HAMPSHIRE COLLEGE

Modulation of P1 as a Function of Visual Selective Attention in Adults and Children

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Abstract

Research suggests that children, like adults, show modulation of early brain processes as a function of selective attention (Bartgis, Lilly, & Thomas, 2003, Maatta, Paakkinen, Saavalaninen & Partanen, 2005, Perez-Edgar &Fox, 2005, Sanders, Stevens, Coch, & Neville, 2006, Taylor & Khan, 2000). However, while studies involving auditory attention have shown modulations in the amplitude of the P1 event related potential (ERP) component as a function of selective attention (e.g. Sanders et al., 2006), only changes in latency of early components have been demonstrated with visual stimuli (Taylor and Khan, 2000). The present investigation first replicates adult studies of visual selective attention (e.g. Mangun & Hillyard, 1991) showing selective attention based modulation of the P1 and then extends this research to children ages 7-10. Children and adults were presented with pictures at both fixation and in their peripheral visual field above fixation. In one task they were asked to attend to only the pictures appearing at fixation and determine whether the picture was an animal or vehicle. In a second task they were asked to maintain fixation but also report on pictures not presented at fixation. In both children and adults, P1 amplitude to pictures presented above fixation were significantly increased when the target stimulus was attended (task at both fixation and above fixation) as compared to unattended (task only at fixation). These results show that stimulus processing in children, like adults, is modulated by selective attention early in visual processing.

Background

Selective attention modulates early processing in adults. Specifically the P100, associated with visual processing, changes in amplitude as a function of attention. Previous research suggests that

- **children show modulation of early brain processes as a function of selective auditory attention** (Bartgis, Lilly, & Thomas, 2003, Maatta, Paakkinen, Saavalaninen & Partanen, 2005, Perez-Edgar &Fox, 2005, Sanders, Stevens, Coch, & Neville, 2006, Taylor & Khan, 2000).

- **selective attention modulates latency of early components in children using visual stimuli** (Taylor and Khan, 2000).

Therefore, this study will examine changes in ***amplitude*** as a function of selective attention for ***visual stimuli*** in children. It is hypothesized that visual selective attention will modulate both amplitude and latency of the P100 for adults and children.

Methods

Participants were asked to complete a focused or distributed attention task while electrophysiological recordings were acquired.

Participants

- 7 Adults (3 Males, 4 Females, mean age = 21.57, SD =1.27, 6 White, 1 Hispanic)
- 7 Children (1 Male, 6 Females, mean = 8.86, SD =1.42, 5 White, 1 Black/White, 1 Hispanic/White)

Adult participants were recruited from Hampshire College and child participants were recruited through Hampshire College and within the surrounding Pioneer Valley community. Participants were excluded from participation if they were left handed, had visual impairments that could not be corrected with glasses/contacts, were diagnosed with or suspected learning disorders, were currently on psychotropic medications, or if they were born premature (ie less than 36 weeks). Participants received $10 for participation.

Electrophysiological Recordings

- ERPs were collected using a SYNAMPs amplifier with SCAN recording software. Thirty-two channel tin ElectroCaps using a linked-mastoid reference were used with a sampling rate of 250Hz and a filter of .1 to 100Hz. Additionally recordings from EOG and HEOG were collected to detect and exclude trials containing blink artifacts.
- Recordings from OZ, O1, and O2 were averaged by condition and analyzed.

Methods (cont.)

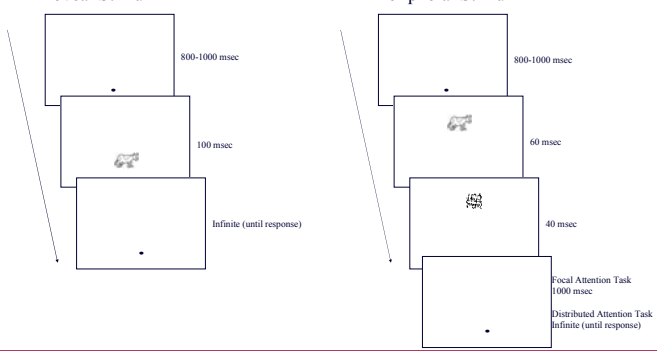
Selective and Divided Attention Tasks:

- 280 trials
  - 50% of trials showed pictures at fixation, 50% of pictures in the periphery
    - 50% animal stimuli, 50% vehicle stimuli

- **Participants completed two versions of task**
  - **Focal Attention participants asked to categorize stimuli at fixation only**
  - **Distributed Attention participants asked to categorize stimuli at fixation and in periphery**
- **Participants were asked to press one button if the target item was an animal and one if it was a vehicle.**
- **Only ERP responses to peripheral stimuli were analyzed for both focused and distributed tasks**

Animal Stimuli 

Vehicle Stimuli 



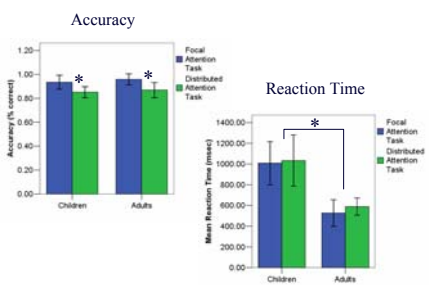
Results

Accuracy

- **Higher Accuracy for Focal Attention task as compared to Distributed Attention task**
  - Main Effect of Task: 2(Task) x 2 (Age) MANOVA F(1,12)=103.35, p<.001

Reaction Time

- **Faster Reaction Times for Adults as compared to Children**
  - Main Effect of Age: 2(Task) x 2 (Age) MANOVA F(1,12)=26.94, p<.001



Results (cont.)

Electrophysiological Data

Average Amplitude P100 to Peripheral Stimuli
(2(Age) x 3(Task) Repeated Measures MANOVA)

- **Main Effect of Task**
  - **O1** (F(1,12)=2.89, p=.115)
  - **OZ** F(1,12)=14.39, p=.003)*
  - **O2** (F(1,12)=10.74, p=.007)*
- **Interaction of Age and Task**
  - **O1** F(1,12)=4.22, p=.062)
  - **OZ** F(1,12)=7.21, p=.020)*
  - **O2** F(1,12)=6.13, p=.029)*

Latency P100 to Peripheral Stimuli
(2(Age) x 3(Task) Repeated Measures MANOVA)

- **Main Effect of Age**
  - **O1** (F(1,12)=26.71, p<.001)*
  - **OZ** F(1,12)=23.60, p<.001)*
  - **O2** (F(1,12)=32.85, p<.001)*

Discussion

- Behavioral Data suggests that while there are no differences in reaction time between the focal task and the distributed attention task there are decrements in accuracy for the distributed attention task as has been found in a number of studies of divided attention (which occurs during the distributed attention task) (e.g. Parasuraman, 1998)

- In contrast, ERP data show increased amplitude in the distributed attention task as compared to the focal attention task as attention is directed towards the peripheral stimulus.

- Moreover, this difference in amplitude between focal and distributed attention is seen in both adults and children. This replicates and extends studies of selective auditory attention in children (e.g. Sanders et al. 2006)

=> This study suggests that children, like adults show modulation of the P100 to visual stimuli as a function of attention.

References

Please see handout, download this poster and references from the web at
http://helios.hampshire.edu/~jwcCS/JCouperus.htm,
or contact the first author at jcouperus@hampshire.edu.

Acknowledgements

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References

Bartgis, J., A. R. Lilly, et al. (2003). "Event-related potential and behavioral measures of attention in 5-, 7-, and 9-year-olds." Journal of General Psychology 130(3): 311-335.

Maatta, S., A. Paakkonen, et al. (2005). "Selective attention event-related potential effects from auditory novel stimuli in children and adults." Clinical Neurophysiology 116(1): 129-41.

Mangun, G. R. and S. A. Hillyard (1991). "Modulations of sensory-evoked brain potentials indicate changes in perceptual processing during visual-spatial priming." Journal of Experimental Psychology: Human Perception and Performance 17(4): 1057-1074.

Parasuraman, R. (1998). The attentive brain. Cambridge, MA, US, The MIT Press.

Perez-Edgar, K. and N. A. Fox (2005). "A Behavioral and Electrophysiological Study of Children's Selective Attention Under Neutral and Affective Conditions." Journal of Cognition and Development 6(1): 89-118.

Sanders, L. D., C. Stevens, et al. (2006). "Selective auditory attention in 3-to 5-year-old children: An event-related potential study." Neuropsychologia 44(11): 2126-2138.

Taylor, M. J. and S. C. Khan (2000). "Top-down modulation of early selective attention processes in children." International Journal of Psychophysiology 37(2): 135-147.