1. Cochlear implants support spoken language development more effectively than hearing aids for children with profound—and perhaps severe—hearing loss.
   a. See Geers, 2003 and 2006, for overviews of findings
   b. See Marschark & Spencer, 2006, and Spencer & Marschark, 2003, regarding comparisons of deaf children with CIs to children with moderate to severe hearing loss using hearing aids

2. There is great diversity in outcomes
   a. See Spencer, 2004, for outcomes in a small group of children getting CIs before 27 months of age. Outcomes varied widely from age-appropriate spoken language to little if any language development.
   b. Early Intervention has raised developmental levels, but only on average to “low-average” level...that means at the 25%ile or higher and is still not equivalent to expectations for hearing children. (See Yoshinaga-Itano, 2003, for an overview.)

3. Development of spoken language using CIs is known to be affected by a combination of pre-implant factors, most of which affect development of deaf and hard-of-hearing children in general
   a. Hearing experience prior to use CI either from gradual or late loss of hearing—or from effective use of hearing aids--gives significant advantage post-implant. This is one explanation for the occasional research finding that older age at implantation results in faster and better progress than younger ages at implant. (See Eisenberg, Kirk, Martinez, Ying, & Miyamoto, 2004)
      i. This may be due to pre-implant language levels being relatively high
      ii. It may be due to auditory input during a critical or sensitive period for neurological development
   b. Language levels pre-implant, regardless of modality of language, support faster and better progress across modalities post-implant
      i. If implants are received by 2 years, having a relatively large sign vocabulary predicts not only sign but spoken language *and* later reading advantages (Connor, Hieber, Arts, & Zwolen, 2000; Connor & Hieber, 2004)
   c. Other studies show little if any differences depending on pre-implant modality (Marschark, Rhoten, & Fabich, 2007)
   d. The convergence of research opinion: unless there is pre-existing hearing, younger ages at implantation provide the best comes; do not assure “success” in spoken language.
      i. Geers', 2006, finding of lack of age effects may be due to presence of later-deafened children in her sample.
         1. Critical period for neurological organization to effectively organize auditory input may begins to close at 1 year (Rubin, 1997).
2. Sharma, Dorman, & Spahr, 2002, indicate window doesn’t close until 3.5 years—and some plasticity remains even past then
3. Mayberry, Lock & Kazmi (2002) suggest critical issue is learning a first language early in life; that will support native-like learning of a second language later. Modality is not important.
e. Nonverbal cognitive abilities, and secondary disabilities, strongly predict language outcomes using cochlear implants (e.g., Spencer, 2004; Waltzman, Scalchunes, & Cohen, 2000).
   i. Many researchers (e.g., Geers, 2003) include only children with “normal” or higher cognitive functioning and no disabilities in samples. This results in findings being inapplicable to over one-third of deaf and hard-of-hearing children.
   ii. Many children with multiple disabilities make progress with CIs, but much more slowly and needing extra visual supports when compared to more advantaged deaf children (Pyman, Blamey, Lacy, Clark, & Dowell, 2000).
f. The importance of high quality communication and interaction experiences cannot be over-stated. Everything learned about benefits of supporting natural and responsive early parent-child interactions and family-focused early interventions holds true whether or not a CI is used. (McCormick & Archbold, 2003)

4. Post-implant outcomes are affected by—
a. Implant and processing characteristics (Zwolan, Ashbaugh, & Alarfaj, 2004).
b. Quality and intensity of intervention experiences—This need does not differ between children with and without CIs, but intervention (at least related to spoken language) is often greatly intensified after CI and this needs to be kept in mind when interpreting research.
c. Quality of family engagement and academic program. Similar for all children, not just deaf children and not just children with CI. (See Spencer, 2004, Moeller, 2000.)
d. Time since cochlear implantation has two contradictory effects—
   i. Growth in language skills, vocabulary/syntax has been reported to “speed up” and even “catch up” after longer use—when use begins early. (ref)
   ii. But, reading achievement has actually been found to drop compared to hearing peers with age (Geers, Tobey, Moog, & Brenner, 2008)
   iii. Statistically-based predictions of continuous, linear growth must be validated through observation over time (e.g., Nicholas & Geers, 2008)
e. Exposure to aural-oral language in meaningful situations (Moog & Geers, 2003 in Geers, 2003)—But what is sufficient exposure? And, does using sign language post-implant interfere with developing spoken abilities?
   i. Qualitative studies (Spencer, 2000; Yoshinaga-Itano, 2006) indicate no interference
   ii. Wilkins & Ertmer (2002) note 10% carefully pre-selected children in high quality oral preschool program change to TC.
   iii. In another qualitative report, Moeller (2006) gives examples of one child for whom continuing signing did not slow spoken language—but another who needed a “break” from signs in part of the day to direct attention to spoken language input. (Note both individual differences and no complete or sudden withdrawal of signing.)
iv. Geers’ (2003) study (remember involving only advantaged children) shows a small but statistical advantage for spoken language programming—but note that this might indicate appropriate placement decisions, not causality.

v. Connor et al studies already discussed.

vi. Linda Spencer and Bruce Tomblin’s group in Iowa show children in TC programs actually combining sign and speech to produce effective English models (Spencer, Tye-Murray, & Tomblin, 1998). TC children with CIs are keeping up with hearing norms on tests of reading skills (Spencer, Gantz, & Knutson, 2004).

vii. But data are lacking comparing use of natural sign language and spoken language separately – as opposed to use of sign-supported speech. The former is theoretically more justified….the latter seems to be an intuitive reaction of parents who have been using signs when children begin to show spoken language understanding using CIs.

f. English skills as seen in development of vocabulary and syntax require sensitive but direct, meaningful instruction.

5. Special needs for additional research (—broader than just for children using CIs)
   a. Finding the best ways to support bilingual and bicultural knowledge in children using CIs—especially since bicultural identity formation appears to give advantages (Bat-Chava, 2000)
      i. Note that there is mixed evidence about CI users social experiences (e.g., Remmel & Peters conjecture aberrant social experiences affect ToM development.)
   b. Identifying most effective curriculum and teaching methods to build English structures and literacy skills
   c. Cognitive and learning styles needs of deaf and hard-of-hearing students (Marschark & Hauser, 2008) need further investigation. Reports of tendencies toward “bottom-up” instead of “top-down” reading and learning practices, lessened sequential memory skills for verbal materials, difficulties integrating information and ideas across time and topics. Pisoni et al, 2008, don’t find CIs to remediate these problems.
   d. Studies of hard-of-hearing children and similarities as well as differences with children using CIs (see Moeller et al., 2007)

6. IMPLICATIONS FOR PRACTICE
   a. Flexible and individualized approaches are required for language methods, educational placement, intervention approaches.
      i. Implement response-to-intervention approaches.
      ii. Recognize communication needs and capabilities as well as desires of families.
      iii. “Build in” options and diversity in language and learning programming over time.
   b. Promote language development regardless of modality...Promoting respect for language decisions and a sense of “so let’s see what works best with little Sally” on the part of both staff and parents. (Include teachers/staff fluent in variety of languages and languagemodes
   c. Design or adopt approaches to support cognitive skills, literacy skills, math and science abilities, and appreciation of geography/history/government concepts and
information. Use language as a tool for learning—not as the overwhelming learning goal.

References (Merely examples):


Spencer, P. 4/15/2009


