A VERIFICATION PROTOCOL OF FM SYSTEMS FOR CHILDREN WITH COCHLEAR IMPLANT

Zenker, F. [(1)], Mora Espino, R. [(2)], Rodríguez Jiménez, M.C. [(3)], Mesa Suárez, J.L. [(4)]
Coello Marrero, A. [(4)], Suárez Rodríguez, M. [(3)] and Barajas de Prat, J.J.[(3)]

(1) Fundación Canaria Dr. Barajas para la Prevención e Investigación de la Sordera (2) Clínica Barajas, (3) Universidad de la Laguna, (4) Consejería de Educación, Cultura y Deportes del Gobierno de Canarias.

ABSTRACT

Children with Cochlear Implants (CIs) can receive significant benefit in speech recognition through the use of an FM system in the educational setting. However, there are numerous settings as well as equipment arrangements that may be selected for a particular child. Therefore, a clinical protocol is needed for verification of performance to determine the optimum settings and arrangement. Evaluation through informal listening checks or electrouacoustic measures as conventionally done with Hearing Aids are not possible with CIs. Optimal connections and setting must be ensured by systematic speech recognition measures. This study shows a verification protocol of the benefit of FM systems connected with the Cochlear SPrint procesor. Speech recognition is measured in the sound field by live voice with the CI speech processor alone and combined with the FM receiver. Speech perception scores were obtained in quiet and in background noise with portable equipment of speakers in the children's classroom. Benefit of the FM System was established through identification of words and sentences with different lexical and grammatical difficulties. This protocol may be used to behaviourally verify the benefit received when coupling FM systems to Cis.

INTRODUCTION

Frequency modulated (FM) systems have been standard equipment for children with hearing loss in educational settings for many years. FM systems increase the signal to noise ratio through a microphone placed a few centimetres from the mouth of a talker and providing a wireless connection to the listener's Cochlear Implant (CI). The primary benefit of FM system is the resulting improvement of signal-to-noise ratio that allows the user to increase attention span, reduce distractibility, and increase sound awareness and discrimination .

The only way to ensure optimal connections and settings in a FM System is through systematic Speech Recognition Testing. Two parameters must be taken in account in order to fit a FM Systems to CIs. First, the appropriate audio mixing must be established through the Sensitivity of the microphone of the CI Speech Processor. Second, the FM Advantage must be adjusted in order to optimize loudness of the FM signal.

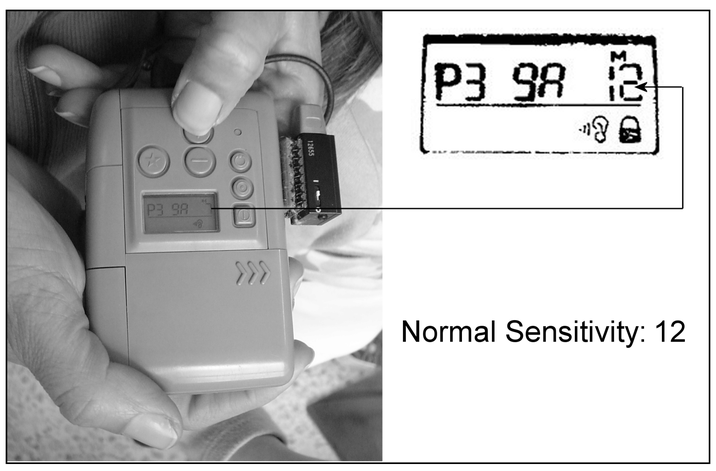
In this poster a verification protocol for fitting a Phonak Campus S to a Nucleus 24 Cochlear Implant is proposed. Evaluation of speech recognition benefit in noise with and without the FM system was carried out. The results confirm that the settings in both the CI and FM receiver are optimal.

VERIFICATION PROTOCOL

In the following lines a protocol in six steps is proposed in order to adjust the loudness of the FM compared to the environmental input and to confirm the FM benefit.

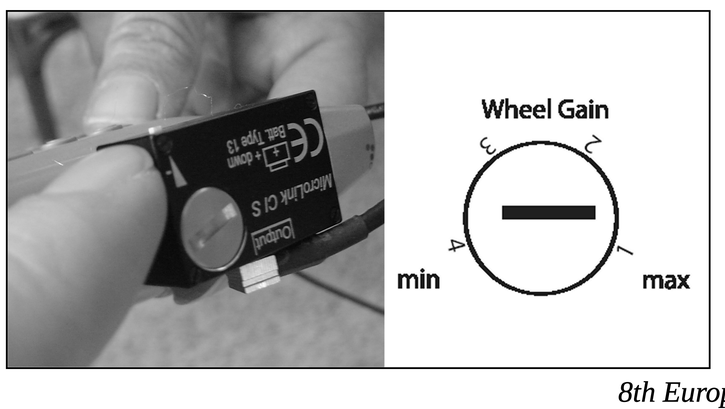
1. SPEECH PROCESSOR SETTING

SPrint monitor earphones were used to verify operation of the Phonak Campus S FM transmitter and MicroLink CI+FM receiver when connected to the speech processor. The present verification protocol must run under normal (12) sensitivity parameters. Optimal sensitivity adjustment must be reviewed in step 6.

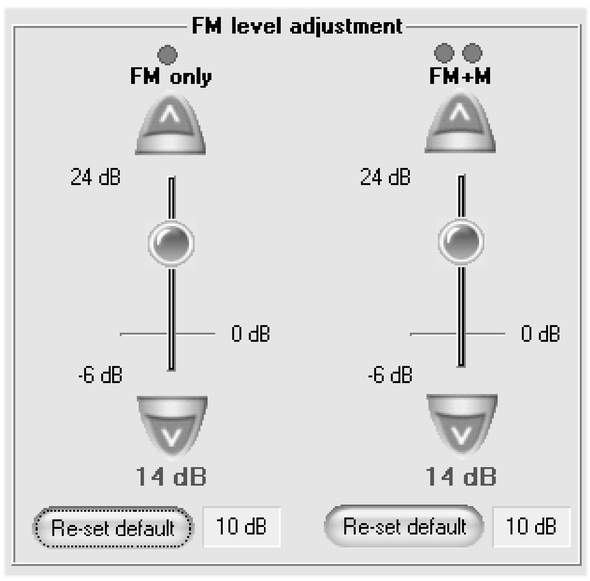


2. FM SYSTEM SETTING

The MicroLink interface has a wheel gain control that is fixed at 80%. Changes over FM advantage are achieved programming the internal gain through the Phonak FM Successware software.

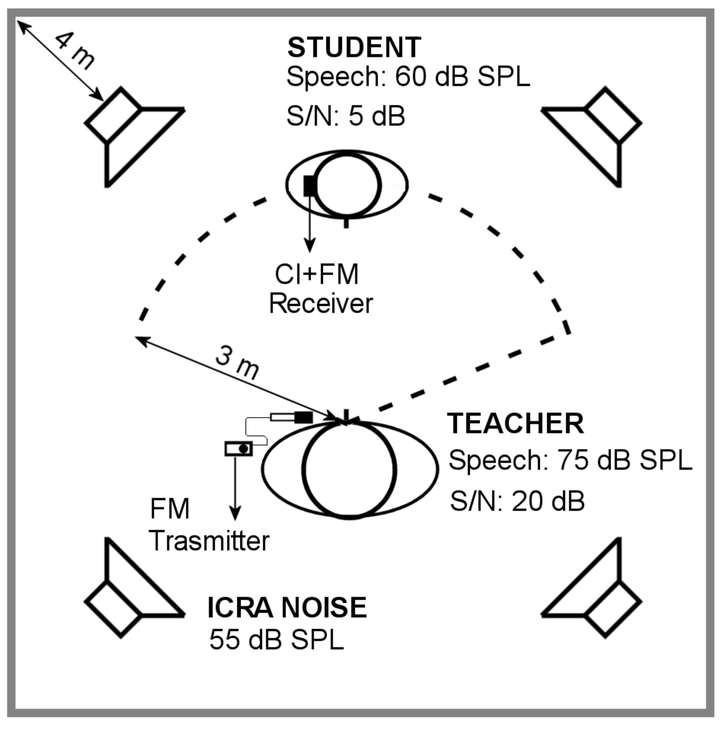


The default internal gain (FM advantage) of the MLxS receiver is 10dB with a range of -6 to +24dB available. Reprograming for optimal gain will be determine at Step 5.



3. TESTING ARRANGEMENT

Testing is carried out in the child's classroom. Noise is recorded multi-talker babble from the ICRA CD 1 Track 7. Loudspeakers are placed 1m from and facing the four corners of the room at 75 cm above the floor. Average root-mean-square (rms) noise level was 55 dB SPL at the student locations. Students are seated in the arc of a circle of radius 3 m, centred at the talker's mouth. The FM microphone is placed on the talker's chest at 30 cm from the mouth. Speech level measured was 74 dB SPL at the teacher's microphone and 60 dB SPL at the student location.



4. SPEECH MATERIAL

Speech perception is measured in two conditions; percentage of phonemes recognizes in list of frequent and infrequent words and percentage of words recognized in list of complex and simple phrases. Results are individually analyzed by an assisted computer software.

5. FM BENEFIT

In the following figure we show the results of a single case. The FM benefit is established as the difference with and without FM. In this patient a clear benefit is obtained by the FM system in the Specch Recpetion Testing scores.

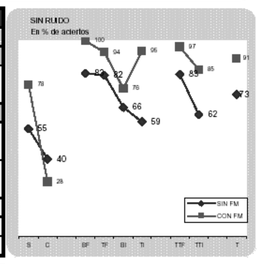
IHGF- IDENTIFICACIÓN DEL HABLA Y GANANCIA FUNCIONAL DE LAS FM

PROYECTO FM CANARIAS- CONSEJERÍA DE EDUCACIÓN, CULTURA Y DEPORTES DEL GOBIERNO DE CANARIAS
FUNDACIÓN CANARIA DR BARAJAS PARA LA PREVENCIÓN E INVESTIGACIÓN DE LA SORDERA

ALUMNO:		**CENTRO:**	CEIP Reyes Católicos
POBLACIÓN:	Las Palmas	**EXAMEN:**	12 de Marzo de 2007
ISLA:	Gran Canaria	**AULA:**	2º Primaria
EXPLORADOR:	Franz Zenker / Rosa Mora	**CORRECCIÓN:**	Cochlear Sprint

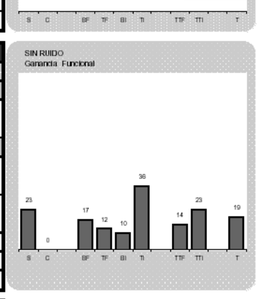
% RECONOCIMIENTO SIN FRECUENCIA MODULADA SIN RUIDO

Número de Item	1	2	3	4	5	6	7	8	9	10	Porcentaje
Complejidad Sintáctica											
Sencillas (S)	3	0	1	4	2	4	2	1	2	3	*55,00 %*
Complejas (C)	4	4	2	3	4	4	3	2	6	0	*39,51 %*
Frecuencia Léxica											
Bisilabicas Frecuentes (BF)	4	3	5	0	5	4	5	5	4	5	*83,33 %*
Bisilabicas Infrecuentes (BI)	2	2	4	2	3	5	3	4	5	3	*66,00 %*
Trisilabicas Frecuentes (TF)	5	5	5	4	7	4	6	3	3	5	*82,46 %*
Trisilabicas Infrecuentes (TI)	5	3	2	4	5	5	0	6	2	2	*58,62 %*
											Total Frecuentes (TTF) 82,89 %
											Total Infrecuentes (TTI) 62,31 %
											Total (T) 72,60 %



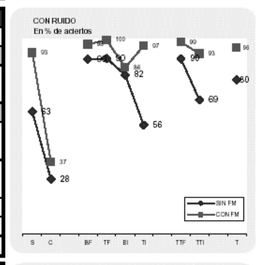
% RECONOCIMIENTO CON FRECUENCIA MODULADA SIN RUIDO

Número de Item	1	2	3	4	5	6	7	8	9	10	Porcentaje
Complejidad Sintáctica											
Sencillas (S)	3	4	3	4	3	2	3	4	3	2	*77,50 %*
Complejas (C)	2	2	3	2	4	2	0	1	2	4	*27,85 %*
Frecuencia Léxica											
Bisilabicas Frecuentes (BF)	4	5	5	5	5	5	5	5	5	5	*100,00 %*
Bisilabicas Infrecuentes (BI)	3	3	4	5	2	4	5	3	3	5	*75,51 %*
Trisilabicas Frecuentes (TF)	7	5	6	8	7	6	7	5	6	8	*94,20 %*
Trisilabicas Infrecuentes (TI)	5	5	7	8	6	4	7	3	5	5	*94,83 %*
											Total Frecuentes (TTF) 97,10 %
											Total Infrecuentes (TTI) 85,17 %
											Total (T) 91,14 %



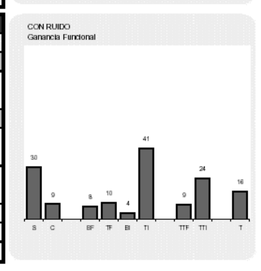
% RECONOCIMIENTO SIN FRECUENCIA MODULADA CON RUIDO

Número de Item	1	2	3	4	5	6	7	8	9	10	Porcentaje
Complejidad Sintáctica											
Sencillas (S)	2	4	4	2	4	2	3	4	1	3	*63,04 %*
Complejas (C)	1	2	4	1	6	2	5	0	0	1	*28,21 %*
Frecuencia Léxica											
Bisilabicas Frecuentes (BF)	4	4	4	3	4	2	3	4	4	4	*90,00 %*
Bisilabicas Infrecuentes (BI)	3	2	2	4	5	4	6	5	5	5	*82,00 %*
Trisilabicas Frecuentes (TF)	6	6	7	6	6	6	6	6	7	0	*90,32 %*
Trisilabicas Infrecuentes (TI)	7	0	3	7	5	5	3	3	4	0	*56,06 %*
											Total Frecuentes (TTF) 90,16 %
											Total Infrecuentes (TTI) 69,03 %
											Total (T) 79,60 %



% RECONOCIMIENTO CON FRECUENCIA MODULADA CON RUIDO

Número de Item	1	2	3	4	5	6	7	8	9	10	Porcentaje
Complejidad Sintáctica											
Sencillas (S)	4	3	4	3	4	5	4	5	5	5	*93,33 %*
Complejas (C)	3	0	3	5	3	1	3	5	2	5	*37,04 %*
Frecuencia Léxica											
Bisilabicas Frecuentes (BF)	4	5	3	4	5	5	4	4	4	4	*97,67 %*
Bisilabicas Infrecuentes (BI)	5	6	5	5	6	4	3	3	2	3	*85,71 %*
Trisilabicas Frecuentes (TF)	6	6	6	7	7	6	6	6	7	6	*100,00 %*
Trisilabicas Infrecuentes (TI)	6	7	7	7	7	6	5	7	6	7	*97,01 %*
											Total Frecuentes (TTF) 98,84 %
											Total Infrecuentes (TTI) 92,86 %
											Total (T) 95,85 %



Fundación Dr. Barajas. C/Pérez de Rozas 8. 38004 Santa Cruz de Tenerife. Tel: 922 27 54 88 E-mail: info@clinicabarajas.com

6. FINE TUNING

If the child's performance is not improved compared to using the CI alone, the ratio between the FM input and the headpiece microphone may need to be adjusted. In general, reducing processor sensitivity will result in a greater FM advantage as a result of reduced input through the CI microphone. Care should be taken in order to not reduce excessively the input of the CI microphone in order to avoid the isolation of the child from his peers. If this is the case, the gain of the MLxS receiver must be changed in order to increase the FM advantage as described in step 2.

REFERENCES

American Speech-Language-Hearing Assocation (2002). Guidelines for fitting and monitoring FM Systems. ***ASHA Desk Reference, 2, 151-171.***

Linda M. Thibodeau (2006). Behavioral Verification of Speech Recognition Benefit for Children with FM System Coupled to Cochlear Implants. ***Audiology Online.***

Calvo, J.C., Maggio De Maggi, M., Zenker,F. (2006).Sistemas de Frecuencia Modulada para educadores. ***Programa Infantil Phonak, Barcelona, 2006.***

Mora Espino, R., Zenker Castro, F., Rodríguez Jiménez, M.C., Mesa Suárez, J.L., Coello Marrero, A. (2006). Los sistemas de Frecuencia Modulada en alumnos con Implante Coclear. [en-línea]. ***Auditio: Revista electrónica de audiología. 1 diciembre 2006, vol. 3(2),pp. 32-36.*** **<http://www.auditio.com/revista/pdf/vol3/2/030201.pdf>**

Dreschler, W.A., Verschuure, H., Ludvigsen, C., Westermann, S. (2001). ICRA Noises: Artificial noise signals with speechlike spectral and temporal propieties for hearing instrument assessment. ***Audiology. 40: 148-157.***

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