

**EFFECT OF STIMULATION RATE ON SENTENCE, WORD AND  
LEXICAL-TONE RECOGNITION PERFORMANCE OF  
CANTONESE-SPEAKING COCHLEAR IMPLANT RECIPIENTS –  
IMPLICATIONS ON THE ADEQUACY OF CURRENT SPEECH CODING  
STRATEGIES FOR TONE LANGUAGES**

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**ABSTRACT**

**Objectives**

This study aimed at investigating if higher rate of electrical stimulation would provide better outcomes in Cantonese-speaking cochlear implant recipients.

**Design**

Nine post-lingual deafened subjects implanted with the Nucleus 24 CI24M receiver/ stimulator participated in the study. They were evaluated on speech recognition and subjective preference on two stimulation conditions in a repeated measures experimental design : (1) low rate of stimulation with 275 pulses per second per channel (pps/ ch) from the Advanced Combination Encoder (ACE) speech coding strategy (LOW RATE), and (2) high rate of stimulation with 1320 pps/ ch ACE (HIGH RATE).

## **Results**

The two stimulation conditions did not give different performance in open-set word recognition and open-set sentence recognition-in-noise, while HIGH RATE gave better performance in lexical-tone identification. There were more lexical-tone confusion errors in LOW RATE. Eight lexical-tone-confusion pairs (each confusion pair involves a target lexical-tone and an error lexical-tone) were found to have higher occurrence than other confusion pairs. Five out of nine subjects preferred HIGH RATE from subjective evaluation.

## **Conclusions**

Higher analysis rate and stimulation rate encode fundamental frequency (F0) modulation of the lexical-tone stimuli more adequately by minimizing aliasing effect, which might have contributed to the better performance of lexical-tone identification in HIGH RATE. The ability of the existing speech processing scheme in representing F0 for speakers with different F0 range was discussed. Lexical-tones with mid to low F0 were easily confused among one another, due to the crowding of F0 values. However, the degree of F0 separation was not sufficient to explain all the results from lexical-tone-confusion analysis.

## **Presentations**

Yuen, K. C. P., Murray, B. Wong, T. K. C., Wong, E. C. M., Chan, V., Chung, I., Tong, M. C. F., van Hasselt, A. C., Yu, H. C. (2004) Effects of stimulation rate on Cantonese lexical-tone recognition in cochlear implant recipients ? Can current speech coding strategies optimize performance for tonal languages? Paper presented at the *XXVIIth International Congress of Audiogoy, Phoenix, 26-30 Sep, 2004.*

Yuen, K. C. P., Murray, B. Wong, T. K. C., Wong, E. C. M., Chan, V., Chung, I., Tong, M. C. F., van Hasselt, A. C., Yu, H. C. (2003). Effect of stimulation rate on speech recognition performance of Cantonese-speaking cochlear implant recipients using the Nucleus 24 ACE speech coding strategy. Paper presented at the *Fourth Asia Pacific Symposium on Cochlear Implant and Related Sciences, Taipei.*