THE EFFECTS OF TASK DIFFICULTY ON THE MISMATCH NEGATIVITY (MMN) DURING INTER-MODAL SELECTIVE ATTENTION.

Alexandra Muller-Gass and Kenneth Campbell, School of Psychology, University of Ottawa.

INTRODUCTION

- The stimulus to which the processes induced by the MMN are independent of attention remains unclear. Initial studies indicated that the amplitude of the MMN was unaffected by whether the subject was attending to or ignoring the eliciting auditory stimuli [1]. More recently, studies have reported that the MMN elicited by small deviants is enhanced in amplitude with auditory attention [2-6].

- The effect of engagement in the attentional task on the detection MMN is also expected to modulate the MMN. Capacity model defines attention as the process of selecting responses to specific inputs [7]. These attentional resources are limited. According to the capacity model, more attentional resources may be available for the processing the task-relevant auditory stimuli. Some studies comparing the MMN elicited during the Easy and Difficult conditions showed that the amplitude of the MMN is associated with the degree of attentional resources that are allocated to the standard stimuli. This effect may however be affected by stimulus characteristics [8].

- ERP activity was recorded from 8 channels (Fz, Cz, Pz, Oz, F3, F4, M1, M2).

PART 1

METHOD

SUBJECTS

- Twelve (6 women) between 17 and 27 years.

STIMULI

- Mixed sequences of equiprobable auditory and visual stimuli were presented with a random ISI ranging between 200 and 350 ms.

F1. VISUAL STIMULI

F2. TARGET DETECTION

F3. VISUAL TARGET ERPS

F4. STANDARD ERPS

PART 2

METHOD

SUBJECTS AND STIMULI

- Same as in Part 1.

PROCEDURE

- After completing Part 1, subjects were instructed to divide their attention between visual and auditory channels and to discriminate both visual and auditory deviants. The visual task was again easy or difficult. A total of 3000 trials per subject were selected at random from the total number of trials. The auditory channel was used for discrimination of tones. In different conditions, the deviant stimuli was either easy or difficult to detect.

PROCEDURE

- Subjects were asked to button press upon detection of the visual target and ignore the auditory stimuli. A total of 3000 trials were presented with equal probability. These blocks of stimuli were presented for each task difficulty. The presentation of the conditions alternated between easy and difficult tasks and was counterbalanced across participants.

EEG RECORDING

- EEG activity was recorded from 8 channels (D, Cz, Oz, F3, F4, M1, M2).

RESULTS

- Visual and Auditory standard deviants elicited significantly different amplitudes between standard and deviant stimuli. No differences were found for the deviant stimuli.

F5. FREQUENCY MMN

F6. INTENSITY MMN

F7. VISUAL TARGET DETECTION

F8. AUDITORY TARGET DETECTION

F9. AUDITORY STANDARDS

F10. FREQUENCY DIFFERENCE WAVES

CONCLUSIONS

- The Easy and Difficult visual discrimination tasks successfully varied task difficulty. In the Easy task, reaction time (RT) was lower and the error rate (ER) was higher. In the Difficult task, reaction time (RT) was higher and the error rate (ER) was lower. The auditory task was significantly affected by attention. This enhancement however not significantly affected the MMN to frequency deviants.

- When subjects attended to both visual and auditory channels, their visual task performance (deviation-related negativity (D RN)) was not significantly affected by attention. This effect was more pronounced in the Easy task than in the Difficult task. Task difficulty did not however have an attenuation effect on the visual and auditory standard deviations (ps < .0001). Interestingly, the level of difficulty of the visual discrimination task did not significantly affect the MMN to frequency (F1) and intensity (F2) deviants.

- The deviance-related negativity was significantly larger when subjects attended to both visual and auditory channels and to discriminate both visual and auditory deviants. The visual task was again easy or difficult. A total of 3000 trials were presented at random. One block of stimuli was presented for each subject. The visual and auditory standard effects were found to be significant (ps < .0001).

- In the Easy task, reaction time (RT) was faster and hit rate (HR) was unaffected by whether the subject was attending to or ignoring the eliciting auditory stimuli. The true MMN comes from the longer RTs for the intensity relative to the frequency deviant (F11). Support for this also comes from the longer RTs for the intensity deviant (F11). Support for this also comes from the longer RTs for the intensity deviant (F9).

REFERENCES