

SPEECH PERCEPTION BY PRELINGUALLY DEAF CHILDREN WITH COCHLEAR IMPLANTS AND A FRENCH AUDIOVISUAL FEATURE TEST

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Les implants cochléaires pour les adultes et les enfants : derniers développements. Les implants cochléaires permettent de stimuler électriquement les neurones auditifs chez les patients sourds qui ne retirent qu'un bénéfice limité des prothèses auditives. Cet expose passe en revue les principes de base du traitement du signal et de la sélection des patients. Des données récentes provenant d'adultes et enfants qui ont reçu des implants cochléaires seront décrites. Elles incluront des enfants à surdité prélinguale suivis pendant cinq ans après l'implantation. Quoique la plupart des enfants fassent des progrès réguliers dans la compréhension de la parole, certains enfants ne retirent que des bénéfices très limités de leur implant cochléaire. Nous discuterons des variables pouvant influencer les performances. Un deuxième groupe qui sera discuté inclura des adultes à surdité post-linguale. Nous discuterons les résultats à long terme de patients utilisant les implants Ineraid, Nucleus et Clarion. La moyenne des résultats préliminaires suggèrent que les patients munis d'implants Clarion progressent à un rythme rapide et obtiennent de meilleurs résultats quant à la compréhension de la parole. Nous pouvons expliquer environ 40 % de la variance de performance des patients en examinant les variables pré-implant dans les domaines biographique, psychologique et électrophysiologique. Un nouvel appareil à multicanaux développé en Autriche, l'implant cochléaire MedEl, permet un large éventail de manipulation des paramètres lors des réglages individuels.

Mots-clés:

implant cochléaire, surdité profonde, prélinguale, postlinguale, traitement du signal.

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Cochlear implants have been shown to be effective in postlingually deaf adults and children, and in prelingually deaf children (Gantz et al., 1994 ; Miyamoto et al., 1993 ; Staller et al., 1991 ; Waltzman et al., 1994 ; Fryauf-Bertschy et al., 1992 ; 1997 ; for a review see Tyler, 1993). In this report we review recent speech perception data on prelingually deaf children and present the results of an audiovisual feature test. This test can be easily adapted for French children.

METHOD

Subjects

All children were deaf before the age of two years, received no or minimal benefit from hearing aids, and used Total Communication (see Fryauf-Bertschy et al., 1997 for details). All children used feature extraction versions of the 21 channel Cochlear Corporation implant (Blarney,

Dowell, dark, & Seligman, 1987 ; dark & Tong, 1982 ; Skinner et al., 1991). Details of the tests used and testing protocols are found in Fryauf-Bertschy et al. (1997) and Tyler (1993).

Audiovisual Feature Test

We have recently developed an audiovisual feature test in English for young hearing-impaired children (Tyler & Champe, 1993). This test has several attractive features and can easily be adapted for use in other languages.

The items for this test are shown in Table 1. It is primarily based on the letters of the alphabet, which are often learned early in life by most children. Before the test begins, it is necessary to ensure that the children have the test items in their vocabulary, and associate the correct label to each of the test items. This is often accomplished by having a child label each of the test items, or having them point to the items in responses to sign or a lipreading-only presentation. If a child does not know the items then the child cannot take the test at that time. In that situation, parents or teachers can be asked to practice the child on those items at home or school. The child could then return at a later date for testing after all test items are within their vocabulary.

In the test, the child hears a single stimulus, for example [si] and then points to the correct symbol Id. In our current application of the test, we present each item 6 times in random order, for a total of 60 stimuli per test. Additional stimuli could be presented to increase the test's reliability. If the child's limited attention does not permit the administration of all 60 stimuli, then a subset could be presented and combined with the results from another subset administered during another session.

This test has several advantages shared by other closed-set nonsense syllable tests, including the ability to :

- 1- evaluate the phonetic feature error patterns including information transmission analysis (Miller & Nicely, 1955) and sequential information transmission analysis (Wang and Bilger, 1973).
- 2- provide multiple presentations of the test without concern that becoming familiar with the test items will influence the results ;
- 3- administer multiple lists that are equally difficult. This is particularly important in comparing performance across children or across audiovisual conditions.

These advantages make the test particularly attractive for measuring sound, vision and sound-plus-vision conditions.

In addition,

- 4- this particular test is useful because it can be administered to many deaf children who are 5- to 6-years of age and older, something not possible with most nonsense syllable tests.

Although the test will not be directly comparable across languages unless all phonemes are identical, it will allow speech features to be tested in young hearing-impaired children in these languages and allows a general comparison to be made.

Table 1. Preliminary recommendations for test stimuli to be used in English and French. In English, the stimuli are the test phoneme coupled with the vowel /I/. In French, the stimuli are the test phoneme coupled with the vowel /e/. The English translation is shown when words are used in French.

test phoneme	English	French
/b/	b	b
/d/	d	dé (dice)
/p/	p	p
/t/	t	thé (tea)
/k/	key	
/f/		fée (fairy)
/v/	v	v
/s/	c	s
/z/	z	z
/m/	me	mes (my)
/n/	knee	nez (nose)
/z/ ("zh" as in measure)		j

RESULTS

Average Performance Over Time

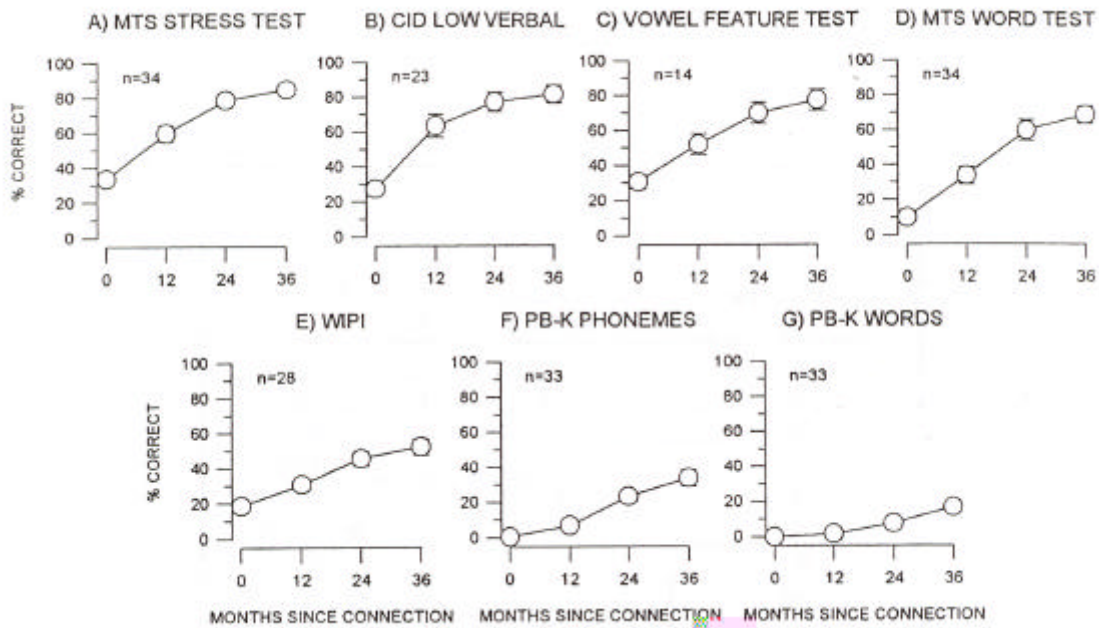


Figure 1
Average results of the MTS Tests, the CID Test, the Iowa Vowel Feature Test, the WIPI Test and the PB-K word recognition Test.

Figure 1 displays the average results for several of our speech perception tests. For each test, the same group of children is represented at each test interval. The easiest is the MTS test (Eber & Alencewicz, 1976) based on "Stress" scoring, with average scores of over 80 correct after 3 years of experience. Many children have scored 100 correct on this test, and these average scores are therefore influenced by ceiling effects. The most difficult test in the PK-B open set word recognition test (Haskins, 1949), with scores averaging only about 20 after three years of cochlear implant use. Average performance continues to increase after 36 months of implant use on test except where ceiling effects limit test results.

Performance at Three Years

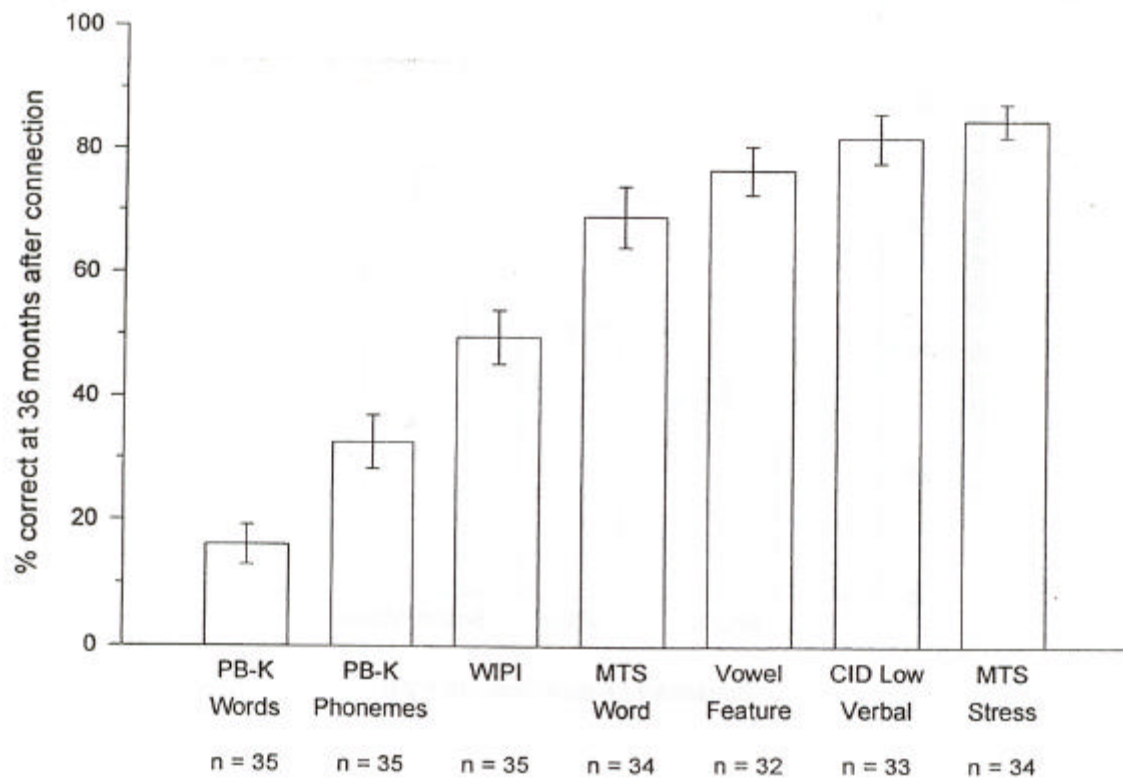


Figure 2
Average results after 36 months of cochlear implant use.

Average performance after 36 months of cochlear implant use is shown in figure 2. The order of difficulty among tests shows a progression from closed- set tests of perception, to closed-set word recognition, to open-set recognition.

Audiovisual Performance

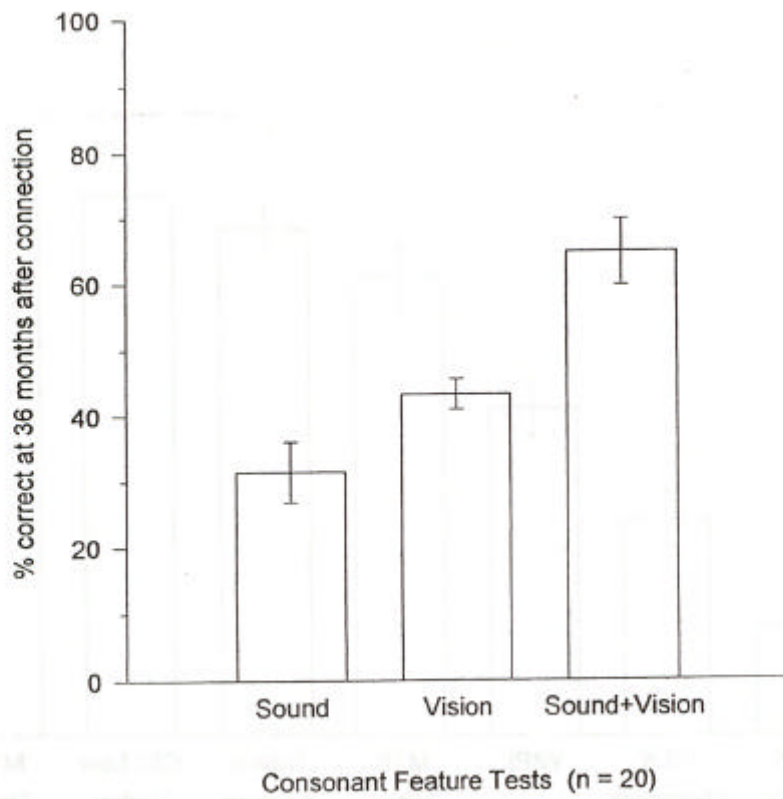


Figure 3
Average results from the Audiovisual Feature Test presented in the audition, vision, .and audiovisual modalities.

Performance on the Audiovisual Feature Test is shown for 20 children in figure 3. Performance in sound alone averaged about 30 correct. When this information supplemented the vision modality (vision alone scores were about 42 correct), performance increased to over 60 correct on the audiovisual task.

DISCUSSION

These increases in speech perception observed in prelingually deaf children provide the foundation for changes in speech production (e.g. Osberger et al., 1991 ; Tye-Murray et al., 1991). It is hoped that they will also lead to educational changes (Tyler, Davis & Lansing, 1987). The audiovisual Feature Test provides an opportunity to measure audiovisual performance in young deaf children, and can be adapted to other languages, including French.

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