Growing Up With a Cochlear Implant: Education, Vocation, and Affiliation

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The long-term educational/vocational, affiliation, and quality-of-life outcomes of the first and second cohorts of children with bilateral, profound hearing loss who received cochlear implants under a large National Institutes of Health–funded study was investigated in 41 of 61 eligible participants. Educational and vocational outcomes were collected from user survey data. Affiliation and quality-of-life data were collected from the Satisfaction-with-Life scale and the Deaf Identity Scale. Qualitative results indicated that compared with their hearing, adult-age peers, this group obtained high educational achievement, and they reported a very high satisfaction of life. With respect to forming an identity in these first 2 cohorts of cochlear implant users, we found that most of the individuals endorsed a dual identity, which indicates they feel just as comfortable with Deaf individuals as they do with hearing individuals. Quantitative results revealed a significant relationship between ability to hear and ability to speak, in addition to consistency of device use. Additional relationships were found between mother’s and the individual’s educational statuses, hearing scores, and communication system used. Younger individuals scored higher on satisfaction-with-life measures, and they also tended to endorse a dual identity more often. Taken together, these findings diminish concerns that profoundly deaf individuals growing up with cochlear implants will become culturally bereft and unable to function in the hearing world.

Rubin and Morreale (2000) has argued that well-developed communication skills have become crucial for adults in order for them to successfully participate in today’s society. The focus of Rubin’s paper was concerned with the increasing importance of communication in the workplace; however, communication skills are also a prime force in shaping cultures and binding members to a culture. Indeed, evidence for the important role of communication in a society is demonstrated by the formation of Deaf cultures that have centered upon the use of sign language. These cultures have provided rich social milieus in which individuals with severe to profound deafness have been able to gain full social contacts and experience. We must recognize, however, that Deaf cultures exist within a larger matrix society that uses speech for communication and that in fact, 95%–96% of children with congenital, severe to profound hearing loss are born to parents who are members of this larger hearing community (Mitchell, 2004). Until the advent of cochlear implants (CIs), hearing parents of deaf children had two cultural alternatives for their child. One choice was to raise their child in a Deaf culture that was well suited to these children’s abilities, but which limited their participation in the parent’s hearing culture. The second choice was to raise the child in the hearing world, which allowed the child to remain in the parent’s culture, but often presented a considerable challenge for communication development and risk of failure. More than 20 years ago, cochlear implantation provided a third alternative, by facilitating access to spoken language (Spencer and Tomblin, 2005). However, the use of CIs in the pediatric population elicited controversy and rancor by some proponents of Deaf culture, who objected to the medical model.
of deafness and who felt that deaf people were being subjected to audism and being denied their cultural identity and affiliation (Christiansen & Leigh, 2005; Lane, Hoffmeister, & Bahan, 1996). Considerable concern was voiced that these children would not fare well with respect to speech and language development and would not have the opportunity to develop sign proficiency and Deaf inculturation (Crouch, 1997; Lane & Grodin, 1997). Sparrow (2005) continued to express these concerns as follows:

The danger with existing cochlear implants is that they risk depriving such children of full membership of any culture. Implantees may end up trapped “between cultures,” unable to function effectively in a hearing context but also lacking the facility with sign language available to those who grow up with it as their first language. (pp. 143–144)

Sparrow’s statement emphasized two areas to investigate with regard to pediatric implantation. First, the importance for outcomes research to assess where these individuals “end up” developmentally. The assumption is that this end point is in adulthood. Second, Sparrow indicates that we must determine whether these children find themselves without a cultural affiliation at the time of adulthood. The current study was aimed at directly addressing these issues. There is, however, existing evidence suggesting that most children with CIs may end up as successful members of the hearing community, and we will present this background information.

CI technology has been recognized as providing children who have limited hearing with considerably more auditory information than what was available with hearing aids (Geers & Moog, 1992; Thoutenhoofd et al., 2005; Uziel et al., 2007). CIs have also been credited with facilitating the development of very functional speech–production skills (Geers, 2002; Geers, Spehar, & Sedey, 2002; Peng, Spencer, & Tomblin, 2004; Tomblin, Peng, Spencer & Lu 2008; Tye-Murray, Spencer, & Woodworth, 1995). Input from the CI also contributes to the development of phonological awareness and processing, which are skills associated with the ability to decode words and to read (DesJardin, Ambrose, & Eisenberg, 2009; Spencer & Oleson, 2008; Spencer & Tomblin, 2009). Finally, there is evidence that children who have grown up with CIs are quite likely to read at grade level and to achieve scores on academic tests that are within 1 SD of their hearing peers (Spencer, Barker, & Tomblin, 2003, Spencer, Gantz, & Knutsen, 2004; Uziel et al., 2007). Another by–product of the advent of CIs has been an increased propensity for these deaf children to participate in mainstream educational environments (Huber, Wolfgang, & Klaus, 2008; Waltzman, Cohen, Green, & Roland, 2002). All of these childhood competencies are critical signs of acculturation in the hearing community and all of these outcomes have been atypical in deaf children who were not implanted. Without the auditory information provided by an implant, children who are deaf have had substantial difficulties in most areas of academic performance as well as spoken language development (Traxler, 2000). These academic difficulties have been shown to extend into adulthood in the form of lower postsecondary education attendance and lower income (Bullis, Davis, Bull, & Johnson, 1997; Luckner, 2002; MacLeod–Gallinger, 1992a, 1992b; Punch, Hyde, & Creed, 2004; Schien & Delk, 1974). Such transitional difficulties do appear to be surmountable for those deaf youth who obtain a college education (Schroedel & Geyer, 2000). Luckner (2002) has attributed the variability in the transitional outcome of deaf youth to their language and communication skills. To the extent that CIs provide an avenue to communication competence using speech, we should expect that successful transitions into adulthood should be improved.

Self-perceived Outcomes

Adult outcomes of individuals who received CIs as children may report educational and occupational status, which may then attribute an external evaluation based on traditional mainstream social values. We must, however, also evaluate these outcomes in terms that reflect the personal perspectives of individuals who are deaf, who may not perceive themselves to be a member of the majority society. In this case, we must consider whether the individuals identify themselves with the mainstream hearing society, with the Deaf culture, or perhaps with both cultures. Additionally we need to consider how the individuals view themselves in accord with their own personal values.
Cultural identity. Although the construct of identity is complex and the definition is evolving, researchers agree that a positive self-perception is important in order to achieve success. For example, adolescents who have hearing loss and who see themselves as disabled may tend to limit themselves and seek out fewer challenges (Hauser-Cram, Durand, & Warfield, 2007). There is some tension in the social sciences field regarding the perspectives about defining identity. In brief, individuals develop an identity via forming thoughts about themselves that help to connect them to specific social groups (Baumeister, Storch & Geffken, 2008; Grotevant, 1992; Moskowitz, 2005). One’s identity is individualized but may be a collection of several ideas about oneself in conjunction with forming a group affiliation (Ashmore, Deux, & McLaughlin-Volpe, 2004). Identity forms in adolescence yet evolves during the lifetime (Grotevant, 1992).

Having a profound bilateral hearing loss becomes a part of one’s identity in one way or another. Throughout time, various labels for having profound hearing loss have been used, and some of those labels have not been kind. Leigh (2009) explains the complexity of labels and self-categorization. She elucidates that as part of forming an identity, an individual will go through a complex decision-making process in choosing a label from which to identify. This process includes using an amalgam of information that weaves past experiences and emotional connotations made while forming relationships with the groups that are associated with the label. For example, Hurwitz et al. (1997–1998) notes that one aspect of a “Deaf” label is an expectation of using sign language to communicate, whereas the label “Hard of Hearing” may have an expectation of successful communication using spoken language. How persons see themselves may be either positively or negatively influenced by their ability to meet the expectations imposed by a specific label. For a thorough discussion regarding Deaf identity, please see Leigh (2009).

Several studies have examined what happens with regard to Deaf cultural identity after receipt of a CI. For example, Wald and Knutson (2000) looked at the perception of cultural identity of 45 adolescents with and without CIs who were deaf using the Deaf Identity Development Scale (DIDS; Glickman & Carey, 1993). Results indicated that those who used CIs were more likely to endorse a hearing identity than those who did not wear CIs, yet the most common endorsement by both CI users and those who did not wear CIs was a bicultural (Deaf/hearing) identity. Most, Wiesel, and Blitzer (2007) also studied, using the Glickman DIDS, the identity of 115 individuals with severe to profound hearing loss when they were between the ages of 14 and 21 years. Of these respondents, 10 were CI users, 92 were hearing aid users and 13 used no sensory aids. Results of this study revealed that the group as a whole endorsed a bicultural identity most often, followed by a hearing identity, then a deaf identity, with a marginal identity being endorsed less frequently. The endorsement of a bicultural identity was significantly higher than any other identity. The study also reported that the respondents who used spoken language as their main way to communicate endorsed a hearing identity more often than any other identity, and respondents who used a total communication approach endorsed a bicultural identity more frequently. A qualitative study completed by Wheeler, Archbold, Gregory, and Skipp (2007) looked at the identity perceptions of 29 adolescents who were between the ages of 13 and 17 years when they were interviewed and who were implanted between the ages of 3 and 12. The themes that emerged from their study were that the children varied in their use of sign and speech and were comfortable switching between the two communication modalities. Wheeler et al. (2007) reported, “The majority recognize themselves as intrinsically deaf in the sense that they cannot hear without their implant but do not demonstrate a culturally deaf identity” (Wheeler et al., 2007, pp. 136).

Satisfaction with life. Social identity is generated by each individual and is best determined by self-report. In concert with this construct is another another self-generated construct, which is satisfaction with life or quality of life. This construct, like the construct of identity, is multidimensional and involves appearance, health, social relationships, and the ability to cope (Hintermair, 2008). One’s quality of life is subjective and changes with the modification of any of the aforementioned dimensions. The extent one feels satisfied with their ability to affiliate with a community may influence their quality of life. To this degree, one
may expect that an increased ability to communicate with those in one's environment increases the quality of life. Huber (2005) looked at the medical quality of life reported by 11 adolescents between the ages of 13 and 16 who had CIs and found that their reported quality of life was similar to that of peers with hearing. In the same study, 18 children with CIs who were younger, between the ages of 8 and 12, reported medical quality-of-life levels that were below that of their hearing peers.

Cohort Factors in CI Outcomes Research

Research on outcomes always entails a longitudinal perspective. As such, we are able to learn about the status of individuals who have passed through an earlier developmental period. Because of the dynamic nature of the field of deaf education and CI technology, researchers and educators may find it is necessary to adopt a “cohort” approach when analyzing outcome data. That is, when examining CI outcomes, it is important to consider which “generation” of CI users is included in a particular study. The outcomes of any cohort will reflect the practices specific to that cohort. Because pediatric cochlear implantation has been new, this field has experienced rapid changes in technology and clinical practice. For example, if a child received a CI in the late 1980s or early 1990s (Cohort 1), there was an age restriction of 36 months and only certain devices were available. By the mid-1990s, there was a major technology shift, and the age of eligibility for implantation was lowered to 18 months (Cohort 2). The internal device available for the first cohort of CI users supported some of the first processing strategies (e.g., F0F1F2, F0F1, and MPEAK strategies), which were feature-extraction strategies and so named for the formant features extracted, thus F0 indicates the fundamental, F1 indicates first format, and MPEAK indicates multiple-peak strategy. The second generation of internal devices advanced to processing strategies that were different (e.g., peak picking strategies and/or continuous interleaved sampling or CIS). In general, the newer generation technologies provided greater options and flexibility with regard to the parameters of stimulation of pulse rate, pulse width, filter overlap, compression function, and signal bandwidth. These changes continued, and again, around 2000, there was another technology shift, with the age of implantation being lowered to 12 months (Cohort 3). Finally, as of this writing, the practice of simultaneous bilateral implantation has increased, and there are some new technologies being used (e.g., short electrodes and hybrid devices).

Because of these possible “cohort effects,” it is wise for the reader to be cognizant of when in time the participants of a particular study were implanted. To some extent, this dictates the parameters of age for candidacy and technology available to the individuals in a particular study. A case in point: if a child was 36 months when implanted and part of Cohort 1 (received an implant in the late 1980s or early 1990s), two things might stand out. First, the child was implanted at a relatively young age for that point in time, and second, it is almost certain the technology received at the time was the first technology available. As a result, the child most likely has had at least two upgrades in the external processor, and the internal receiver and electrode array, if original, is again of the first technology that was available. Conversely, if a child was 36 months at the time of implantation and received one CI in 2011 (thus, of Cohort 4), several things are now salient. This time, the child is relatively “old” at time of implantation; the technology received is most likely the most current available to date; yet it is notable that the child received only one CI, in a climate where bilateral cochlear implantation was becoming the standard of care.

In consideration of the above, the leading edge of the first “cohorts” of CI users would now have 20 or more years of CI experience, and as of now, the first two cohorts of profoundly deaf youngsters to have grown up using CIs are now young adults. The question posed is how does this experience influence ultimate levels of educational, occupational, and cultural affiliation? This area of investigation has received only preliminary attention, yet it is important because outcome data may influence insurance reimbursement practices and government policy with regard to educational programming. Furthermore, the dearth of long-term outcome research on this topic was the source of criticism by those who oppose cochlear implantation (Crouch, 1997). Specifically, critics have pointed out that investigators have not yet ascertained the educational and vocational status of those who receive
CIs, nor have they determined outcomes with respect to ability to identify or affiliate with a community. The purpose of this paper is to illuminate the educational and vocational status of members of the first two cohorts of CI users and to ascertain whether these individuals do indeed find a community with which to affiliate.

In summary, studies looking at affiliation, identity, and quality of life generally indicate that growing up with a CI has not seemed to create a generation of culturally bereft individuals; rather, CI users report similar levels of quality of life and ability to affiliate as their peers who have hearing. The purpose of this current study is to replicate previous findings and to provide additional educational, vocational, and living status information for the first two cohorts of CI users.

Methods
Participants
The candidates for this study were participants from the first two cohorts (i.e., received their CIs between the years 1987 and 1999) of consecutively implanted children at the University of Iowa Hospitals and Clinics who received a CI before their 15th birthday. This study did not directly assess communication modality; however, we were able to use information provided by the individuals regarding whether they typically used American Sign Language, Signed English, or Oral English in their daily communications. The current study commenced by assembling a potential participant list who were implanted between the years 1987 and 1999 and who had reached young adulthood (16 years or older). Thus, we identified 85 individuals who received a CI at the University of Iowa Hospitals and Clinics when they were between the ages of 24 months and 15 years of age between the years 1987 and 1999. A proportion (44/85) of these candidates participated in a larger, longitudinal study funded by the National Institutes of Health (NIH) and met the criteria of having no concomitant disabilities other than having a prelingual, profound bilateral hearing loss. Although many of the participants in this NIH study came from the Midwestern states, parents from both the east coast and the west coast brought their children to participate because the study covered the cost of the device and the surgery. The remaining candidates, who did not participate in the longitudinal study, were more variable in their age of CI, etiology of hearing loss, and overall demographics. Demographic information on individuals who did (responders) and did not (nonresponders) return the survey can be found in Tables 1 and 2, respectively.

We were able to locate the current mailing addresses for 61 of the 85 candidates. Importantly, of the 24 candidates we were unable to locate, hospital records confirmed that 14 of the individuals had notified the clinic that they had discontinued using their CI. Thus, 61 study packets were mailed out to young adult CI users. The packets contained three questionnaires (to be described), a letter of explanation that assured anonymity, directions for how to receive reimbursement of a $25.00 gift card upon return of the questionnaires, and a return, postage-paid envelope. After 2 months, a second, reminder packet was mailed out to those who had not responded to the first mailing.

Cohort Considerations
Important developments during this period in which the candidates received their CIs included the following: (a) the U.S. Food and Drug Administration (FDA) approved the procedure for children as young as 2 years of age in 1990 and (b) the age eligibility was lowered to 18 months in 1995. The internal devices available at this time were some of the first generations of devices, as described earlier, and the external devices were of the body-worn type and large by today’s standards. There were no behind-the-ear models available for the external device until 2002. Another consideration about this cohort is that some members were the very first pediatric patients in the United States to receive a CI, and some of them were quite “old” (more than 12 years of age when they received their CI).

Measures
In order to assess educational, vocational, and family status, we administered The Living Status Questionnaire. This tool was originally composed as part of a NIH study of children with specific language impairments, and the questionnaire items were drawn from those in the U.S. Census, so that the data obtained from this questionnaire could be related to the Census data. Questions in this inventory were related
to educational background, work and family status and history, plus social and leisure activities.

To assess overall quality of life, we administered a global measure of life satisfaction, the Satisfaction-with-Life scale (SWLS; Diener, Emmons, Larson, & Griffin, 1985). This scale comprises five items designed to measure life satisfaction as a “cognitive–judgmental process” (Diener et al., 1985). Participants were directed to read a statement and then rate their level of agreement using a 1–7 scale, where a rating of “1” indicates strong disagreement and “7” indicates strong agreement. The items can be found in Table 3.

### Table 1: Demographic and device information for responders

| ID  | Survey age | Age at CI (mo) | User status | Etiology | Speech processor | Processing strategy |
|-----|-------------|----------------|-------------|----------|------------------|---------------------|
| M1  | 22          | 46             | 3           | Unk      | Nucleus Esprit   | 2 F0F1F2            |
| F2  | 22          | 65             | 3           | Unk      | Nucleus Spectra  | F0F1F2              |
| M3  | 23          | 50             | 3           | Men      | Nucleus Spectra  | F0F1F2              |
| F4  | 21          | 61             | 3           | Men      | Nucleus Esprit   | 2 SPEAK             |
| F5  | 18          | 44             | 3           | CMV      | Nucleus Spectra  | F0F1F2              |
| M6  | 28          | 130            | 2           | Men      | Nucleus Spectra  | F0F1F2              |
| F7  | 25          | 193            | 1           | Mon      | Nucleus Esprit   | 24 SPEAK            |
| F8  | 22          | 142            | 3           | Unk      | Nucleus Sprint   | CIS                 |
| M9  | 20          | 110            | 3           | Unk      | Clarion 1.2      | CIS                 |
| F10 | 21          | 68             | 3           | Unk      | Nucleus Sprint   | CIS                 |
| M11 | 23          | 104            | 1           | Men      | Nucleus Spectra  | MPEAK               |
| M12 | 18          | 34             | 3           | Cx26     | Nucleus MSP      | MPEAK               |
| M13 | 18          | 87             | 3           | Anox–cp  | Nucleus Spectra  | SPEAK               |
| F14 | 28          | 144            | 2           | Men      | Nucleus MSP      | F0F1F2              |
| M15 | 22          | 34             | 3           | Waard    | Nucleus MSP      | MPEAK               |
| F16 | 22          | 62             | 1           | Unk      | Nucleus MSP      | MPEAK               |
| F17 | 21          | 52             | 3           | Unk      | Nucleus MSP      | MPEAK               |
| M18 | 20          | 42             | 3           | Men      | Nucleus MSP      | MPEAK               |
| M19 | 24          | 131            | 3           | Men      | Nucleus Spectra  | SPEAK               |
| F20 | 18          | 42             | 3           | Unk      | Nucleus Spectra  | SPEAK               |
| M21 | 20          | 146            | 3           | Unk-f    | Nucleus 3G       | ACE                 |
| M22 | 20          | 89             | 3           | Unk-f    | Nucleus Spectra  | SPEAK               |
| M23 | 18          | 66             | 3           | Unk      | Nucleus Spectra  | SPEAK               |
| M24 | 18          | 40             | 3           | Cx26     | Nucleus Spectra  | SPEAK               |
| F25 | 19          | 46             | 3           | Unk      | Nucleus MSP      | MPEAK               |
| M26 | 19          | 30             | 3           | Men      | Nucleus Spectra  | SPEAK               |
| F27 | 35          | 183            | 2           | Mon      | Nucleus WSP      | F0F1F2              |
| F28 | 19          | 65             | 3           | anox     | Nucleus MSP      | MPEAK               |
| F29 | 24          | 80             | 3           | Unk      | Nucleus MSP      | MPEAK               |
| M30 | 25          | 135            | 3           | Unk      | Nucleus Spectra  | SPEAK               |
| M31 | 17          | 65             | 3           | Unk      | Nucleus 3G       | SPEAK               |
| F32 | 22          | 130            | 3           | Unk      | Clarion 1.2      | CIS                 |
| F33 | 23          | 58             | 3           | Unk      | Nucleus Esprit   | 2 SPEAK             |
| F34 | 29          | 117            | 2           | Unk      | Nucleus MSP      | MPEAK               |
| M35 | 19          | 76             | 3           | Cx26     | Nucleus Spectra  | SPEAK               |
| M36 | 20          | 114            | 3           | EVA      | Nucleus Esprit   | 24 SPEAK            |
| F37 | 28          | 89             | 3           | Ototox   | Nucleus MSP      | MPEAK               |
| F38 | 19          | 33             | 2           | Unk      | Nucleus MSP      | MPEAK               |
| F39 | 21          | 183            | 3           | Cx26     | Nucleus 3G       | ACE                 |
| F40 | 25          | 60             | 2           | Men      | Nucleus MSP      | MPEAK               |

Mean 21.9 86.7 2.7
SD 3.8 45.1 .6

Note. CI, cochlear implant; Cx26 = connexin; EVA = Enlarged vestibular aqueduct; Men = meningitis; Mon = Mondini Syndrome; Ototox = ototoxicity; Unk = unknown; Unk-f = unknown but other family members have hearing loss.

*1 = nonuser; 2 = up to 8 hr daily; 3 = all waking hours of the day.*
In order to assess affiliation patterns of identity, the Deaf Identity Scale (Weinberg & Sterritt, 1986) was administered. This scale was composed of three subscales, including Hearing Identification, Deaf Identification, and Dual Identification. Each subscale consisted of five statements regarding the individual’s desire to associate with and the individual’s assumed similarity with deaf, hearing, or both groups. Participants were asked to respond to each of the 15 statements by indicating whether it was true or false for them.

Results

Response Rate and Demographics of Responders and Nonresponders

For all 61 candidates (respondents and nonrespondents), database and hospital records were examined to extract demographic information related to mother’s educational level, communication system used, daily device-usage times, and the most recent speech-perception score reported as phonemes percent score on the Phonetically Balanced Kindergarten Word list (PBK; Haskins, 1949), and the most recent speech-production score in the form of phoneme percent correct on a sentence-repetition task. For an explanation of the speech-perception and -production tests, please refer to Spencer & Oleson (2008). Tables 5 and 6 display all the test scores, educational information,
and communication system information for survey responders and nonresponders, respectively.

Of the 61 identified candidates for whom we had the current addresses, we received 41 responses (22 females, 19 males) or a response rate of 67%. The average age of respondents was 21.9 years (SD: 3.8 years) and ranged from 17–35 years, and the mean age of implant surgery for the respondents was 86 months or 6.84 years (SD: 3.66 years), with a range of 2–15 years. Two of the 41 responders reported that they had a concomitant disability. Participant F-28 reported having had mild cerebral palsy and walked with a mild gait disturbance; and participant M-13 reported having severe, spastic cerebral palsy and being confined to a wheelchair. Thirty-three (80%) of the 41 respondents indicated they used their CI all the waking hours of the day; 5 (12%) of the 41 respondents reported they used their CIs for up to 8 hr a day, and 3 (7%) of the 41 respondents reported they used their CIs for less than 3 hr a day. Mother's education level ranged from 1 (8th grade) to 6 (graduate degree). The average level of mother's education was 4 (equal to a two-year college degree). The average speech-production score was 78.4% (SD: 22.2) phonemes correct, and the average speech-perception score was 56.6% (SD: 31.3) phonemes correct. Five (12%) of the 41 respondents reported they used American Sign Language as their primary communication system, 28 (68%) of the 41 respondents reported they used Signed English and Speech to communicate, and 8 (20%) of the 41 reported they used Speech only to communicate.

There were 20 individuals who did not send their information packets back. Of the nonresponders, the average age of implant surgery was 98.5 months or 8.2 years (SD: 4 years). Additionally, 11 (55%) of the 20 nonresponders were on record as being nonusers, and 9 (45%) of the individuals who did not respond to the survey were on record as being full-time users. Mother's education level ranged from 3 (some college) to 6 (graduate degree). The average level of mother's education was 4.5 (somewhere between a two-year college degree and a college degree). The average speech-production score was 55.7% (SD: 23.7) phonemes correct, and the average speech-perception score was 39.8% (SD: 31.8) phonemes correct. Fourteen (70%) of the 20 nonrespondents were on record as using American Sign Language as their primary communication system, 5 (25%) of the 20 nonrespondents were on record as using Signed English and Speech to communicate, and 1 (5%) of the 20 was on record as using Speech only to communicate.

Living status questionnaire. Figure 1 presents information regarding educational outcomes for the respondents compared with young adults between the ages of 20 and 24 from the most recent U.S. Census figures (U.S. Census, 2010). All of the CI respondents had reached the age of high school graduation eligibility (age 17 or older). All but two respondents graduated from high school. Of the 39 graduates, 38 reported graduating from mainstream high school programs, and one reported graduating from a state school for the Deaf. Of the two individuals who did not graduate, one reported dropping out in the 11th grade due to pregnancy, and one reported being homeschooled through 8th grade according to their religious culture and custom. The proportion (34%) of CI users whose highest level of educational attainment was that of a high school graduate was a bit higher than that (27%) provided by the U.S. Census figures. Additionally, the proportion (32%) of CI users whose highest level of educational attainment was a four-year university program was also higher than that (24%) of the general public. Of the respondents who reported they had received a diploma from their
postsecondary institution, the types of employment categories included business administration, agriculture, health care, and service. With regard to marital status, 61% of these young adults reported that they were single, slightly greater than 21% reported being married or living with a partner, and 10% reported being engaged. There were no divorced individuals at this reporting point. For individuals between 20 and

| Table 5 | Education, communication, and test scores for respondents |
|---------|----------------------------------------------------------|
| ID      | Moms’ education\(^a\) | Degree status\(^b\) | Speech score | PBK score | Communication system\(^b\) | Satisfaction with life | Affiliate hearing | Affiliate Deaf | Affiliate Dual |
| M1      | 5                     | 5                     | 96           | 85        | 2                      | 7                    | 2                | 0              | 5              |
| F2      | 4                     | 3                     | 88           | 48        | 2                      | 6                    | 4                | 1              | 4              |
| M3      | 4                     | 4                     | 96           | 77        | 2                      | 3                    | 3                | 0              | 4              |
| F4      | 3                     | 3                     | 96           | 85        | 2                      | 6                    | 1                | 1              | 5              |
| F5      | 5                     | 4                     | 97           | 82        | 2                      | 7                    | 2                | 0              | 5              |
| M6      | 6                     | 3                     | 42           | 10        | 2                      | 3                    | 1                | 0              | 5              |
| F7      | 4                     | 4                     | 48           | 11        | 2                      | 6                    | 2                | 0              | 4              |
| F8      | 3                     | 4                     | 68           | 82        | 2                      | 6                    | 2                | 0              | 5              |
| M9      | 3                     | 3                     | 72           | 81        | 2                      | 6                    | 3                | 0              | 5              |
| F10     | 5                     | 5                     | 96           | 79        | 2                      | 6                    | 2                | 0              | 5              |
| M11     | 3                     | 4                     | 53           | 10        | 1                      | 5                    | 5                | 0              | 4              |
| M12     | 3                     | 3                     | 90           | 84        | 2                      | 5                    | 3                | 0              | 4              |
| M13     | 5                     | 2                     | 23           | 47        | 2                      | 7                    | 3                | 0              | 4              |
| F14     | 3                     | 2                     | 50           | 12        | 2                      | 6                    | 4                | 0              | 3              |
| M15     | 3                     | 3                     | 89           | 57        | 2                      | 6                    | 0                | 1              | 5              |
| F16     | 5                     | 3                     | 65           | 18        | 1                      | 7                    | 0                | 5              | 5              |
| F17     | 3                     | 4                     | 97           | 70        | 2                      | 6                    | 1                | 0              | 5              |
| M18     | 5                     | 3                     | 95           | 70        | 3                      | 5                    | 1                | 0              | 5              |
| M19     | 5                     | 3                     | 92           | 72        | 3                      | 3                    | 1                | 0              | 5              |
| F20     | 5                     | 3                     | 90           | 44        | 2                      | 6                    | 2                | 0              | 5              |
| M21     | 5                     | 4                     | 88           | 96        | 3                      | 7                    | 4                | 0              | 3              |
| M22     | 5                     | 2                     | 46           | 93        | 3                      | 5                    | 2                | 0              | 5              |
| M23     | 4                     | 3                     | 97           | 87        | 3                      | 6                    | 4                | 0              | 5              |
| M24     | 4                     | 3                     | 100          | 94        | 2                      | 7                    | 4                | 0              | 5              |
| F25     | 5                     | 4                     | 85           | 48        | 2                      | 5                    | 2                | 0              | 5              |
| M26     | 5                     | 3                     | 96           | 85        | 1                      | 7                    | 0                | 0              | 5              |
| F27     | 3                     | 2                     | 57           | 12        | 2                      | 6                    | 1                | 2              | 4              |
| F28     | 4                     | 3                     | 27           | 15        | 2                      | 6                    | 2                | 2              | 4              |
| F29     | 4                     | 5                     | 71           | 28        | 2                      | 5                    | 3                | 0              | 4              |
| M30     | 6                     | 5                     | 95           | 85        | 3                      | 7                    | 3                | 0              | 3              |
| M31     | 4                     | 2                     | 100          | 76        | 2                      | 7                    | 4                | 0              | 5              |
| F32     | 1                     | 1                     | 79           | 13        | 2                      | 6                    | 0                | 0              | 3              |
| F33     | 4                     | 5                     | 96           | 67        | 2                      | 5                    | 3                | 0              | 4              |
| F34     | 4                     | 3                     | 97           | 88        | 2                      | 6                    | 3                | 0              | 5              |
| M35     | 5                     | 2                     | 97           | 90        | 3                      | 7                    | 4                | 0              | 5              |
| M36     | 5                     | 3                     | 90           | 92        | 3                      | 7                    | 3                | 0              | 5              |
| F37     | 2                     | 1                     | 90           | 33        | 2                      | 5                    | 3                | 0              | 4              |
| F38     | 3                     | 3                     | 42           | 1         | 1                      | 7                    | 4                | 0              | 5              |
| F39     | 1                     | 2                     | 48           | 22        | 2                      | 6                    | 2                | 0              | 5              |
| F40     | 5                     | 3                     | 81           | 24        | 1                      | 5                    | 1                | 0              | 5              |
| F41     | 3                     | 2                     | 88           | 46        | 2                      | 7                    | 2                | 0              | 5              |
| Mean    | 4                     | 3.1                   | 78.4         | 56.6      | 2.1                    | 5.9                  | 2.3              | .3             | 4.5            |
| SD      | 1.2                   | 1.0                   | 22.2         | 31.3      | .6                     | 1.1                  | 1.3              | .9             | .7             |

Note. PBK = Phonetically Balanced Kindergarten word list.

\(^a\)1 = 8th grade; 2 = high school degree; 3 = some college; 4 = associate’s degree; 5 = bachelor’s degree; 6 = graduate degree.

\(^b\)1 = American Sign Language; 2 = Signed English; 3 = Oral English.
24 living in the United States, 27% reported being married (U.S. Census, 2009).

Satisfaction with Life

The respondents answered each of the five questions posed in the scale using the 1–7 rating scale as described earlier and as listed in Table 3. The possible range of total scores was 5 (low satisfaction) to 35 (high satisfaction). The mean “subscale” score for the respondents was 5.9 (SD: 1.1), and the mean “total” score for the respondents was 27.54 (SD: 4.52), which indicates that the CI respondents report a high level of satisfaction with life; this is 4 points higher than the mean of college undergraduates in the study by Diener et al. (1985). Figure 2 presents the breakdown of the percentage of individuals and the levels of satisfaction they endorsed in the survey.

Deaf Identity Scale

Each participant’s primary identity was determined by comparing the total score from the Deaf Identification, Hearing Identification, and Dual Identification subscales. Results are presented in Figure 3. Primary identity was assigned based on the subscale that received the highest score. A majority (87%) of the respondents endorsed a primary Dual identification. Just 8% of the respondents endorsed a primary Hearing identity, 3% endorsed the same amount of items from the Hearing identity and Dual identity lists, and 0% of the respondents endorsed a primary Deaf identity. Figure 3 reveals the percentage of responses overall for each subscale. Looking at the subscales, one can see that 79% of the respondents endorsed all five items from the Dual identity scale, and conversely 79% of the respondents endorsed no items on the Deaf identity scale.

Intercorrelations Between Variables for Responders

A Pearson’s correlation analysis was performed between the demographic variables, archived test records, and current survey scores. Table 7 presents the correlation matrix between the variables. Users who were older when they got their CI, of course, tended to be older when they completed the survey. Individuals who were younger when they received their CI tended to wear their device more hours per day ($r = -.46, p < .01$). Those who wore their device more hours per day tended to score higher on the speech-production tests and the hearing test ($r = .45, p < .01$; and $r = .60, p < .001$, respectively), and they were more likely to use Speech and Sign or Speech only to communicate ($r = .51, p < .001$). Older age of implantation
was correlated with endorsement of a Dual identity ($r = -.38, p < .05$) and lower PBK hearing ($r = -.43, p < .01$). The participants’ age at time of survey was negatively correlated with the satisfaction-with-life score ($r = -.34, p < .01$). Levels of Mothers’ education were positively correlated with the individual’s speech-perception score, degree status,
and a child’s tendency to use either speech as a way to communicate \( (r = .39, p < .01; r = .28, p < .05; \text{and} \ r = .53, p < .001, \text{respectively}) \).

**Discussion**

Of the original 85 individuals who consecutively received a CI at the University of Iowa Hospitals and Clinics from the first two cohorts of CI users, we were able to locate 61. Furthermore, we were able to confirm that at least 14 (18%) of the original 85 candidates had discontinued using their CIs. Of the remaining 71 candidates, we lost 10 to follow-up care, leaving us with a final mailing of 61. Possible reasons for loss of follow-up contact are that families move and establish care elsewhere; young adults move away from their homes; females may marry and change names; individuals may become nonusers and discontinue

![Figure 3](https://example.com/image.png)

Figure 3  Deaf identity scale results.

**Table 7**  Correlations between demographic and test variables for respondents

| Survey age | Age CI User status | Speech score | PBK score | Moms’ education SWL score | ID hear ID Deaf ID dual | SWL status | Communication system |
|------------|--------------------|--------------|-----------|--------------------------|------------------------|------------|---------------------|
| 1          | .58*** - .46** - .17 | -.42** - .17 | -.34** - .16 | .15 - .31’ - .08 | -.09 | Degree status |
| 2          | - .31’ - .40 - .29 | -.26 - .05 | .01 - .04 - .38” - .19 | .25 | Communication system |
| 3          | .45** .60*** .16 | .06 | .01 - .39” .09 - .01 | .51”” | |
| 4          | .67*** .14 .07 | -.01 - .22 | .21 .24 | .25 | |
| 5          | .39” .18 | .15 - .31’ | .27 .26 | .53”” | |
| 6          | -.01 - .14 | .04 | .27 .28 | .34”’ | |
| 7          | .15 .16 | .02 - .07 | -.07 | |
| 8          | -.36” - .27 | .09 | .17 | |
| 9          | .02 - .10 | - .29” | |
| 10         | -.01 | - .11 | |
| 11         | | | |
| 12         | | | |

*p < .05; **p < .01; ***p < .001.
contact with the implant center. Reasons for nonuse may be related to the consecutive nature of the first two cohorts, which was such that some of the individuals were nearly young adults at the time they received their CI and had little auditory input at the point they received their CI and, subsequently, little follow-up service. Some of the original CI users were placed in educational environments that did not endorse the use of a CI. Additionally, there were limited options for the external device and some individuals were not comfortable wearing the larger processor, especially during their adolescent years. Thus, the final 61 candidates were subject to our ability to contact them, and we can be confident that these candidates reflect CI users who had consistent follow-up care to maintain their device. The response rate of 67% for this study is based on the 61 “reachable” candidates and is in concert with the response rate to mail surveys that are published in medical journals, which varies from 54%–68% (Asch, Jedrziewski, & Christakis, 1997).

In this study, we found that all but one of the individuals were educated within their local community and had attended mainstream schools or were home-schooled according to their religious practice; moreover, one went to a state school for the Deaf. This indicates that the public educational system was responsible for educating the children of the first two CI cohorts through their high school graduation. Furthermore, for the individuals who pursued post-secondary education, there was a greater tendency to attend a 4-year college/university program compared with a vocational or community college. The educational attainment of these individuals is in concert or exceeds that of the general population and provides evidence that the pattern of educational and vocational subattainment by those with hearing loss or deafness is dissipating in this group of CI users.

The individuals in this study endorsed a high level of satisfaction with life, with a mean score of 27.54 on the SWLS (Diener et al., 1985). Indeed, these numbers exceed the means for every representative group that has been published, as reported by an update on the tool that was published in 2008 (Pavot & Diener, 2008). Groups from which published data from the SWLS was available included international and cross-cultural samples, clinical and counselling samples, and health-related samples. The high level of satisfaction with life reported by the CI users in this study can also be taken as evidence of high subjective well-being (SWB), because the SWLS scale was also found to be a reliable and valid measure of SWB (Pavot & Diener, 2008). These high levels of satisfaction bode well for this group of CI users because high satisfaction with life and high SWB are associated with strong social relationships (Diener & Seligman, 2002), marital satisfaction (Glenn & Weaver, 1981), and high levels of physical health, longevity, and survival (Lyubomirsky, King, & Diener, 2005). Satisfaction with life tends to be broadly based on a combination of perceptions about major life events, such as academic performance, romantic relationships, and family relationships, such that the construct “satisfaction with life” is a reflection of important domains in a person’s life (Pavot & Diener, 2008). To the extent that this is true, we can surmise that having profound hearing loss and using a CI has not had a negative effect on satisfaction with life for these young adults.

Finally, with respect to forming an identity, we found that most of the individuals in the study endorsed a Dual identity, which indicates they feel just as comfortable with Deaf individuals as they do with hearing individuals. This finding is in concert with other studies of CI users (Most, Weisel, & Blitzer, 2007; Wald & Knutson, 2000, Wheeler et al., 2007). The current study used a different scale from the studies cited herein, which all used the DIDS developed by Glickman and Carey (1993), which may be indicative that the Deaf Identity Scale (Weinberg & Sterritt, 1986) is measuring similar constructs as the longer DIDS. In the original study using the Deaf Identity Scale, participants used a Total Communication (TC) philosophy, which is commensurate with a majority of participants in the current study. Additionally, Weinberg and Sterritt (1986) found that endorsing a Dual identity was associated with better outcomes in terms of academic placement, social relationships, personal adjustment, and perceived family acceptance than was the endorsement of a Deaf identity or a Hearing identity. The current findings of high satisfaction with life, high rates of postsecondary education, and high tendency to support Dual identity in CI users supports the original findings of Weinberg and Sterritt (1986).
Additionally, although this study did not directly assess the communication mode used by the CI recipients, the first two cohorts studied at the University of Iowa comprised children who were educated with a TC philosophy, which indicates they used signed English and/or American Sign Language and that they used oral speech both as receptive and expressive communicative methods. This may account for the endorsement of a Dual identity. What we do not know, however, is whether using a CI in the context of TC will or will not be a continuing trend with subsequent cohorts, nor do we know whether the results found in these TC users can be extended to those who grew up using oral communication.

This study is a snapshot in time of where the first two cohorts of CI users are with respect to life outcomes. Although this picture is seemingly a positive one, we can still learn a lot from these first two cohorts to apply to upcoming cohorts. We learned that there was a greater risk of nonuse with children who were older when they first received their CI and that poor speech perception was related to poor speech production and a discontinuation of CI use. These findings inform current practice and preoperative counselling. Children who are older are not denied a CI, but the CI team works to make sure the child’s and the families’ expectations are appropriate.

Another point of interest is that the professionals who educated these children may not have had, in their professional training, coursework that addressed the technological aspects of the devices, the particular capabilities of the devices, or the learning patterns of the children fit with the device. In two studies, speech-language clinicians indicated they felt neither comfortable nor prepared to work with children who have CIs (Luckhurst, 2008; Palacio, 2001). We also acknowledge that many factors combine to influence educational success, such as early intervention, language proficiency, and cognitive skills such as memory, attention, and executive functioning (Pisoni, Conway, Kronenberger, Henning, & Anaya, 2010). What we learn and have learned from these initial CI users will be fuel for continuing education programs for professionals and must be incorporated into training programs for those who will be working with deaf individuals. It will be important to tap the knowledge of professionals and researchers, integrating and disseminating this information so that we can institute best practices in a timely way.

It would also be appropriate to continue to follow up with the first two cohorts as they leave young adulthood and enter into their midlife phase. For subsequent cohorts of CI users, it will be important to document and compare life outcomes, specifically in education, vocation, and affiliation, with the previous cohorts and to compare groups who use different communication philosophies and modalities. As mentioned, CI technology continues to improve; the age of implantation has decreased, and it is becoming common for recipients to receive two CIs since the first pediatric CI users began their journey. To the extent that these changes are good things and to the extent that we can integrate what we know and have learned into training professionals so they can apply this knowledge in the field of deaf education, the future looks bright for subsequent cohorts of CI users.

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Conflicts of Interest
No conflicts of interest were reported.

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