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Bilingual hearing acquisition in Welsh and English following cochlear implantation

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Abstract

A post lingually deafened adult equilingual in Welsh and English, received rehabilitation in both languages following cochlear implantation.

Hearing acquisition was very similar in both languages, indicating that there is no need to vary the electrode coding strategy for different languages of Indo-European origin. The situation may be difficult for tonal languages such as Chinese.

Key words: Cochlear implant; Hearing acquisition, bilingual

Introduction

The Nucleus 22 Channel cochlear implant was initially implanted in English speaking subjects. However, results from German (Battner *et al.*, 1987), Japanese (Funasaka *et al.*, 1987) and Spanish (Garcia-Ibanez *et al.*, 1987) centres have shown that patients with different languages achieve similar progress following implantation. Interestingly, due to the similar formant composition of some vowels in German, minor variations to the electrode frequency coding strategy were found to be beneficial.

There is only one report in the literature of cochlear implantation in a bilingual subject–a Chinese man who spoke Chinese at home but who had studied English in High School (Xu *et al.*, 1987). Although he made good progress in both languages, his progress performance in Chinese was better as this was the language more familiar to him.

We report the progress of a patient who was equilingual in English and in the ancient Celtic tongue of Welsh which is a working everyday language in many parts of Wales. She had both Welsh and English speaking relatives and spoke both languages with equal fluency at home. We devised a rehabilitation strategy that involved therapy sessions of equal duration in both languages. We monitored her progress in order to determine whether either the rate of progress or the final results following rehabilitation varied between the two languages.

Case report

Our patient was a 57-year-old lady who became deaf in the left ear at the age of four, shortly after adenotonsillectomy. She suffered from chronic suppurative otitis media affecting both ears and gradually lost all hearing in the right ear so that, one year prior to implantation, a large subtotal perforation of the right ear was repaired with underlay perichondrium. Computed tomography (CT) scanning and magnetic resonance imaging (MRI) showed a normal cochlea and a promontory test revealed a good dynamic range in the right ear to testing over the frequency range 50–1600 Hz. A Nucleus 22 Channel device was implanted in August, 1991, and the electrodes were all inserted into the right cochlea with ease. Stapedial reflex testing at operation confirmed the device was working satisfactorily. After switch on, Bipolar +1 stimulation was used with 20 electrodes. The dynamic range on all 20 electrodes was excellent.

Methods

After an initial two-day familiarisation with the implant, the patient began a series of graded exercises. The exercises performed consisted of initial discrimination tests where the patient was asked to say whether two vowels or sentences were the same or different. These were followed by more difficult identification exercises where the patient identified the presented vowel, word or sentences from a variety of choices. These were performed without visual clues.

The exercises were carried out over a three-month period in both English and Welsh. The Welsh exercises were devised from the Cochlear AG English rehabilitation

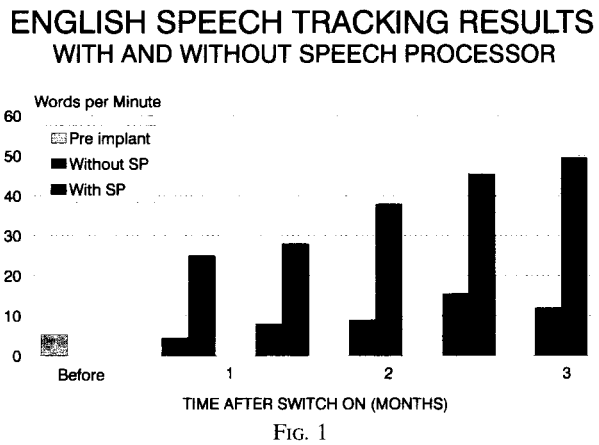

FIG. 1

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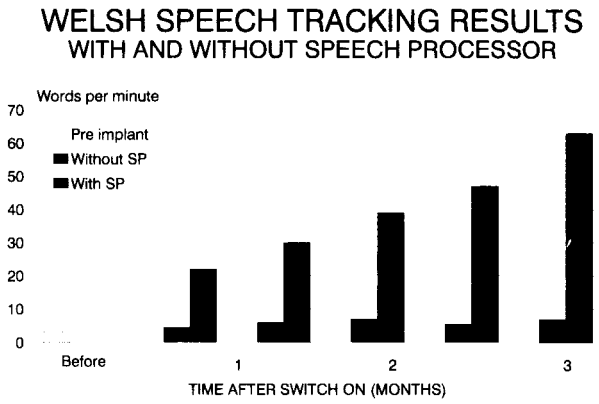

FIG. 2

manual using Welsh vowels, words and sentences that were as similar as possible (see appendix). Open set speech tracking and paragraph tracking both with lip reading were recorded in both languages (Figures 1, 2, 3).

Results

The results indicate remarkable similarity in progress in both languages. In 92 per cent of exercises, there was less than 10 per cent difference in scores between English and Welsh. These exercises included word length, discrimination, word length discrimination in sentences, sentence discrimination, sentence identification, word identification and paragraph tracking. In eight per cent of exercises, there was more than 10 per cent difference in scoring (Figure 4). This occurred in vowel length discrimination and word discrimination tests (Figure 5).

The correlation coefficient between English and Welsh scoring in speech tracking was 0.998 (Figures 1, 2). This was obtained by subtracting scoring without the speech processor from scoring with the speech processor and comparing English and Welsh.

Discussion

From the results, it appears that the variations in language have relatively little effect on progress following cochlear implantation. The high correlative coefficient in speech tracking progress between English and Welsh indicates almost identical progress in both languages. It is of interest to look at the exercises where there was significant variation.

The exercise involving vowel length discrimination appeared to be more difficult in Welsh (Figure 5).

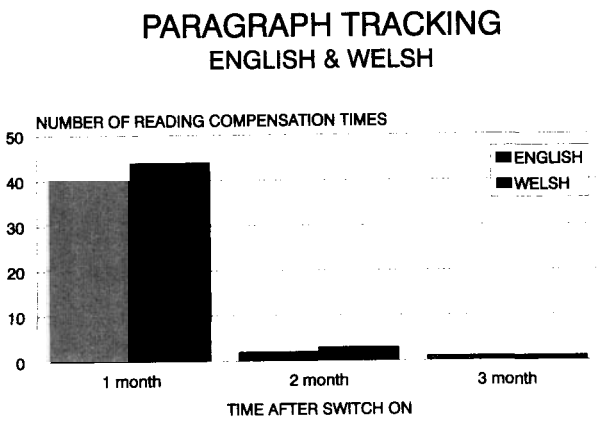

FIG. 3

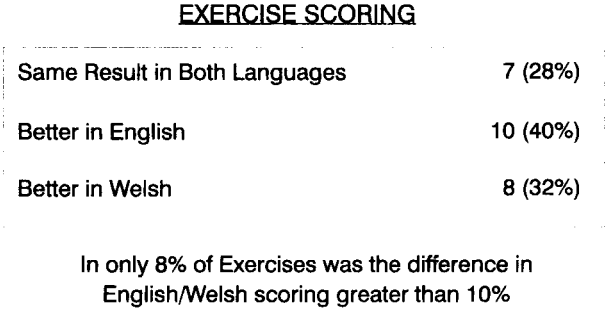

FIG. 4

However, it was difficult to create a similar vowel length exercise in Welsh owing to the fact that in North Wales, the clear qualitative difference between long and short vowels is not as marked as in South Wales. (Ball and Jones, 1984) It was, therefore, difficult to create minimal pairs based on the length of vowel as some vowels can be pronounced long or short in Welsh depending on regional accent.

Word discrimination (saying whether two consecutive words are the same or different usually by changing the vowel in the middle) was more difficult in Welsh (Figure 5). This again may be due to some regional variation in pronunciation of vowels in Welsh (our speech therapist came from East Clwyd and the patient was from Gwynedd) and also the fact that certain vowels such as short 'e' tend to be produced rather more open in the mouth in North Welsh than English. There is also an extra vowel sound in Welsh long /ɨ/ as in tŷ which is very close to long /i/. It might be helpful in the future to develop a more sensitive vowel minimal pair list and standardise it on hearing north Welsh speakers.

Paragraph tracking where the patient listened to a spoken passage and followed it by pointing to the written word appeared slightly easier in English in the first month, although the difference was less than 10 per cent (Figure 3). This may have been due to the fact that the patient, like many other Welsh speakers of her age group had had her formal written education in English and used Welsh primarily as a spoken language.

In conclusion, despite the relatively minor variations between the two languages, 92 per cent of the exercises showed less than 10 per cent variation in scoring with a correlation coefficient of 0.9998 English/Welsh speech tracking results. This concurs with previous studies (Battner *et al.*, 1987; Funasaka *et al.*, 1987, Garcia-Ibanez *et al.* 1987) which found that patients with different languages progress at a similar rate following implantation although they were not working with bilingual patients.

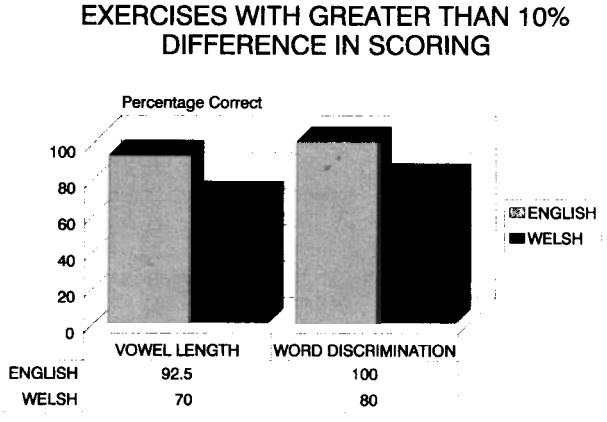

FIG. 5

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There is, therefore, no need to vary the electrode coding strategy for different languages of Indo-European origin although the situation may be different for tonal languages such as Chinese. In Indo-European tongues, the pattern of neuronal survival should be the main determinant of electrode usage.

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Appendix

Scores in English and Welsh in progressive exercises derived from the cochlear AG English rehabilitation manual.

Exercise		English score		Welsh score	
A2.1	Word length discrimination	75.5		84.4	
A2.2	Word length discrimination	90		90	
A3.1	Paragraph tracking	4		4.5	
A4.1	Word length discrimination with carrier phrase	90		95	
A4.2	Word length discrimination with carrier phrase	100		100	
A4.3	Word length discrimination with carrier phrase	100		95	
A5.1	Sentence discrimination		100		100
A5.2	Vowel length discrimination in words		92.5		77.5
A6.1	Pattern discrimination of sentences	100		100	
A6.2	Pattern discrimination of words		100		80
B1.1	Word length identification	86.6		84	
B1.2	Word length identification	100		93	
B2.1	Sentence identification		96.6		100
B3.1	Phrase length identification	96.6		86.6	
B3.2	Phrase length identification	86.6		93.3	
B3.3	Phrase length identification	100		93.3	
B4.1	Sentence length identification		93.7		100
B4.2	Sentence length identification		95		100
B4.3	Sentence length identification		91.6		100
B5.1	Paragraph tracking	2		3	
B5.2	Paragraph tracking	2		2	
B5.3	Paragraph tracking	1		1	
B7.1	Vowel length discrimination		100		100
B7.2	Vowel length discrimination		86.6		76.6
B8.1	Question/statement discrimination	64.2		67.8	

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