Examining the Communication Skills of a Young Cochlear Implant Pioneer

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The purpose of this longitudinal case study was to closely examine one deaf child's experience with a cochlear implant and his speech, language, and communication skills from kindergarten through high school using both developmental and sociocultural frameworks. The target child was one of the first children to receive a cochlear implant in the United States in 1988, when he was 5 years of age. The developmental analysis revealed that prior to receiving a cochlear implant the child demonstrated profound delays in speech and language skill development. His speech and language skills grew slowly during the first 3–4 years following implantation, very rapidly from about 5 through 7 years postimplantation, then slowed to rates that were highly similar to same-age peers with normal hearing. The sociocultural analysis revealed that the child’s communicative competence improved; that he used sign language but use of sign language decreased as his oral communication skills improved; that as his oral communication skills improved, the adults talked and directed the topic of conversation less frequently; and that topics became less concrete and more personal over time. The results of this study indicate that we may learn more about how to support children who use cochlear implants by examining what they are saying as well as how they are saying it.

Cochlear implants offer substantial usable hearing to deaf children and are one of the most important technological breakthroughs in the field of biomedical engineering. Accumulating research on the speech and language skills of children who use cochlear implants has revealed that cochlear implants can have lasting beneficial effects on children’s speech perception, oral language, and literacy development compared to children using conventional hearing aids (Connor & Zwolan, 2004; Geers, 2002; Svirsky, 2001; Tomblin, Barker, Spencer, Zhang, & Gantz, 2005; Tye-Murray, Spencer, & Woodworth, 1995). However, there are substantial individual differences among children who use cochlear implants. Qualitative research methods, including ethnographic studies and case studies, have proven influential with regard to understanding social and cultural influences on the acquisition of language and intervention and on defining communicative competence, for example, with children who are Hispanic or African American (ASHA, 1988). Achieving better understanding of communicative competence in social and cultural spheres is a clear benefit offered by qualitative research and one that can contribute to our understanding of how best to serve children and young adults with cochlear implants as they increasingly enter the mainstream, at school and in society overall. This is the purpose of this case study.

Case studies (Barone, 2003), especially those that use multiple lenses or frameworks, can be particularly revealing (McCartney, 1998). For this reason
I examined one child’s gains in speech and language skills, as measured by formal and informal assessments, as he used his implant over time and then investigated how he used these developing skills by analyzing the content of his conversations with cochlear implant center professionals over the years.

Christopher received a cochlear implant at 5 years of age in 1988. The investigation follows him longitudinally and closely examines his speech and language development, in the context of a large longitudinal study with many children, using developmental and sociocultural frameworks.

Developmental Framework

Within the developmental theoretical framework, assessment assumes that there is a predictable developmental order to language acquisition. The size of children’s vocabulary, length of utterances, syntactic complexity, morphemes used, and pragmatic skills may be compared against a set of benchmarks or norms according to the child’s age (Locke, 1993). Children who demonstrate skills that differ from the norms demonstrate developmental delays. Implicit within the developmental frame is the assumption that the course of language acquisition transcends cultural differences.

Accumulating research on language development with cochlear implants reveals that cochlear implant use may increase the rate of children’s language acquisition (Connor, Craig, Heavener, Raudenbush, & Zwolan, 2006; Miyamoto, Svirsky, & Robbins, 1997). Children using hearing aids appear to develop language skills at half the rate of peers with normal hearing sensitivity (Carney & Moeller, 1998; Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000). But for young implant users, the rate of vocabulary growth parallels that of their peers with normal hearing sensitivity. Still, the children with implants, as a group, are substantially delayed compared with their age peers with normal hearing sensitivity. However, the gap between chronological age and language age, which normally widens over time for many deaf children, on average, remains constant for children who use cochlear implants (Connor et al., 2006; Svirsky et al., 2000).

Sociocultural Analysis

The sociocultural analysis differs from the developmental evaluation because it assesses “children’s discourse to more general interpretive ethnographic accounts of cultural beliefs and practices of the families, social groups, or communities into which the children are socialized” (Schiffelin & Ochs, p. 168, in Crago & Cole, 1991). Language becomes part of a more general theory of socialization (Connor & Rex, in press).

In an assessment of Christopher’s language using a sociocultural frame, his errors of articulation and syntax were of less importance. More important was analyzing the environment in which Christopher was expected to communicate, why he used sign language early on but discontinued its use until high school, issues surrounding his family and school environment that contributed to his success, and so on. The goal of this study was to endeavor to describe the complexity of factors that defined Christopher’s changing speech and language skills and to characterize the elements that may have contributed to his increasing effectiveness as an oral communicator.

Methods

Participants

Christopher was diagnosed with a congenital severe sensorineural hearing loss that progressed until it became profound at the age of 3 years. The etiology of deafness was familial. Preoperative and postimplantation thresholds achieved are depicted in the audiogram provided in Figure 1. He received a cochlear implant (Cochlear Corporation device using the SPEECH processing strategy) at the age of 5 years in 1988 and achieved hearing sensitivity levels that were highly similar to those achieved by other children using cochlear implants. Thresholds typically fall between 20 and 40 dB hearing level across frequencies (Nevins & Chute, 1996). In 1994, he received a new processor (Cochlear Corporation device using the SPEECH processing strategy) at the age of 5 years in 1988 and achieved hearing sensitivity levels that were highly similar to those achieved by other children using cochlear implants. Thresholds typically fall between 20 and 40 dB hearing level across frequencies (Nevins & Chute, 1996). In 1994, he received a new processor with the most current processing strategy (SPECTRA) around the time of his 6-year assessment. Based on parent and clinical report, he was a consistent user of the device.
Christopher grew up in a middle-class neighborhood in a university town in the Midwest. He had been enrolled in special education for deaf children since his hearing loss was diagnosed shortly after birth. Early services were provided in the home. He joined a playgroup when he was 2 years old and started pre-school at 4 years of age. He attended an oral communication public school program that focused on the development of speaking and listening skills. Christopher evidently learned a system of sign language when he attended speech and hearing summer camp, although there is no formal documentation of this. He discussed the camp activities in the 3-, 5-, 6-, and 7-year postimplantation language samples with a great deal of enthusiasm. During the last assessment, for which there were no language samples, he was attending high school, where he received special education services including access to a sign language interpreter, according to his managing audiologist; the specific sign system was unknown.

Although Christopher presents a profile typical of many young implant users, his status as a pioneer user is notable. Only four children had received implants at the university cochlear implant center at the time of his surgery, and the device had not yet been granted approval by the FDA although approval followed shortly thereafter.

Assessments

A formal assessment of Christopher’s speech and language skills was conducted approximately yearly as part of FDA clinical trials and to monitor his speech, language, and audiological status. Such assessments were conducted with all the children who received cochlear implants at the center; thus, Christopher’s results can be compared to assessment results for over 200 children (Connor, Hieber, Arts, & Zwolan, 2000; Connor et al., 2006; Connor & Zwolan, 2004). Assessment results for Christopher were available through 2003 when Christopher was 19 years of age and had used his implant for 14 years. Language samples were collected at all the evaluation sessions through the 7-year postimplantation evaluation. Except for a small set of assessments designated by the FDA clinical trials, the tests administered at the yearly sessions varied according to educational and clinical priorities and Christopher’s age (e.g., assessment of his reading was not conducted prior to the age of 10 years). For this reason, assessment results for some specific measures are missing.

“Intelligibility,” which is how easily a child’s speech is understood by a listener with experience working with deaf children, includes scores from two tests, the McGarr Test of Intelligibility (McGarr, 1983), which was administered as part of the FDA protocol until 1991, and computation of percentage of consonant correct (PCC), which is the number of correctly articulated consonant phonemes on a test of articulation (e.g., Arizona Test of Articulation, Fudala, 1974) divided by the total number of consonant phonemes, and was computed using software (Long & Fey, 1993). PCC is strongly associated with intelligibility and is psychometrically sound (Connor et al., 2000; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997; Shriberg & Kwiatkowski, 1988). Results on the McGarr and PCC are highly similar and appear to assess the same construct, intelligibility (Connor et al., 2000).

“Receptive spoken vocabulary” was assessed using the Peabody Picture Vocabulary Test, both the revised
and third editions (PPVT; Dunn & Dunn, 1981, 1997). Both versions assess receptive vocabulary using a four-choice picture format and have documented reliability and validity. PPVT-R scores were converted to PPVT-3 scores. The original FDA protocol designated that the PPVT be administered using speech alone, no sign language. As such, it might be considered a test of spoken receptive vocabulary. Results are reported as language quotients, which may be interpreted like a standard score with a mean of 100 and a standard deviation of 15. The language quotient is the age equivalent score divided by chronological age times 100. One hundred percent would suggest age appropriate language skills when compared to same-age peers with normal hearing sensitivity (Strong, Clark, & Walden, 1994). Language quotients are used instead of standard scores when children’s raw scores fall below the range of standard score norms provided in the examiners’ manuals.

“Expressive vocabulary” was assessed using the Woodcock–Johnson Tests of Achievement, picture vocabulary subtest (Woodcock & Johnson, 1990). In this test, children name pictures of increasingly unfamiliar objects. Both signed and spoken responses were accepted in this picture-naming task. Language quotients are provided.

“Reading comprehension” was assessed using the Woodcock Reading Mastery Tests-Revised passage comprehension subtest (Woodcock, 1987) or the Woodcock–Johnson Tests of Achievement passage comprehension subtest (Woodcock & Mather, 2001). These tasks are highly similar and use a cloze procedure to assess general reading comprehension. The child is presented passages, which are increasingly complex, and asked to provide the missing word. For example, “The swan is swimming in the ___.” Both spoken and signed responses were accepted. Only responses that were syntactically and semantically meaningful were scored as correct. Language quotients or, when possible, standard scores are reported.

The Videotaping and Transcription of the Language Samples

During each yearly evaluation session, a video-audio-taped language sample was collected using a video camera on a tripod with a lapel or flat microphone. Christopher’s assessment followed center protocol. For younger children, toys or pictures were used to facilitate conversation. With older children the time was typically used to talk about a variety of topics such as family, sports, or, as in Christopher’s case, summer camp. The child directed the topic of conversation, and the goal was to say as little as possible and still keep the conversation going. The language sample conversation typically lasted between 15 and 20 min.

Segments of these language samples were selected for and shown at a cochlear implant symposium that took place in 1993 shortly after Christopher’s 5-year evaluation. Christopher’s mother reviewed the tape and was given a copy. The 6-, 7-, and 8-year evaluation segments were added later, with Christopher’s mother’s permission. Christopher’s language samples were selected because he was considered a typical-to-good implant user and, in retrospect, this was a fair assessment especially given new and improved cochlear implant technology and the increasingly younger ages at which children receive implants (Connor et al., 2006).

The video was transcribed for this study using the Chat protocol of the Child Language Data Exchange System (CHILDES), which is a computerized system for analyzing language samples (MacWhinney, 1994). The utterances were divided into communication units (C-units), which are described by Loban (1976). The C-unit is a complete utterance such as a sentence, including all clauses. However, the utterance is divided at the simple conjunctions and, or, and but if two complete sentences are formed. Thus, the utterance, “I went to the park but I didn’t get to go on the swing” would include two C-units separated at “but.” In this way, the complexity of children’s utterances is not overestimated, which is an important consideration for older children (Nippold, 1988). Sign language transcription was indicated on a separate tier labeled %sig. Sounds not produced were enclosed in parentheses. For example, from the 30-month postimplantation evaluation:

ADU: did you eat at home?
ADU: or did you eat at McDonalds?
ADU: where?
Mean length of C-unit (MLCU) and the number of different words (NDW) were computed using CLAN2 software (MacWhinney, 1994). Children's MLCU increases over time in a predictable manner and so can be compared to scores achieved by typically developing children (Miller, 1981). NDW is the number of words the child uses and may be used as a measure of vocabulary (Hart & Risley, 1995). Complex syntax (SYN) was analyzed using syntactic and morphemic analysis (Miller, 1981), wherein the child is assigned to Brown's Stages I through V based on the morphemes used. Stage I has a predicted chronological age of 19–26 months, Stage II 27–30 months, Stage III 31–34 months, Stage IV 35–38 months, and Stage V 43–48 months. Because the samples were brief, caution should be used in comparing these results with those for children with normal hearing sensitivity.

Qualitative analysis of the language samples, using a sociocultural framework, was accomplished using repeated viewing of the videos and transcripts looking for emerging themes using methods described by Bogdan and Biklen (1998) and Crago and Cole (1991). The focus was on what Christopher was saying and how he was interacting with others around him rather than on his linguistic maturity and intelligibility. Evidence of his attitude toward the cochlear implant and his own deafness was also considered.

Results and Discussion

Developmental Analysis of Assessment Results

Formal and informal assessment results. Results of formal testing (see Table 1) revealed that, after 13 years of implant use and intensive special education services
designed for deaf children, including speech and language therapy, Christopher achieved speech and language skills, falling slightly below average but within normal limits for his age when compared to peers with normal hearing sensitivity. However, his communication skills were well-above expectations when compared to other children with severe to profound sensorineural hearing loss using hearing aids. Moreover, his overall rate of progress was similar to that achieved by other children using cochlear implants at the center and nationwide.

Although progress was fairly steady over the 13-year period, it was not linear (see Table 1 and Figures 2 and 3). Rather, progress appeared to be curvilinear, specifically it had a cubic trend. Christopher’s speech and language skills grew slowly during the first 3–4 years following implantation, very rapidly from about 5 through 7 years postimplantation, and then slowed to rates that were highly similar to same-age peers with normal hearing. This was most evident for speech intelligibility, receptive vocabulary, and reading.

Language sample results. Six language samples progressing over time were used in these analyses. The first sample was collected when Christopher was 4 years 7 months old. He had not yet received the cochlear implant and was using conventional hearing aids as well as a tact-aid (which provided auditory information through vibrators attached to his wrist). The second sample, at the 6-month postimplantation

Figure 2  Speech intelligibility growth (percentage) over time.

(aka activation, initial stimulation, or hookup), was recorded about 1 year later, when Christopher was 5 years 8 months old. He was wearing his cochlear implant. The third language sample was collected when Christopher was 6 years 8 months old. He had used the cochlear implant for about 1 year. The fourth language sample was recorded when Christopher was 7 years 10 months old and had been using the cochlear implant for about 3 years. The fifth language sample was obtained about 2 years later when Christopher was 9 years 11 months old. He had been using his cochlear implant for 5 years. The sixth language sample was recorded when Christopher was 10 years 10 months old. He had used his cochlear implant for 6 years. The seventh and final sample was collected when Christopher was 12 years 2 months old. He had used his cochlear implant for 7 years.

Analysis of the language samples suggested growth similar to that observed on standardized tests, specifically in MLCU and NDW. Further, syntactic analysis indicated growth in the syntactic complexity (SYN) of Christopher’s sentence structure over time. Again, the curvilinear pattern of growth in language skills was apparent in NDW and SYN. There was very little growth initially followed by a burst of growth between
3 and 5 years after he received the implant, followed by slower growth thereafter (Table 2).

Review of the language samples elicited at the 8-year postimplantation evaluation indicated persistent syntactic errors such as deleted infinitive to (“Well I might go __ Camp W...”), deletion of the copula was and the conjunction (“When I __ in sixth grade __ seventh grade”), and deletion of the article a (“So they give me _ better one”). Pragmatic analysis revealed improvement over time in turn taking and better comprehension of his conversation partner’s speech and meaning. He also exhibited an improved ability to stay on the topic. By the 8-year evaluation, at the age of 12 years, Christopher demonstrated fluent conversation skills with significant syntactic errors, functionally intelligible speech, and good receptive and expressive vocabulary skills.

### Qualitative Analysis of Language Samples

Repeated viewings of the videotape revealed four themes: (a) Christopher’s listening and speaking skills improved; (b) Christopher started using sign language and then stopped; (c) as Christopher’s communication skills improved, the adults talked less and directed the topic of conversation less; and (d) as Christopher’s communication skills improved, the topics of conversation became more abstract moving from “here and now” about objects, to events, to about family and friends, and finally to about his cultural identity. The themes are each discussed in more detail below.

### Christopher’s listening and speaking skills improved.

Christopher’s ability to use the auditory information provided by the implant improved steadily over time, as demonstrated in significant improvements in listening and speaking skills. As early as 6 months after activation he used the high-frequency sounds /sh/ and /s/. He responded to his name, even though he had trouble locating the speaker. At the 5-year postimplantation evaluation, Christopher failed to respond to the clinicians’ questions. It was not clear, however, whether the breakdown was in his auditory perception or whether the vocabulary and syntax were too complex for him to understand. By the 6-year postactivation evaluation, when Christopher was almost 11 years old, he was hearing and understanding spoken language well enough to carry on a conversation, albeit in a quiet room with only one speaker.

Christopher’s ability to talk, using spoken English, improved over time and appeared to keep pace with improvements in his listening skills. Before he received the implant, he struggled to produce sounds, used sound effects rather than words, imitated rather than initiated words, and used non-English phonemes such as imploded stops. He still used non-English phonemes at the 6-month postactivation evaluation, but these were not apparent thereafter. At the 1-year evaluation, Christopher started talking about a past event, lunch at McDonalds, rather than imitating or talking about the toy he held in his hand. His speech was still very difficult to understand except for isolated words, and listeners appeared to rely on his sign language to understand what he was saying. Talking about McDonalds was a good topic and one Christopher clearly enjoyed. At the 3-year evaluation, Christopher was talking more but was still very difficult to understand.

### Table 2

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Age at evaluation (months)</th>
<th>MLCU Achieved</th>
<th>MLCU Expected</th>
<th>NDWa Achieved</th>
<th>NDWa Expected</th>
<th>SYN Achieved</th>
<th>SYN Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preimplant</td>
<td>55</td>
<td>2.0</td>
<td>5.6</td>
<td>2</td>
<td>I</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>6 months</td>
<td>68</td>
<td>2.4</td>
<td>6.0</td>
<td>11</td>
<td>I</td>
<td>V+</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td>80</td>
<td>2.1 (&gt;6.0)</td>
<td></td>
<td>20</td>
<td>I</td>
<td>V+</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>94</td>
<td>3.6</td>
<td></td>
<td>30</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 years</td>
<td>119</td>
<td>4.0</td>
<td></td>
<td>51</td>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 years</td>
<td>134</td>
<td>5.6</td>
<td></td>
<td>81</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 years</td>
<td>146</td>
<td>5.0</td>
<td></td>
<td>95</td>
<td>V+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aOnly intelligible words were included in the calculation.*
His utterances resembled sentences rather than single words and abbreviated phrases. Most of the words were unintelligible and may have been jargon. Christopher may have been using nonsense words as place markers so that the sentences resembled English sentence structure.

At the 5-year evaluation, Christopher was easy to understand within context. Out of context, his speech was more difficult to comprehend because there were still notable articulation errors. By the 6- and 7-year evaluations, Christopher was a fluent talker experimenting with advanced discourse using words like “neither,” “so,” and “because.” His sentences were long and fairly complex, although there were errors in syntax, for example, “They won’t work well so they give me better one.”

Christopher started using formal sign language and then stopped. Christopher’s use of gesture was apparent in all the language samples. However, at the 1-year evaluation, when he was almost 7 years of age, he used sign language during the language sample. His mother, who was in the room but off camera, could understand his signs and usually repeated what he signed rather than what he said. The first signs were simple, concrete, and discrete with no hint of American Sign Language (ASL) or Signed English grammar. Christopher repeated the sign for “pop” several times as he said the word and may have meant the plural form. Also, he rocked the “green” sign repeatedly, a babbling-like action that has been observed in very young native sign language users (Petitto & Marentette, 1991). At the 3-year evaluation, Christopher was almost 8 years old and his sign language skills had progressed. He was using ASL grammar with no trace of the babbling and the isolated signs noted previously. The clinician seemed to be relying on his signs to understand what Christopher was saying. Unfortunately, we cannot tell if she was signing back to him or the system she was using because she was off camera.

At the 5-year evaluation, Christopher was almost 10 years old and did not use signs during the evaluation. Christopher may not have realized that the clinician (the author) knew Signed English because he was meeting her for the first time. At the 6-year evaluation, traces of ASL were apparent in his gestures and he used ASL when he described riding horses. At the 7-year evaluation, when Christopher was 12 years old, he used small telegraphic signs to highlight certain statements but did not use specific signs in any true communicative way. It is interesting to note that small telegraphic signs may be used when two fluent speakers talk to each other. It may be that Christopher was bilingual and switching to English when he was at the clinic where, he knew, the goal was to talk in spoken English.

As Christopher’s communication skills improved, the adults talked and directed the topic of conversation less frequently. The adults in the video directed and controlled the topic of conversation until the 1-year postimplantation evaluation, when Christopher was first observed to use formal signs. At the preoperative evaluation he seemed anxious to please in a communication task that was not spontaneous or child driven. At the 6-month postimplantation evaluation, Christopher started to take some control of the topic but still followed the adults’ lead, imitating them and then talking about the bear’s telephone, which he was holding in his hands. This can be seen in the dialogue below. Phonemes in parentheses were not produced.

<table>
<thead>
<tr>
<th>ADU:</th>
<th>What’s on the back [of the bear]?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI:</td>
<td>(th)e ba(ck).</td>
</tr>
<tr>
<td>CHI:</td>
<td>(te(l)ephone</td>
</tr>
</tbody>
</table>

By the 1-year evaluation, the adults were responding with “ah” and repeating Christopher’s words. At the 5-year evaluation (Christopher was almost 7 years old), his conversation skills were emerging and Christopher controlled the pace and topics by controlling photographs he was sharing with the clinician. He ignored questions he did not want to answer, even though he had seemingly heard them, by moving on to a new photograph, “an(d), uh, I have, uh, more pictures.” His conversation skills and understanding of the rules of casual conversation continually improved over time. It is interesting to note that the clinician’s “well,” uttered at the end of the sample from the 7-year evaluation, carried a real note of regret that the break time and conversation needed to end. Christopher’s grasp of the rules was evident in this sample from the 7-year interval evaluation (Christopher
is 12 years old. Words in <> were spoken but not counted in the MLCU computations. The [/] indicates a repetition; the [//] indicates rephrasing or reformulation of a word or phrase.

ADU: Did you go to camp this summer?
CHI: Yeah this summer but <not>[/] not 1995, 96 summer.
ADU: You’ll go next summer then?
CHI: <1 want> [///] well I might go Camp W—because I’m going to be thirteen and <camp> [///] Only fourteen can go to camp.

As Christopher’s communication skills improved, the topics of conversation became more personal. The topics of conversation moved from the here and now about pictures and objects, to about family and friends, and finally to about Christopher’s cultural identity. He progressed from making a hammering noise in response to a picture of a hammer at the age of 5 years, to, at the age of 12 years and after using the implant for 7 years, expressing an affiliation with the children and adults who were deaf and hard of hearing. When Christopher controlled the topic of conversation, starting with the 5-year evaluation when he was almost 10 years, he talked about his family and friends. “And my mom and my teacher [Mrs.] B were talking about horses.”

At the 6-year evaluation he related a well-developed story about falling off his horse after his friend, J, “[ran] and scream and that scare the horse.” In the final segment, which is presented below, when Christopher was 12 years old and had used the implant for 7 years, he talked about Miss America and his friend. In this discussion, he revealed that he identified himself as part of a group in which he was proud to be a member, “Deaf and hearing loss.” Christopher talked about his friend’s hearing loss, how he lost his hearing, and that he used hearing aids. He talked about Heather Whitestone, Miss America, who was also deaf, and how he met her in a city not far from his home. He also talked about having a cochlear implant, which he called a processor. Remember that Christopher was one of the first children to receive a cochlear implant and so was, probably, the only one of his peers to use one.

ADU: so now Justin does-’nt wear a hearing aid does he?
CHI: yeah.
ADU: Justin has a hearing aid too?
CHI: he deaf (be)cause he had a high fever when he was two year-s old.
ADU: ah.
CHI: just like Heather Whitestone.
ADU: just like Heather Whitestone.
CHI: Miss Alabama.
CHI: or Miss America.
CHI: I met her in [a Midwestern city].
ADU: did you real-ly?
CHI: all the Deaf kid-s <come-ing> [///] come-ing xxx Miss America.
CHI: from all over [Midwestern state] come to [the Midwestern city].
ADU: they did?
CHI: and school.
ADU: to see.
CHI: Deaf and hearing loss.
ADU: cool.
ADU: so Justin use-es hearing aids not a cochlear implant then.
CHI: no.
CHI: hearing aids work for him but not me.
ADU: no.
CHI: you know why?
CHI: because.
ADU: why?
CHI: they wo-’nt work well.
CHI: so they give me better one.
CHI: Processor.

Discussion

The observed growth in Christopher’s language skills supports the results observed by Miyamoto, Svirsky, and colleagues (Miyamoto et al., 1997; Svirsky et al., 2000) and others (Connor et al., 2006; Tomblin et al., 2005). Using hearing aids, his receptive vocabulary score and MLCU were less than 50% of expected scores based on norms for peers with normal hearing. After using the implant for 7 years, his receptive vocabulary improved to 85% and his MLCU improved to 83% of expected scores based on norms for peers.
with normal hearing. After 13 years of implant use, expressive vocabulary improved to a language quotient of 94; by his 14-year postimplant evaluation, his reading comprehension improved to a standard score of 88. This suggests that for this child using a cochlear implant, language skills improved at a rate greater than would have been expected had he continued to use hearing aids. As Svirsky and colleagues observe, children with profound sensorineural hearing loss, on average, demonstrate growth rates about half those observed for children with normal hearing (Svirsky et al., 2000).

For Christopher, gains largely related to the burst of growth observed in language skills and speech from 3 years to about 8 years of implant use (ages 7.8 through 14 years) after which growth slowed. For speech, this was most likely because Christopher was approaching 100% speech intelligibility. For vocabulary and reading, the gap between his chronological age and the age equivalent narrowed substantially during this time. After this burst of growth, growth seemed to stabilize at a rate highly similar to that of the test standardization sample (i.e., children with normal hearing) and the gap did not get wider for either reading or expressive vocabulary.

This cubic (slow–fast–slower) growth trajectory is not reported in the literature but has been seen clinically (Connor, Hieber, & Zwolan, 1997). Individual differences in children’s growth trajectories tend to become obscured when studies include greater numbers of children and compute mean growth rates (e.g., Connor et al., 2000; Svirsky et al., 2000). New cluster procedures (e.g., M-Plus) may help to elucidate these individual differences in larger samples. This cubic trajectory may, for example, be typical of children who receive their implants relatively late in childhood by today’s standards.

Christopher developed from an ineffective communicator to a young man able to articulate important observations about himself and his friends; these skills were built on a foundation of improving speech and language skills. The findings suggest that as Christopher’s intelligibility, vocabulary, and morphosyntactic skills improved so did the pragmatics and quality of his discourse. It was not the case that he had to first establish strong speech and language skills and then begin to engage in culturally/pragmatically appropriate and engaging conversations. Instead, these results suggest an intertwining of mechanical and sociocultural aspects of language development. The clinical and educational implication is that one can take advantage of this intertwining and provide opportunities for students to talk about subjects that are important to them, including their cultural identity. This motivation may, in turn, support the further development of vocabulary and morphosyntax as well as intelligibility. The role of motivation is becoming better understood in the general education (Guthrie et al., 2004) and has implications for the education of deaf children as well.

Christopher used sign language in his early language samples to support his communication but then stopped (or decreased its use with certain conversation partners) once his spoken language skills improved. Although there is controversy regarding the use of sign language by and with children who use cochlear implants (e.g., Geers, 2004), for Christopher, his gestures and signs appeared to support rather than detract from his communicative efforts. There was no evidence that use of signs decreased or interfered with Christopher’s spoken language or developing articulation skills.

A speech–language pathologist, whose practice did not include serving deaf children, reviewed the videotaped language samples. She had difficulty understanding Christopher until the last segment, and even then she had to listen carefully. The differences between experienced and naive listeners’ ability to understand the speech of deaf children are well documented (McGarr, 1983). Although Christopher was described as a good communicator, this may have to be redefined by noting that he was an effective communicator within the world of the deaf and hard of hearing. Is there a deaf dialect (oral and signed) defined by the constraints imposed by the nature of high-frequency hearing loss? Do members of this culture implicitly know this syntactic code or “dialect” while others outside the culture, like the speech pathologist, did not? Questions about common languages and dialects are beyond the scope of this article but interesting to contemplate.

From an historical perspective, Christopher’s clear progress as a communicator is important. Subtle pressures
imposed by his role as a pioneer during the years when researchers’ goals focused on demonstrating the efficacy of the device may have played a part in his success. Consider also that he was old, by today’s standards, when he received his cochlear implant, and that for the first 5 years that he used a cochlear implant, he utilized the older SPEECH processing strategies. Research indicates that newer strategies provide better auditory information to children (Geers, 2002). We might expect even better communication skills for children receiving the implant today. A large part of Christopher’s success with the cochlear implant was surely related to the support he received from his family, teachers, and therapists.

Both developmental and sociocultural frameworks revealed important information about this young cochlear implant pioneer. We may learn more about how to support children who use cochlear implants by examining what they are saying; attending to the sociocultural aspects of language, as well as the mechanics of how well they are saying it; and attending to their developing articulation, vocabulary, syntax, and pragmatic skills. This study further highlights the importance of continuing follow-up and assessment of children who use cochlear implants so that we can better understand long-term outcomes. Achieving better information about children’s developing communicative competence in social and cultural spheres can contribute to our understanding of how best to serve children and young adults with cochlear implants as they increasingly enter the mainstream at school and in society overall.

References


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