English Article Use in Bimodal Bilingual Children with Cochlear Implants: Effects of Language Transfer and Early Language Exposure

Corina Goodwin, Kathryn Davidson, and Diane Lillo-Martin

1. Introduction

Children all over the world successfully acquire two or more languages with appropriate input. Children who are born with typical hearing into households where a sign language is the home language (because one or both parents are Deaf signers; these children are known as Kodas) are no different – they can successfully acquire both a spoken language and a sign language and become *bimodal bilinguals* (Chen Pichler, Lee & Lillo-Martin, 2014; Quadros, Lillo-Martin & Chen Pichler, 2016). Despite this, bilingualism is generally discouraged for deaf children who obtain cochlear implants (CIs) and are subsequently trained in a spoken language (Teschendorf, Janeschik, Bagus, Lang & Arweiler-Harbeck, 2011; Bunta & Douglas, 2013). Parents are often advised not to use a sign language with their deaf children who have (or will have) a CI, because of fears that decreased time spent in speech training will lead to decreased performance with spoken language (Humphries et al., 2012; Mauldin, 2012). However, such fears are based on very little evidence, especially from children whose input to a sign language starts at birth and comes from fluent signers – such as deaf children from deaf, signing parents, who receive cochlear implants (whom we will refer to as DDCIs). In this paper, we report on a study of the development of English articles by DDCIs, and compare them to both Kodas and monolingual English-speaking children. Our finding,

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that DDCIs do not differ from Kodas or monolinguals, can be seen as an indication that time spent with a sign language does not necessarily lead to difficulties in the development of spoken language; further research is planned to see whether similar results are found with children whose sign input is different (i.e., from hearing parents learning to sign along with their child).

We start by providing some necessary background information on bimodal bilingualism, language development in children with CIs, and previous research on the development of English articles. We then turn to a description of our study and discussion of its results.

2. Background

Bimodal bilinguals know languages in two different modalities – a sign language and a spoken language. Research with adults (Emmorey, Borinstein, Thompson & Gollan, 2008; Emmorey, Giezen & Gollan, 2016) and children (van den Bogaerde & Baker, 2008) has found many similarities with unimodal bilingualism. For both groups, even with high fluency in both languages, bilingual effects can be observed; for example, there is psycholinguistic evidence that both languages are always active for bimodal bilinguals as well as unimodal bilinguals. One important difference is that bimodal bilinguals are much less likely than unimodal bilinguals to use code-switching; instead, they produce code-blending, the simultaneous production of (parts of) a proposition in both sign and speech (Emmorey et al., 2008; Quadros et al., 2016). The relevance of code-blending to the issues of the current paper will be discussed briefly below.

A cochlear implant is a permanent electronic device implanted surgically, intended to provide hearing for those who are deaf. It should be noted that the quality of sound is different from acoustic hearing, but with training many CI recipients are able to hear, understand, and produce speech. Typically, deaf children who receive a CI have hearing parents who did not know any sign language before their child was born, and frequently these parents are advised not to use sign language with their implanted children (Humphries et al., 2012; Mauldin, 2012). Outcomes in spoken language development among these children are quite variable. While some children do achieve age-appropriate grammatical use, many lag behind their peers with typical hearing and there is much wider variability in test scores than for hearing children (Niparko et al., 2010; Peterson et al., 2010). Understanding factors that lead to more or less success with spoken language is a matter of current research. Similarly, relations between language and cognitive or social-emotional development are now under study (Beer et al., 2014; Hall, Eigsti, Bortfeld & Lillo-Martin, 2017; Wiefferink et al., 2013).

One clue to understanding the variability associated with outcomes for CI users is to control for the early period of language deprivation by studying children who have been exposed to an accessible sign language from birth (DDCI). If receiving linguistic input in this early period is crucial, then signing

children might perform better on tests of spoken language. Although such work is rare and the number of participants is small, evidence consistent with this conjecture is emerging (Cruz et al., 2014; Davidson, Lillo-Martin & Chen Pichler, 2014; also Hassanzadeh, 2012 on children in Iran).

Our current study takes this approach with a focus on the acquisition of English articles (*the, a(n)).* Articles are of particular interest because they are prosodically light, and even hearing monolingual English-speaking children omit articles in unstressed contexts (Demuth & McCullough, 2009). Thus, children with CIs might face perceptual challenges with articles. Furthermore, if children exposed to ASL might transfer their knowledge of that language while acquiring English, this could lead to problems, since ASL does not require articles as English does (Koulidobrova, 2012).

For hearing monolingual English-speaking children, articles are produced as early as 1;04, but they are commonly omitted in required contexts for several years. It has been argued that omission patterns may be at least partially determined by prosodic factors (Brown, 1973; Demuth & McCullough, 2009; Kupisch et al., 2009). Detailed information about rates of omission in the spontaneous production of children over age 3 was not found, so we included monolingual comparison data in the study described below. In studies using controlled experiments, problems with pragmatically appropriate use of definite vs. indefinite articles is seen as late as age 4 (Ionin et al., 2004; Schaeffer & Matthewson, 2005).

Previous studies with bilingual children have indicated the possibility for cross-language influence in the use of articles (Kupisch, 2007). Under such influence, children might use the structure that is appropriate for one of their languages, even if they are using the words from the other. So, for example, articles might be omitted where they are required in English; or articles might be used in contexts appropriate for one language but not the other (e.g., with proper names). In cases where one language lacks a morphological realization of articles and the other requires them (as in the ASL/English case), an extended period of article omission and/or use of pragmatically inappropriate articles has been observed (Mede & Gürel, 2010; Zdorenko & Paradis, 2008).

With this background in place, we turn to our study. We examined the use of English articles in longitudinal spontaneous production data from DDCIs and Kodas. As a comparison, we similarly coded the same kind of production data from hearing monolingual English-speaking children. And, to examine how potential transfer effects in the ASL/English pair compares to unimodal bilinguals, we coded similar data from Cantonese/English bilingual children, because Cantonese, like ASL, does not have required articles.

3. Method

3.1. Participants

English article use during spontaneous play sessions was analyzed for 3 hearing bimodal bilinguals (Kodas; 3 males) and 3 Deaf children with cochlear

implants born to Deaf parents (DDCIs; 2 males), with comparison data from 19 monolingual English-speaking children (16 males), and 2 Cantonese-English bilinguals (1 male). The ASL-English bilingual transcripts were drawn from a larger study of bimodal bilinguals (Chen Pichler, Hochgesang, Lillo-Martin, Quadros & Reynolds, 2016; Quadros, Lillo-Martin & Chen Pichler, 2014). Transcripts for the monolingual English and unimodal bilingual participants were drawn from the Childes database (Braunwald, 1997; MacWhinney, 2000; Nicholas & Geers, 1997; Song et al., 2013; Yip & Matthews, 2000).

All six bimodal bilingual children were recorded within the US in language targeted sessions (either ASL sessions with a Deaf parent or researcher, or English sessions with a hearing, English-speaking researcher or parent). The monolingual English data were collected at various sites across the US, while the Cantonese-English data were recorded in Hong Kong. The bimodal bilinguals had at least one Deaf, signing parent and were exposed to American Sign Language from birth and English either from birth or after cochlear implantation. All of the Deaf children received their first cochlear implant by the age of 1;06. Both groups of bimodal bilinguals are of relatively high SES when mother's education is considered as a proxy measure: all mothers have at least a Bachelor's degree. For all four groups, the children were aged 3;00-6;06 in the sessions used for this study.

3.2. Method

One hundred utterances from each transcript were analyzed. All noun phrases were coded as either requiring an article or not based on the adult grammar, using full interpretation of fragments. When a child did not produce an article in an obligatory context, this was coded as an article omission. If a child produced an article, but the form was incorrect given the context (e.g., definite instead of indefinite), this was coded as pragmatically inappropriate. Decisions about pragmatic appropriateness were only possible when videos of the play sessions were available; therefore, these results are only presented for the bimodal bilinguals, whose data was always analyzed alongside video.

A total of 65 sessions were coded: 20 for kodas, 17 for DDCIs, 24 for monolinguals, and 4 for unimodal bilinguals. For bimodal bilinguals, these included only English-target sessions. Table 1 shows the number of sessions from each group at each age interval. Note that for DDCI, the ages are chronological, not 'hearing age' which discounts time pre-implant. Six additional ASL-target sessions were analyzed, coming from one koda and one DDCI at each of the first three age intervals. In these sessions, the children interacted with a Deaf, signing researcher or parent and most of their speech was produced in code-blended utterances containing both signs and speech.

Table 1
Number of Sessions for Each Group at Each Age Interval

Age (Range)	Koda	DDCI	Monolingual	Unimodal Bilingual
3;00 (3;00-3;03)	6	2	6	1
3;06 (3;04-3;09)	5	3	6	1
4;00 (3;10-4;03)	4	2	6	2
4;06 (4;04-4;09)	-	1	6	-
5;00 (4;10-5;03)	3	5	-	-
5;06 (5;04-5;09)	1	3	-	-
6;00 (5;10-6;03)	1	1	-	-

4. Results

Table 2 compares article omission across English-target sessions, ASL-target sessions and Cantonese-English bilinguals. Although data is presented for only one Koda, one DDCI, and two Cantonese-English bilinguals, a clear pattern emerges. For the bimodal bilinguals, English articles are much more likely to be omitted in ASL-target sessions than in English target sessions, showing an effect of linguistic environment. In ASL-target sessions, spoken English may be more heavily ASL-influenced; it is also more likely to be produced in code-blending, which also may lead to more ASL influence (Quadros et al., 2016). See Petroj (2017) for discussion of the use of articles by bimodal bilinguals in whispered code-blending of ASL-target sessions. In addition, the Cantonese-English bilinguals show more omissions than do the bimodal bilinguals in English- or ASL-target sessions. This could also be an effect of linguistic environment considering that these children were being raised in a society in which Cantonese was the dominant community language (i.e., Hong Kong). While this effect of the environment is of some interest (cf. Paradis & Nicoladis, 2007), in order to focus the present paper on grammatical knowledge all subsequent data presented will consider English-target sessions exclusively.

Table 2
Percent of Obligatory Articles Omitted in Spoken English

Age	English-target Koda	English-target DDCI	Cantonese Bilingual	ASL-target Koda	ASL-target DDCI
3;00	21	3	23	80	49
3;06	0	18	35	80	43
4;00	3	0	34	30	33

Figure 1 below presents all data from all monolingual and hearing bimodal bilingual participants as groups, with the DDCI data broken down by individual participants. There is much overlap between the monolingual English and hearing bilingual data points. Furthermore, the younger DDCI participants' (Eli and Nik) article omission rates generally fall into the range of what was found for the hearing bilinguals. It is more difficult to tell whether the oldest DDCI (Gia) omits articles at rates higher than would be expected for the hearing bilinguals or monolinguals, given that there is little data from these participants at the oldest ages.

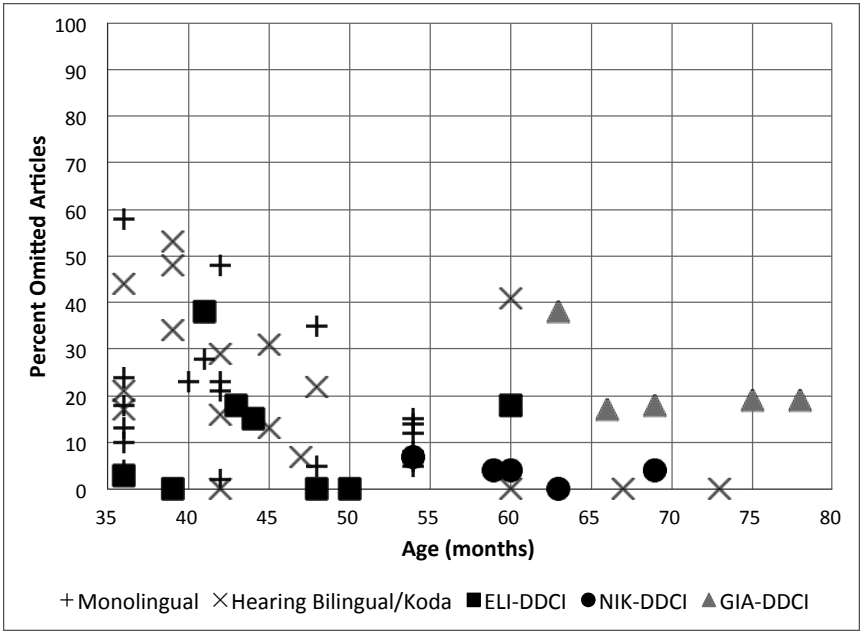

Figure 1
Percent Omitted Articles for Each DDCI Compared to Monolinguals and Kodas

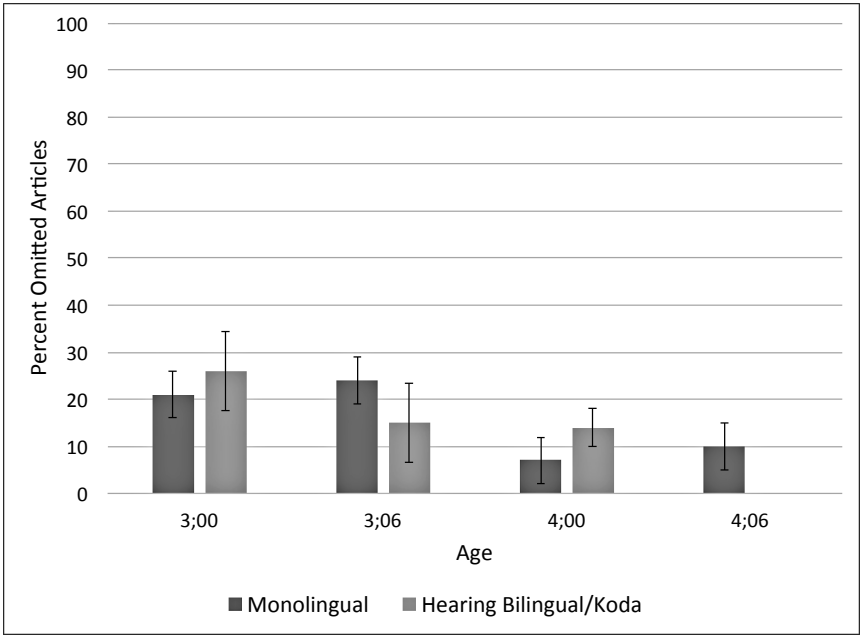

Figure 2
Percent Omitted Articles for Monolinguals and Kodas at Age 3;00, 3;06, 4;00 and 4;06

Figure 2 above compares average article omission rates of monolinguals and hearing bimodal bilinguals at six-month intervals. Summarizing across both groups, omission rates and group variability both decrease with increasing age. Moreover, the bilinguals' performance is better than, or near the monolinguals' at all four age intervals, suggesting little to no cross-language influence on English article acquisition in our subjects.

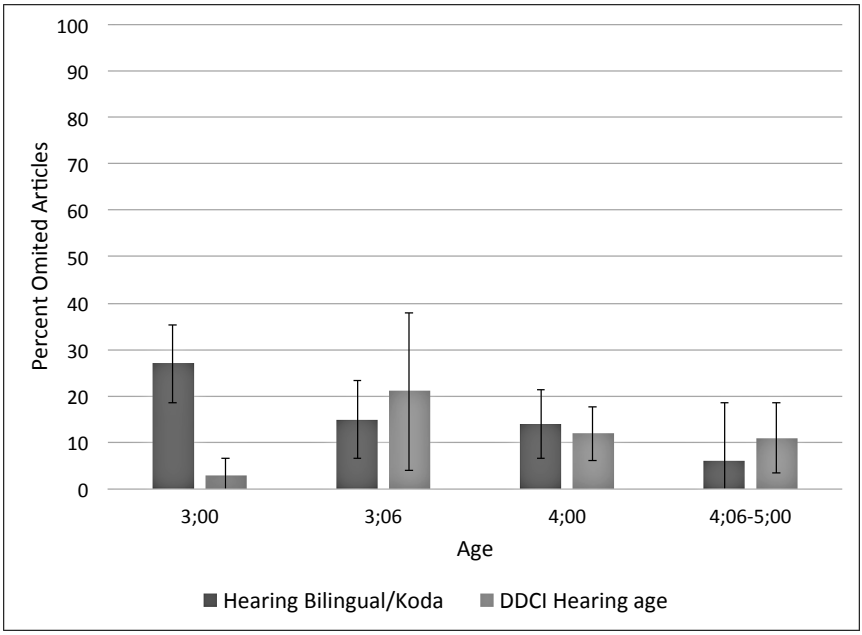

Figure 3
Percent Omitted Articles for Kodas and DDCI by Hearing Age

Because data from the DDCI participants was generally collected at older chronological ages, Figure 3 compares hearing bimodal bilinguals' average article omission rates to that of DDCIs based on their hearing age. Hearing age is the amount of time that has passed since the child received their cochlear implant and represents the length of time they have received spoken English input. As can be seen, omission rates are similar between these two groups between the hearing ages of 3;00 and 5;00. Additionally, Figure 4 below presents the average omission rates for each group at the chronological age of five years. As these two figures demonstrate, there is little to no influence of delayed English input (or electrical/non-acoustic hearing) on article acquisition for the DDCI participants, even with the more stringent chronological age comparison.

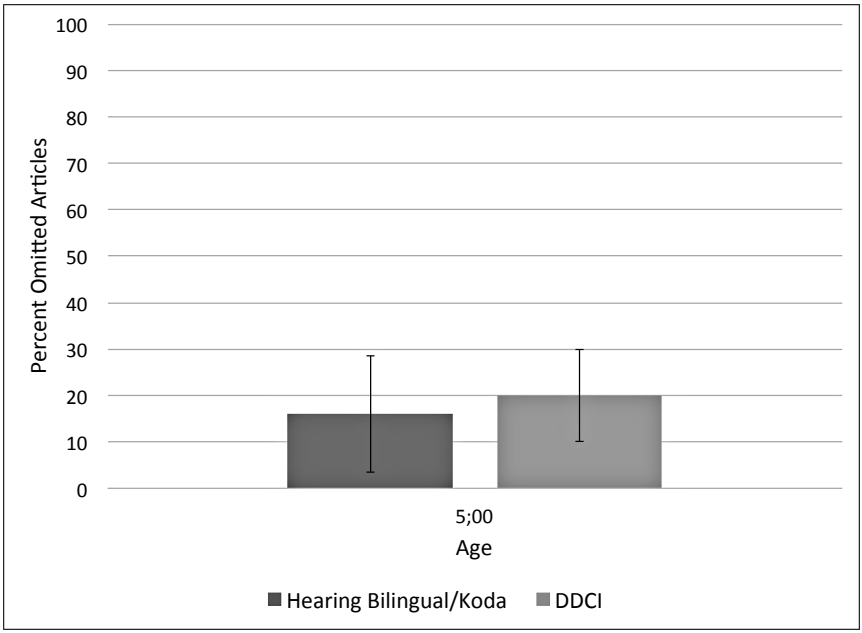

Figure 4
Percent Omitted Articles for Kodas and DDCI at Chronological Age 5;00

Finally, Figure 5 shows the rate of pragmatic errors in the hearing bimodal bilinguals and DDCIs. A pragmatic error is one in which the article the child says is inappropriate for the context, as in the example below. In this example, a birthday cake had not been discussed previously and the child's use of the definite determiner *the* confuses the experimenter.

(Ben 3;00) [lion in context]
BEN: The lion wants to go … and the birthday cake.
He wants to go to the birthday cake.
EXP: The … what? (laughs)
What birthday cake?

Figure 5 shows that all younger children produced pragmatically inappropriate articles, decreasing in frequency with increasing age. As with the article omission rate data presented above, DDCIs performed similarly to hearing bimodal bilinguals.

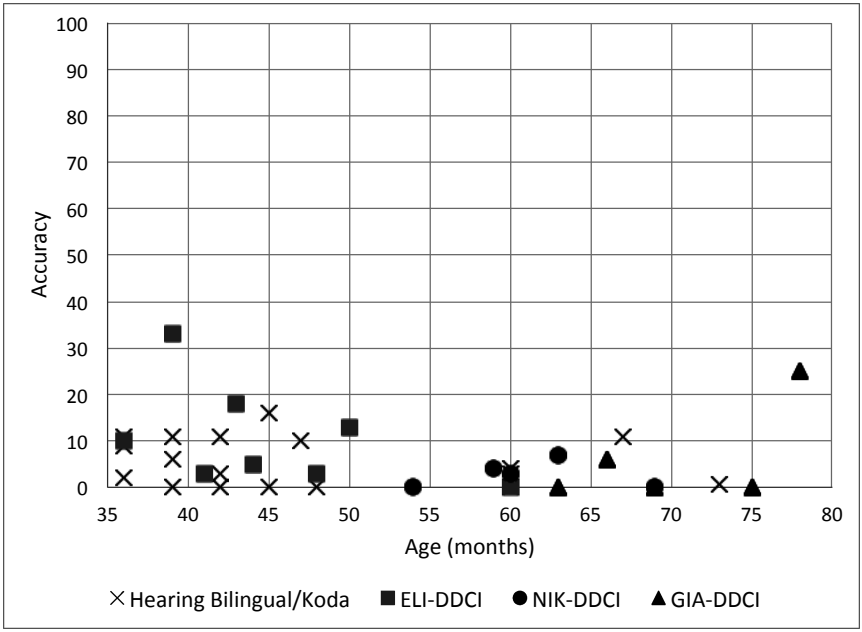

Figure 5
Pragmatic Errors for Kodas and DDCI based on Chronological Age

5. Discussion and Conclusion

To summarize our results: Bimodal bilingual children who use ASL and spoken English, both Kodas and DDCIs, show a degree of omission of obligatory articles in spoken English that is not different from that of hearing monolingual English-speaking children at the same age. Whether measured by hearing age or chronological age, Deaf children with CIs produce English articles at levels of accuracy that increase over time. In addition, errors of pragmatically inappropriate article use are very low in these data.

Although we had anticipated the possibility that influence from ASL might result in higher levels of omission for hearing or deaf bimodal bilinguals, this was not observed. Furthermore, the fact that language exposure is split between ASL and English does not necessarily lead to delays in the use of articles.

We know of no studies of the use of English articles in spontaneous production by non-signing deaf CI users for a direct comparison. However, several studies of spoken language production by deaf CI users have found morphological delays with respect to hearing peers when matched by chronological or hearing age, with some variability across morpheme types (e.g., Guo et al., 2013; Svirsky et al., 2002; Szagun, 2004). Some studies, though not all, have supported the relevance of perceptual salience in accounting for error patterns observed in CI users.

Although the study reported here included a very small number of participants, it lends no support to the idea that exposure to sign language is harmful to spoken language development for deaf children with CIs. In our future work, we hope to study bimodal bilingual development of deaf children with hearing parents who decide to use a sign language, to see whether similar patterns of age-appropriate development are found in that population.

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