi) Language Acquisition project, the simultaneous development of a sign language and a spoken language is investigated for two language pairs: Brazilian Sign Language (Libras) and Brazilian Portuguese (BP), and American Sign Language (ASL) and English (E). Participants include Kodas with at least one Deaf parent and relatively equal exposure to both speech and sign. Data comprise both videotaped naturalistic longitudinal sessions filmed on a weekly basis, alternating between sign target and speech target by changing interlocutors (Chen Pichler, Hochgesang, Lillo-Martin, & Quadros, 2010), and experimental sessions in which specific syntactic and phonological structures are targeted in both the children's signed and spoken languages (Quadros et al., in press). In the subsections that follow, we summarize two studies focused on bimodal bilingual children's productions: degree of coordination and congruence of code-blended utterances; and placement of WH-elements in WH-questions. Following that, we bring up the case of bimodal bilingual Deaf children using CIs, with a review of their overall language development and a study of phonological memory, as measured by pseudosign and pseudoword repetition.

Koda Coordination and Congruence in Code-Blended Utterances

The Language Synthesis model makes certain predictions for the characteristics of code-blended utterances, including the choice of base language, coordination, and congruence. The following types of code-mixed utterances are possible:

1. Full bimodal: everything that is expressed in sign is also expressed in speech (including whispering but not mouthing only)
2. Sign base: more of the message is expressed in sign than in speech
3. Speech base: more of the message is expressed in speech than in sign
4. Complementary: each modality contributes different aspects to the expression

One can also think of these categories as illustrating the different patterns of redundancy expected in the data, given the premise that blended utterances express a single proposition. What is not expected are nonredundant blended utterances violating this premise.

Assuming the one proposition generalization, it can be expected that the timing of speech and sign should be coordinated. For children, however, some exceptions may be found, due to their still-developing physical coordination.

Finally, blends are expected to be predominantly congruent, where word order of simultaneous sign and speech matches, for both children and adults. In some cases, congruency results in an ungrammatical or nonpreferred word order in one language, but usually orders will be chosen that are acceptable in both languages.

To begin to test these predictions, Chen Pichler, Quadros, and Lillo-Martin (2014) and Quadros, Chen Pichler, and Lillo-Martin (2014) carried out a careful analysis of spontaneous production data from two Koda children and their interlocutors, summarized in Table 12.1. The utterances were classified as sign, speech, bimodal, or excluded (interjections and immediate complete imitations were excluded and do not appear in Table 12.1).

Preliminary results for analyses of base language and coordination are given in Figures 12.3 and 12.4. Figure 12.3 shows that while the child BEN used all predicted types of code blending, his adult interlocutors (BEN-Adults), IGOR, and IGOR's adult interlocutors (IGOR-Adults) produced essentially no code blending with a Sign base language.

Table 12.1 Participants in the Study Reported by Quadros et al. (2014)

Participant	Total No. Included Utterances	No. Bimodal Utterances	Sessions Included
BEN (2;00-2;06) (American Koda)	1,347	224	2 sign target, 2 speech target
BEN-Adults	1,197	48	2 sign target, 2 speech target
IGOR (2;02-2;07) (Brazilian Koda)	1,239	162	2 sign target, 2 speech target
IGOR-Adults	2,098	133	2 sign target, 2 speech target

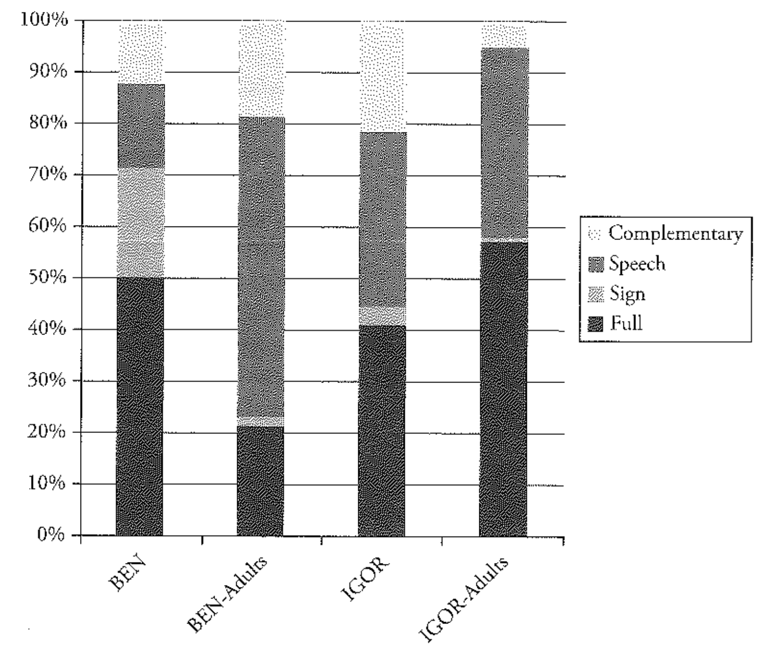

Figure 12.3 Results—Base language (Quadros et al., 2014).

In these sessions, nearly all bimodal examples from adults occurred during Speech target sessions; the adults in signing sessions tended to sign without speech. As for temporal coordination, most code blends fell in the "Included" category, with production in one modality occurring within the temporal extent of production in the other. Generally, code blends featured good temporal coordination

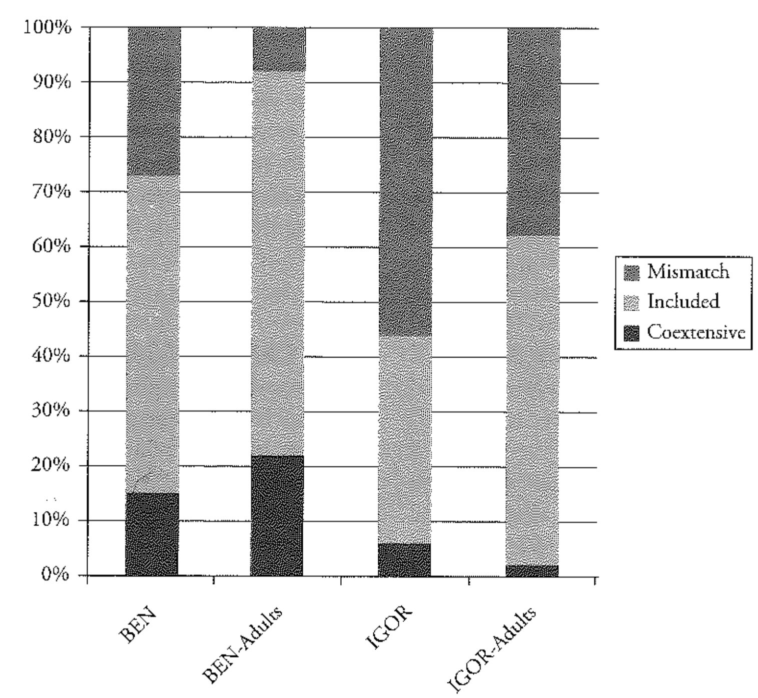

Figure 12.4 Results—Coordination (Quadros et al. 2014).

between signing and redundant speech. However, the Kodas produced more mismatches than adults, as well as a higher number of repetitions and self-corrections, suggesting that children are still developing the ability to coordinate manual and vocal outputs at this age. Importantly, however, Kodas and adults alike make full use of the possibilities made available to them by bimodal bilingualism.

A further analysis of the data from BEN and BEN-adults was conducted to investigate the question of congruence. Only utterances of more than one word in both sign and speech were analyzed. The results showed that (hearing) adults used either congruent structures permitted in both ASL and English, or their blending followed English word order. On the other hand, BEN's blending was more varied, at times following ASL word order. His English also showed nontarget structures due to missing elements (arguments, determiners, verbal morphology, etc.), as is typical for 2-year-old children.

The conclusions from this study are that for both children's and adults' code blends, the two languages contribute to a single proposition, as predicted by the Language Synthesis model. With regard to base language and timing, the utterances are mostly redundant between sign and speech, with strong temporal coordination between speech and sign, although this coordination is still developing for the children.

Structural Combinations in WH-Questions

ASL and Libras display a variety of WH-question structures (interrogative structures that include specific question words that are referred as WH-words, such as *who, what, where*) that are not available in English and BP. These two sign language allow WH-words in sentence-initial, sentence-final, and doubled (initial and final) positions (Nunes & Quadros, 2007; Petronio & Lillo-Martin, 1997), while English and BP allow only sentence-initial WH-questions, plus limited in situ (unmoved) WH-questions in certain contexts.

Given these typological differences within the target language pairs, it is possible that bimodal bilingual children at times used WH-question structures appropriate for one of their languages with words drawn from the other (as is often seen in spoken language bilinguals). This possibility was tested in a series of studies using both longitudinal spontaneous production data from children ages 1;11–3;03 and elicited production data from older children, ages 4–8 years (Lillo-Martin et al., 2012; Quadros et al., 2013).

Bimodal bilingual children in the early stages of language acquisition generally used the structures appropriate to the language from which the words were drawn, but with some notable exceptions in which the children produced spoken WH-in situ and WH-doubling structures, word orders permitted by their sign languages. As for WH-final structures, both spoken English and BP permit WH-in situ in certain limited contexts, but the children used them at a much earlier age than is typical for monolingual children. Thus, this early stage is analyzed as demonstrating effects of the sign languages on the spoken languages.

The opposite effect was found for the older children. They produced WH-questions of a variety of structural types (subject, object, adjunct), but they used the spoken-language-specific WH-initial structures the vast majority of the time. This is in contrast to monolingual ASL signing children at comparable ages, who use a greater variety of the word orders allowed by ASL. Hence, at this later stage in development there is a greater effect of the spoken languages on the sign languages.

There are two conclusions to be drawn from this study. First, synthesis works at various ages and in both directions (sign to speech, speech to sign). The expected structural combinations were observed. Second, there may be a shift in language dominance from sign to speech as the (hearing) children develop. This shift may be particularly notable once they enter public school and have fewer contacts with deaf signers. For parents who wish to support their children's continued use of sign, additional steps can be taken to provide varied opportunities for interactions in sign with peers as well as older signers (cf. Chen Pichler, Lee, & Lillo-Martin, 2014).

Deaf Children With Cochlear Implants as Bimodal Bilinguals

The BiBiBi research project includes native signing, bimodal bilingual children with cochlear implants, a small minority[3] of the cochlear implanted population. One research goal is to determine the degree to which these children's signed and spoken language development parallels that of Kodas. Families of children with cochlear implants are typically exhorted to focus solely on spoken language, in the belief that signing somehow disrupts speech development. Peterson, Pisopni and Miyamoto (2010) summarize this majority perspective thus: "Oral-only communication produc[es] speech and language results superior to those observed in children who use a combination of signing and spoken language" (p. 241). Most children with cochlear implants have hearing, nonsigning parents; consequently, these children have little or no access to language before the implant. In contrast, the children in the BiBiBi project come from signing families with Deaf parents, and so they receive early and fully accessible language exposure from birth. Under such circumstances, signing is predicted to positively affect subsequent spoken language development rather than hinder it.

Davidson, Lillo-Martin, and Chen Pichler (2014) examined English language skills of native signing Deaf children with CIs in comparison to Kodas and nonsigning cochlear-implanted children (the latter group based on previous studies). Demographic information for their participants is summarized in Table 12.2.

Spoken English skills were recorded using several measures: the *Preschool Language Scales (PLS-4)* as a general spoken language measure, the *Expressive Vocabulary Test (EVT)*, the *DIBELS* for phonological awareness, the *Goldman-Fristoe Test of Articulation (GFTA)*, and the *Index of Productive Syntax (IPSyn)* for syntax. Kodas and all of the native signing Deaf children with cochlear implants were also tested using the ASL Receptive Skills Test (Enns & Herman, 2011) to confirm their ASL proficiency. Both groups scored near or above the norm for native signing deaf participants on this test. In addition, all participants passed the *Leiter-R Screener*, indicating normal intelligence.

Results of the spoken English tests indicated that native signing Deaf children with cochlear implants showed no developmental differences compared to their Koda peers in the areas investigated. Native signing children with CIs also performed within published norms for monolingual English children, and much higher than published results for nonsigning children with CIs (Davidson, Lillo-Martin, & Chen Picher, 2014). Based on these results, the authors concluded that sign language exposure, when provided early and intensively enough, does not harm spoken English development for cochlear implanted children and may even mitigate the effects of delayed first-language input.

The results of the Davidson et al. (2014) study add to a growing number of studies that show that sign language acquisition, when received early enough and in an unrestricted manner, does not hinder spoken language acquisition, but rather facilitates it. In her study of Persian second-generation deaf children with cochlear implants and deaf children of hearing parents with cochlear implants, Hassanzadeh (2012) reported "that the second-generation deaf children exceed deaf children of hearing parents in terms of cochlear implantation performance" (p. 989). She concluded that "encouraging deaf children to communicate in sign language from a very early age, before cochlear implantation, appears to improve their ability to learn spoken language after cochlear implantation" (Hassanzadeh, 2012, p. 989). Similarly, Giezen, Baker, and Escudero

Table 12.2 Participants in the Study Reported by Davidson et al. (2014)

	Participant	Age of First English Resting	Age at First Implant	Years Since CI	Mother's Education (years)
Native signers with CIs	PAM	4;00	2;11	1;01	>12
	NIK	5;05	1;04	4;01	>12
	GIA	5;07	1;06	4;01	>12
	FIN	5;08	1;07	4;01	>12
	MAX	6;04	1;08	4;08	>12
Hearing native signers (kodas) $n = 20$	Mean	6;00	N/A	N/A	>12
	Range	4;09-8;02	N/A	N/A	12–21
Nonsigners with CIs	As reported in previous literature Typically high SES: 72% of mothers have 16+ years of education (Nicholas & Geers 2008)				

(2014) argued that exposure to both sign language and spoken language did not hinder the spoken language processing of young 5- to 6-year-old deaf children with cochlear implants. They concluded, "Early and continued access to language in both the visual and auditory modality is crucial to minimize the risk for language and cognitive delay" (2014, p. 121). In addition, Rinaldi and Caselli (2014, p. 798) suggested that "bimodal bilingualism may scaffold the development of spoken language also in deaf children with CI." Taken together, these studies are building up consistent evidence for early use of sign language with deaf children who have (or will receive) cochlear implants.

Another pair of studies involving signing deaf children with cochlear implants was reported in Cruz, Kozak, Pizzio, Quadros, and Chen Pichler (2014) and Kozak, Chen Pichler, Quadros, Cruz, and Pizzio (2013). These studies evaluated the development of phonological memory and production in spoken and signed language for three bimodal bilingual groups: (a) Kodas (from the United States and Brazil), (b) native-signing deaf children with cochlear implants (from the United States and Brazil), and (c) deaf children with cochlear implants from hearing families (from Brazil only). Participants performed two phonological memory tasks, repeating pseudosigns in Libras or ASL (developed by the researchers), and pseudowords in Portuguese (Santos & Bueno, 2003) or English (Carter, Dillon, & Pisoni, 2002). Kozak et al. (2013) and Cruz et al. (2014) predicted that full access to sign language would allow native-signing deaf children to develop spoken language phonological memory more readily than their cochlear-implanted counterparts with only limited access to sign.

Results showed that, as expected, Kodas performed well on both pseudosign and pseudoword tasks. Cochlear-implanted children with deaf parents performed with greater accuracy on the pseudosign task than on the pseudoword task. Their relatively high scores on the pseudoword task indicated that their exposure from birth to sign language bolstered their spoken language development in comparison to that of cochlear-implanted children with restricted access to sign language. This last group performed with less accuracy than the other two groups on both the sign and spoken language tests. However, their overall performance on the pseudosign test was reliably superior to their performance on the pseudoword test, suggesting that they favor the visual channel for language, even with their limited exposure to sign language.

Given the positive results of the studies reported in this section for children in deaf families, the next step is to evaluate spoken language and sign language performance for deaf children using CIs who have strong support for the use of sign language at school, even if their parents are hearing and only began learning sign language after the birth of their deaf child. It is not known to what extent this situation would approach that of the native signing deaf CI users in the BiBiBi study. However, some indication that early sign language use facilitates spoken language development even for children in hearing families comes from the work of Yoshinaga-Itano, Baca, and Sedey (2010). Further research in this area is currently planned.

As evidence mounts for the benefits of early sign exposure for children with CIs, some studies continue to report negative effects of signing on speech development. Wiefferink, Spaai, Uilenburg, Vermeij, and De Raeve (2008) analyzed sign and speech development of Dutch children with CIs in a bilingual school and Flemish children with CIs in oral schools. They found that the Flemish children achieved better results in speech than Dutch children; additionally, the sign language skills of the Dutch children did not improve over time. However, the authors made the point that these results may be related to the linguistic environment, and this would have implications not only for the children's linguistic development but also for their social and emotional development. Linguistic context is certainly one likely factor behind the contradictory findings of research on the effects of early sign exposure on speech development. It is likely that the sign input received by many of the deaf children in the Wiefferink et al. study is more limited, both in quality and quantity, than the full language input received by the deaf children with CIs in the Davidson et al. (2014) study, whose deaf families made possible a linguistic context that is more balanced between sign and speech. Additional factors to consider include levels of residual hearing, age of hearing loss diagnosis, age of implantation, frequency of CI use, and varying propensity for using oral language. Tomblin and Walker (2014) point out that these important variables are not controlled for in many studies examining the effect of sign exposure on speech development, including the Wiefferink et al. study. As such, Tomblin and Walker stress the importance of interpreting the results of these studies with extreme caution.

Another potential complication for the Wiefferink et al. (2008) study particularly is that the researchers measured mean length of utterance (MLU) in speech and in sign, directly comparing the development of this measure in the two languages. However, no baseline for MLU development in native signers was provided, and such information is lacking in the literature. Lillo-Martin, Berk, Hopewell-Albert, and Quadros (2015) reported that MLU does not increase much in sign languages, since the discourse organization in sign languages is different from that found in many spoken languages, and it is therefore not appropriate to compare sign language and spoken language development using MLU. These authors found that in typical ASL and Libras conversation, even adults produce shorter sentences than is typical in adult speech, because the signer can establish the referents in space and then produce a series of short sentences using this spatial information. While syntactic length does not dramatically increase over time, there are other linguistic factors that can be considered instead to evaluate growth of complexity when analyzing sign language development.

In summary, interaction of speech and sign input for deaf children with cochlear implants is highly complex, and results are subject to an overwhelmingly long list of influences. Despite a steady increase in the number of research studies addressing the effects of sign input on the development of spoken language for this population, findings are often contradictory and controversial. However, studies like Davidson et al. (2014), Cruz et al. (2014) and Kozak et al. (2014), that focus on children in truly bilingual sign-speech environments point to a consistent conclusion: when cochlear implanted children receive unrestricted access to a full–fledged, natural sign language, such exposure does not harm development of the spoken language.

Sign Language Interpreters

Sign language interpreters, both Codas and non-Codas, are bimodal bilinguals like the other groups discussed earlier in this chapter, but their professional training and requirements may lead to unique patterns of language interaction. Winston (1989) noted the following features of code mixing used by sign language interpreters: addition of vocabulary from one language into the other, restructuring of sentence types, and mouthing from the spoken language used during signing. Lexical borrowing encompasses ASL mouth configurations and reduced or full English lip movements. Other forms include fingerspelling, particularly "chaining" or alternating a fingerspelled word with its equivalent sign for clarification (Siple, 1995), and simultaneous use of ASL and English linguistic features (code blending).

Native bimodal bilingual Coda interpreters and very fluent non-Coda interpreters who acquired their sign language as a second language differ in their age of sign language acquisition, which can lead to potential differences in the bimodal bilingual behavior of these two interpreter groups. For example, Codas may use certain advanced sign language features that are absent from non-Coda interpreter signing, while non-Coda interpreters may use strategies learned during L2 training that Coda interpreters do not use. However, Davis' (2003) study found no significant differences between Coda and non-Coda interpreters with regard to linguistic transfer.

Metzger and Quadros (2012) investigated various types of linguistic transfer in sign and speech interpreting by two Coda interpreters, one from the United States and the other from Brazil. Their study focused on two questions: (1) Do Coda interpreters use natural code blending (as Codas do in general production)? (2) What is the cognitive effect of bimodal bilingualism for sign language interpreters while engaged in the task of interpretation? The researchers found different types of transfer in Coda sign language interpretation: code switching to fingerpelling associated with mouthing while signing, and code blending with mouthing associated with signing in Libras/ASL base language. Additionally, during monologic interpretation, both the interpreter's spoken and signed languages were available, and they appear to control both languages and make intentional choices about how to use them during the interpretation setting. Code switching and code blending were always used to convey one proposition, in accord with the language synthesis model. It is possible that compared to typical bimodal bilinguals, interpreters may show increased language inhibition and therefore more executive function development than has been previously observed for Codas who were not sign language interpreters. Determining whether these two groups diverge with respect to demonstrating any bilingual advantage requires further research to compare abilities in executive control, attention, and memory, as well as properties of sign plus speech language mixing.

Final Remarks

Studies with bimodal bilinguals are a focus of great interest because they can shed light on bilingualism, bilingual deaf education, and sign/speech interpreting. Up to now, we have seen that bimodal bilinguals activate both their sign language and their spoken languages simultaneously. They show influences from one to the other language through language synthesis processes. Such influences may happen in different ways. For native-signing Kodas and Codas, as well as for native signing deaf children with cochlear implants, these different ways of synthesizing both languages take place naturally and often subconsciously. We have also seen that Kodas and native signing deaf children with cochlear implants develop both languages on par with monolinguals. They also use the same language synthesis resources available for Coda adults. However, young children are still adjusting the timing of their languages in blending contexts. In general, language synthesis accounts for all the code mixing analyzed in the research presented here, that is, code switching, code blending, partial blending, and utterances produced with characteristics from the other language. This is possible due to dual activation of both languages and the fact that bilingual derivations take place in a way that observes features of both languages. The result is a single derivation at the phonological level, where phonological material from both languages may be inserted when they are congruent.

Sign language interpreters, both Codas and non-Codas, can take advantage of both languages depending of sociolinguistic context. They may learn to use the other language to clarify meaning in the target language, for example, when they mouth words in English while signing. This skill may be harder for interpreters, even more for Codas, since they produce both languages simultaneously in several contexts. Understanding how synthesis implies more or less effort to inhibit or produce one language or the other will benefit sign language interpreter training on how to control the use of both languages in the most appropriate manner, depending on the situation. Continuing research will help us to better understand all the implications of the language synthesis model for bimodal bilinguals and how these may apply or impact linguistic theory, as well as linguistic applications, such as bilingual deaf education and sign language interpretation programs.

Acknowledgments

We give warm thanks to the bimodal bilingual children and their families who participated in our research, and to our research assistants and collaborators. We are also grateful for financial support from the Gallaudet Research Institute; CNPQ (Brazilian National Council of Technological and Scientific Development) grants 200031/2009-0 and 470111/2007-0; and award number R01DC009263 from the National Institutes of Health (National Institute on Deafness and Other Communication Disorders). This content is solely the responsibility of the authors and does not necessarily represent the official views of the NIDCD or the NIH.

Notes

1. The formatting used in the examples given by Petitto et al. does not permit a precise interpretation of the relative timing of signs and spoken words.
2. While Petitto et al. (2001) and Emmorey, Borinstein, et al. (2008) do not explicitly state that they required phonation as a criterion for code blending, this fact can be inferred by their reference to English or French code-blended content "speech."
3. Cochlear implants are often regarded as a major threat to the future existence of the Deaf community and, as such, are a very sensitive topic of discussion. A relatively small number of Deaf parents have opted for cochlear implants for their Deaf children for various, personal reasons, but they are similar in one important respect: They are culturally Deaf and are thus committed to signing ASL with their children, in the hope that they will develop as bimodal bilinguals.

References

Baker, A., & Van den Bogaerde, B. (2008). Code-mixing in signs and words in input to and output from children. In C. Plaza Pust & E. Morales Lopez (Eds.), *Sign bilingualism: Language development, interaction, and maintenance in sign language contact situations* (pp. 1–28). Amsterdam, The Netherlands: John Benjamins.

Baker, A., & Van den Bogaerde, B. (2014). KODAs: A special form of bilingualism. In D. Quinto-Pozos (Ed.), *Multilingual aspects of signed language communication and disorder* (pp. 211–234). Bristol, UK: Multilingual Matters.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19*, 290–303.

Bishop, M. (2010). Happen can't hear: An analysis of code-blends in hearing, native signers of American Sign Language. *Sign Language Studies, 11*, 205–240.

Bishop, M., & Hicks, S. (2005). Orange eyes: Bimodal bilingualism in hearing adults from deaf families. *Sign Language Studies, 5*, 188–230.

Carter, A. K., Dillon, C. M., & Pisoni, D. B. (2002). Imitation of nonwords by hearing impaired children with cochlear implants: Suprasegmental analyses. *Clinical Linguistics and Phonetics, 16*, 619–638.

Casey, S., & Emmorey, K. (2009). Co-speech gesture in bimodal bilinguals. *Language and Cognitive Processes, 24*, 290–312.

Chen Pichler, D., Hochgesang, J., Lillo-Martin, D., & Quadros, R. M. (2010). Conventions for sign and speech transcription in child bimodal bilingual corpora. *Language, Interaction and Acquisition, 1*, 11–40.

Chen Pichler, D., Lee, J., & Lillo-Martin, D. (2014). Language development in ASL-English bimodal bilinguals. In D. Quinto-Pozos (Ed.), *Multilingual aspects of signed language communication and disorder* (pp. 235–260). Bristol, UK: Multilingual Matters.

Chen Pichler, D., Quadros, R. M. & Lillo-Martin, D. (2014, June). *Constraints on code-blending in bimodal bilingual development.* Presented at Formal and Experimental Advances in Sign Language Theory (FEAST) 2014, Venice, Italy.

Chomsky, N. (1995). *The minimalist program.* Cambridge, MA: MIT Press.

Cruz, C. R., Kozak, L. V., Pizzio, A. L., Quadros, R. M., & Chen Pichler, D. (2014). Phonological memory and phonological acquisition in bimodal bilingual children. In W. Orman & M. J. Valleau (Eds.), *Proceedings of the 38th Annual Boston University Conference on Language Development* (pp. 103–115). Somerville, MA: Cascadilla Press.

Davidson, K., Lillo-Martin, D., & Chen Picher, D. (2014). Spoken English language measures of native signing children with cochlear implants. *Journal of Deaf Studies and Deaf Education, 19*, 238–250.

Davis, J. (2003). Cross-linguistic strategies used by interpreters. *RID Journal of Interpretation*, 95–128.

Den Dikken, M. (2011). *The distributed morphology of code-switching.* Paper presented at the UIC Bilingualism Forum, University of Illinois, Champagne-Urbana, April 14-15, 2011.

Donati, C., & Branchini, C. (2013). Challenging linearization: Simultaneous mixing in the production of bimodal bilinguals. In T. Biberauer & I. Roberts (Eds.), *Challenges to linearization* (pp. 93–128). Berlin, Germany: Mouton De Gruyter.

Emmorey, K., Borinstein, H. S., Thompson, R., & Gollan, T. H. (2008). Bimodal bilingualism. *Bilingualism: Language and Cognition, 11*, 43–61.

Emmorey, K., Luk, G., Pyers, J. E., & Bialystok, E. (2008). The source of enhanced cognitive control in bilinguals: Evidence from bimodal bilinguals. *Psychological Science, 19*, 1201–1206.

Emmorey, K., Petrich, J. A. F., & Gollan, T. H. (2013). Bimodal bilingualism and the frequency-lag hypothesis. *Journal of Deaf Studies and Deaf Education, 18*, 1–11.

Enns, C. J., & Herman, R. C. (2011). Adapting the assessing British Sign Language development: Receptive Skills Test into American Sign Language. *Journal of Deaf Studies and Deaf Education, 16*, 362–374.

Fung, C. (2012). *Code-blending in early Hong Kong Sign Language: A case study.* Unpublished Master's thesis, The Chinese University of Hong Kong.

Giezen, M. R., Baker, A. E., & Escudero, P. (2014). Relationships between spoken word and sign processing in children with cochlear implants. *Journal of Deaf studies and Deaf Education, 19*, 107–125.

González-Vilbazo, K., & López, L. (2011). Some properties of light verbs in code-switching. *Lingua, 121*, 832–850.

Gumperz, J., & Toribio, A. J. (1999). Codeswitching. In F. Keil & R. Wilson (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 118–119). Cambridge, MA: MIT Press.

Halle, M., & Marantz, A. (1993). Distributed morphology and the pieces of inflection. In K. Hale & S. J. Keyser (Eds.), *The view from Building 20: Essays in honor of Sylvain Bromberger* (pp. 111–176). Cambridge, MA: MIT Press.

Hasanzadeh, S. (2012). Outcomes of cochlear implantation in deaf children of deaf parents: Comparative study. *Journal of Laryngology and Otology, 126*, 989–994.

Kanto, L., Huttunen, K., & Laakso, M. L. (2013). Relationship between the linguistic environments and early bilingual language development of hearing children in Deaf-parented families. *Journal of Deaf Studies and Deaf Education, 18*, 242–260.

Kita, S., & Özyürek, A. (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal? Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language, 48*, 16–32.

Koulidobrova, E. (2013). Influence uninhibited: Null subjects in the speech of ASL-English bilinguals. In S. Stavrakaki, M. Lalioti, & P. Konstantinopoulou (Eds.), *Advances in language acquisition* (pp. 346–355). Newcastle upon Tyne, UK: Cambridge Scholars Press.

Kozak, L. V., Chen Pichler, D., Quadros, R. M., Cruz, C., & Pizzio, A. L. (2013). Pseudoword/sign repetition performance across bimodal bilinguals from the US and Brazil: A comparative analysis. Paper presented at the *11th Conference on Theoretical Issues in Sign Language Research (TISLR11)*, London, 10–13 July, 2013.

Lillo-Martin, D., Quadros, R. M., Koulidobrova, H., & Chen Pichler, D. (2010). Bimodal bilingual cross-language influence in unexpected domains. In J. Costa, A. Castro, M. Lobo & F. Pratas (Eds.), *Language acquisition and development* (pp. 264–275). Newcastle upon Tyne, UK: Cambridge Scholars Press.

Lillo-Martin, D., Koulidobrova, H., Quadros, R. M., & Chen Pichler, D. (2012). Bilingual language synthesis: Evidence from WH-questions in bimodal bilinguals. In A. K. Biller, E. Y. Chung, & A. E. Kimball (Eds.), *Proceedings of the 36th Annual Boston University Conference on Language Development* (pp. 302–314). Somerville, MA: Cascadilla Press.

Lillo-Martin, D., Quadros, R. M., Chen Pichler, D., & Fieldsteel, Z. (2014). Language choice in bimodal bilingual development. *Frontiers in Psychology, 5*, 1163.

LilloMartin, D., Berk, S., HopewellAlbert, C., Quadros, R. M. (2015) MLU and sign language development. Paper presented at the 2nd International Congress on Sign Language Acquisition, Amsterdam, The Netherlands, July 1-3, 2015.

MacSwan, J. (2000). The architecture of the bilingual language faculty: Evidence from intrasentential code switching. *Bilingualism: Language and Cognition, 3*, 37–54.

MacSwan, J. (2005). Codeswitching and generative grammar. *Bilingualism: Language and Cognition, 8*, 1–22.

Mallory, B.L., Zingle, H.W., & Schein, J.D. (1993). Intergenerational communication modes in deaf-parented families. *Sign Language Studies, 78*, 73–92.

Markman, E. (1990). Constraints children place on word learning. *Cognitive Science, 14*, 154–173.

Metzger, M., & Quadros, R. M. (2012). Cognitive control in intermodal bilingual interpreters. In R. M. Quadros, E. Fleetwood, & M. Metzger (Eds.), *Signed language interpreting in Brazil* (pp. 43–56). Washington, DC: Gallaudet University Press.

Myers-Scotton, C. (1997). *Dueling languages: Grammatical structure in codeswitching* (2nd ed.). Oxford, UK: Clarendon Press.

Nicholas, J. G., & Geers, A. E. (2008). Expected test scores for preschoolers with a cochlear implant who use spoken language. *American Journal of Speech-Language Pathology/American Speech-Language-Hearing Association, 17*, 121–138.

Nunes, J., & Quadros, R. M. (2007). Phonetic realization of multiple copies in Brazilian Sign Language. In J.

Quer (Ed.), *Signs of the time* (pp. 179–192). Hamburg, Germany: Signum.

Peterson, N. R., Pisoni, D. B., & Miyamoto, R. T. (2010). Cochlear implants and spoken language processing abilities: Review and assessment of the literature. *Restorative Neurology and Neuroscience, 28*, 237–250.

Petitto, L. A., Katerelos, M., Levi, B., Gauna, K., Tetrault, K., & Ferraro, V. (2001). Bilingual signed and spoken language acquisition from birth: Implications for the mechanisms underlying early bilingual language acquisition. *Journal of Child Language, 28*, 453–496.

Petronio, K., & Lillo-Martin, D. (1997). WH-movement and the position of Spec-CP: Evidence from American Sign Language. *Language, 73*, 18–57.

Pyers, J., & Emmorey, K. (2008). The face of bimodal bilingualism: Grammatical markers in American Sign Language are produced when bilinguals speak to English monolinguals. *Psychological Science, 19*, 531–535.

Quadros, R. M., Chen Pichler, D., & Lillo-Martin, D. (2014, July). Code-blending in bimodal bilingual development. Paper presented at the 6th Conference of the International Society for Gesture Studies (ISGS), San Diego, CA.

Quadros, R. M., Chen Pichler, D., Lillo-Martin, D., Cruz, C. R., Kozak, V. L., Palmer, J. L., . . . Reynolds, W. (2015). Methods in bimodal bilingualism research: Experimental studies. In E. Orfanidou, B. Woll, & G. Morgan (Eds.), *The Blackwell guide to research methods in sign language studies* (pp. 250–280). Hoboken, NJ: Wiley-Blackwell.

Quadros, R. M., Lillo-Martin, D., & Chen Pichler, D. (2013). Early effects of bilingualism on WH-question structures: Insight from sign-speech bilingualism. In S. Stavrakaki, M. Lalioti, & P. Konstantinopoulou (Eds.), *Advances in language acquisition* (pp. 300–308). Newcastle upon Tyne, UK: Cambridge Scholars Press.

Rinaldi, P., & Caselli, M. C. (2014). Language development in a bimodal bilingual child with cochlear implant: A longitudinal study. *Bilingualism: Language and Cognition, 17*, 798–809.

Santos, F. H., & Bueno, O. F. (2003). A validation of the Brazilian children's test of pseudoword repetition in Portuguese speakers aged 4 to 10 years. *Brazilian Journal of Medical and Biological research, 36*, 1533–1547.

Siple, L. (1995). *The use of addition in sign language transliteration*. Unpublished Ph.D. dissertation, University of New York, Buffalo.

Van den Bogaerde, B. (2000). *Input and interaction in deaf families*. Utrecht, the Netherlands: LOT Publications.

Van den Bogaerde, B., & Baker, A. (2005). Code mixing in mother-child interaction in Deaf families. *Sign Language and Linguistics, 8*, 153–176.

Van den Bogaerde, B., & Baker, A. (2008). Bimodal language acquisition in KODAs (kids of deaf adults). In M. Bishop & S. L. Hicks (Eds.), *Hearing, mother-father deaf: Hearing people in deaf families* (pp. 99–131). Washington, DC: Gallaudet University Press.

Volterra, V., & Taeschner, T. (1978). The acquisition and development of language by bilingual children. *Journal of Child Language, 5*, 311–326.

Walker, E., & Tomblin, J. B. (2014). The influence of communication mode on language development in children with cochlear implants. In M. Marschark, G. Tang, & H. Knoors (Eds.), *Bilingualism and bilingual deaf education* (pp. 134–151). New York, NY: Oxford University Press.

Wiefferink, C., Spaai, G., Uilenburg, N., Vermeij, B., & De Raeve, L. (2008). Influence of linguistic environment on children's language development: Flemish versus Dutch children. *Deafness and Education International, 10*(4), 226–243.

Winston, E. A. (1989). Languages in contact: Code mixing and interpreting. In D. Hammond (Ed.), *Proceedings of the 30th Annual Conference of the American Translators Association* (pp. 219–223). Medford, NJ: Learned Information.

Yoshinaga-Itano, C., Baca, R. L., & Sedey, A. L. (2010). Describing the trajectory of language development in the presence of severe-to-profound hearing loss: A closer look at children with cochlear implants versus hearing aids. *Otology and Neurotology, 31*, 1268–1274.