

# Visual Search and the N2pc in Children

## Abstract

While there is growing understanding of visual selective attention in children, some aspects such as selection in the presence of distractors are not well understood. Adult studies suggest that when presented with a visual search task, an enhanced negativity is seen beginning around 200ms (the N2pc) that reflects selection of a target item among distractors (Eimer, Kiss, and Nicholas, 2011). However, to date this effect has only been examined in adults, thus this study was designed to investigate the presence of the N2pc in children. Fourteen children (ages 9-12) and 20 adults (ages 18-22) completed a visual search task in which they were asked to attend to a fixation surrounded by 6 grey and 2 colored (red, green, or blue) letters and numbers. Participants were asked to attend to one of the three colors and indicate (when present), if it was a letter or number, leaving the other colored item as a distractor. Three types of displays were analyzed at parietal electrodes P7 and P8; lateral target/lateral distractor (LTLT), lateral target/midline distractor (LTMD); and midline target/lateral distractor (MTLD). Both adults and children showed a significant increased negativity contralateral as compared to ipsilateral to the target (reflected in the N2pc) in both displays with a lateral target (LTLT  $F(1,32)=24.47, p<.001$  and LTMD  $F(1,32)=4.69, p=.038$ ) while no such effect was seen in displays with a midline target (MTLD,  $p>.05$ ). This suggests that children, like adults, utilized additional resources to select a target item when distractors are present.

## Background

Previous research on selective attention in visual search suggests that top-down attentional set influences processing of attended items in the presence of distractors as seen in the N2pc (e.g. Eimer, Kiss, and Nicholas, 2011).

- While there is growing evidence that children's visual selective attention functions similarly to adults (e.g. Couperus, 2011; Taylor and Khan, 2000) it is not yet clear if selective attention during visual search functions similarly in children.
- Behavioral evidence with children suggests there may be differences in visual search in children as compared to adults (Donnelly et al., 2007).

Thus, this study will examine the N2pc during a visual search task to examine potential differences in the neurological correlates of visual selective attention between adults and children.

## Methods

Participants were asked to complete a visual search task while electrophysiological recordings were collected.

### Participants

Twenty adults (mean age=19.35, SD=1.2, 13F/7M) and Fourteen 9-12 year old children (mean age=10.75, SD=.93, 4F/10M) participated in this study.

Participants were recruited from the Pioneer Valley in Western MA. Participants were excluded from participation if they had visual impairments that could not be corrected with glasses/contacts or if they were born premature (ie less than 36 weeks). Participants received \$10-20 for participation.

### Electrophysiological Recordings

- ERPs were collected using a SYNAMPS2 amplifier with SCAN recording software. Thirty-two channel tin ElectroCaps using a linked-mastoid reference were used with a sampling rate of 1000Hz and a filter of .1 to 100Hz. Additionally recordings from VEOG and HEOG were collected to detect and exclude trials containing blink artifacts.
- Recordings from P7 and P8 were averaged by condition and analyzed.

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## Visual Search Task

(Based on Eimer, Kiss and Nicholas 2011):

➤ 768 trials

➤ 256 of each color combination (red/green, red/blue, green/blue)

➤ Approximately equal numbers of each of 7 possible conditions as a function of color attended:

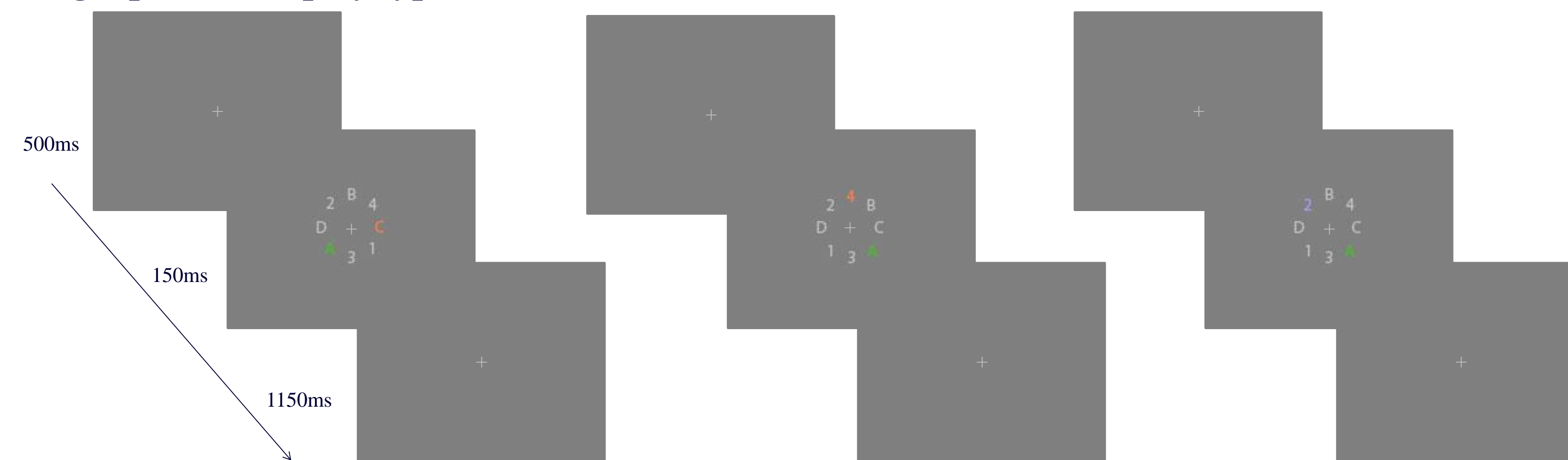
➤ Target midline – Distractor left, Target midline – Distractor right, Distractor midline – Target left, Distractor midline – Target right, Target left – Distractor right, Target right – Distractor left, No target present

➤ Target present conditions collapsed to create 3 conditions for analysis:

➤ Lateral target/Lateral distractor (LTLT), Lateral target/Midline distractor (LTMD); and Midline target/Lateral distractor (MTLD)

➤ Participants were asked to attend to one color and when present indicate if the colored object was a number or letter

➤ ERPs were analyzed for each condition at parietal leads (F7 and F8) for all conditions except no target present display types



Attend RED: Lateral Target/ Lateral Distractor (LTLT) Midline Target/ Lateral Distractor (MTLD) No Target (NT)  
Attend GREEN: Lateral Target/ Lateral Distractor (LTLT) Lateral Target/ Midline Distractor (LTMD) Lateral Target/ Lateral Distractor (LTLT)  
Attend BLUE: No Target (NT) No Target (NT) Lateral Target/ Lateral Distractor (LTLT)

## Methods (cont.)

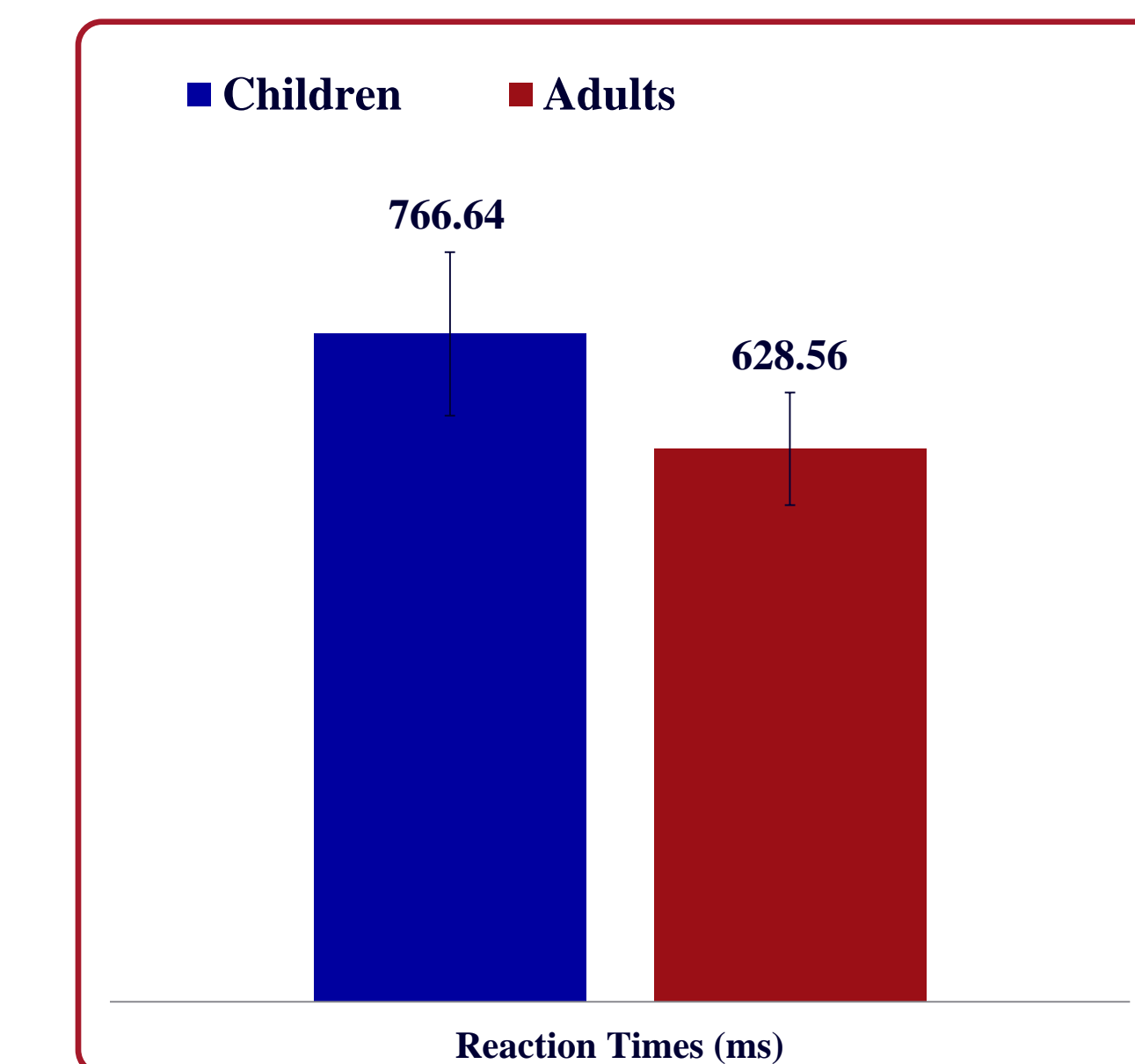
### Behavioral Results:

#### Accuracy

- Mean Accuracy
- Children= 81.4% (SD = 13.9%)
- Adults=83.1% (SD = 14.8%)
- Not significantly different as a function of age  $p>.05$

#### Reaction Time

- Not significantly different as a function of age  $p>.05$



## Results

### Electrophysiological N2pc Results:

2(Age) x 3(Target/Distractor Location) x 2 (Side) Repeated Measures Anova

- Significant Main Effect of Age (Child vs. Adult)
  - $F(1,32) = 51.11, p<.001$
- Significant Interaction between Target/Distractor Location and Side (contralateral vs. ipsilateral)
  - $F(2,32) = 6.29, p=.005$
- No significant three way interaction between Age, Target/Distractor Location and Side

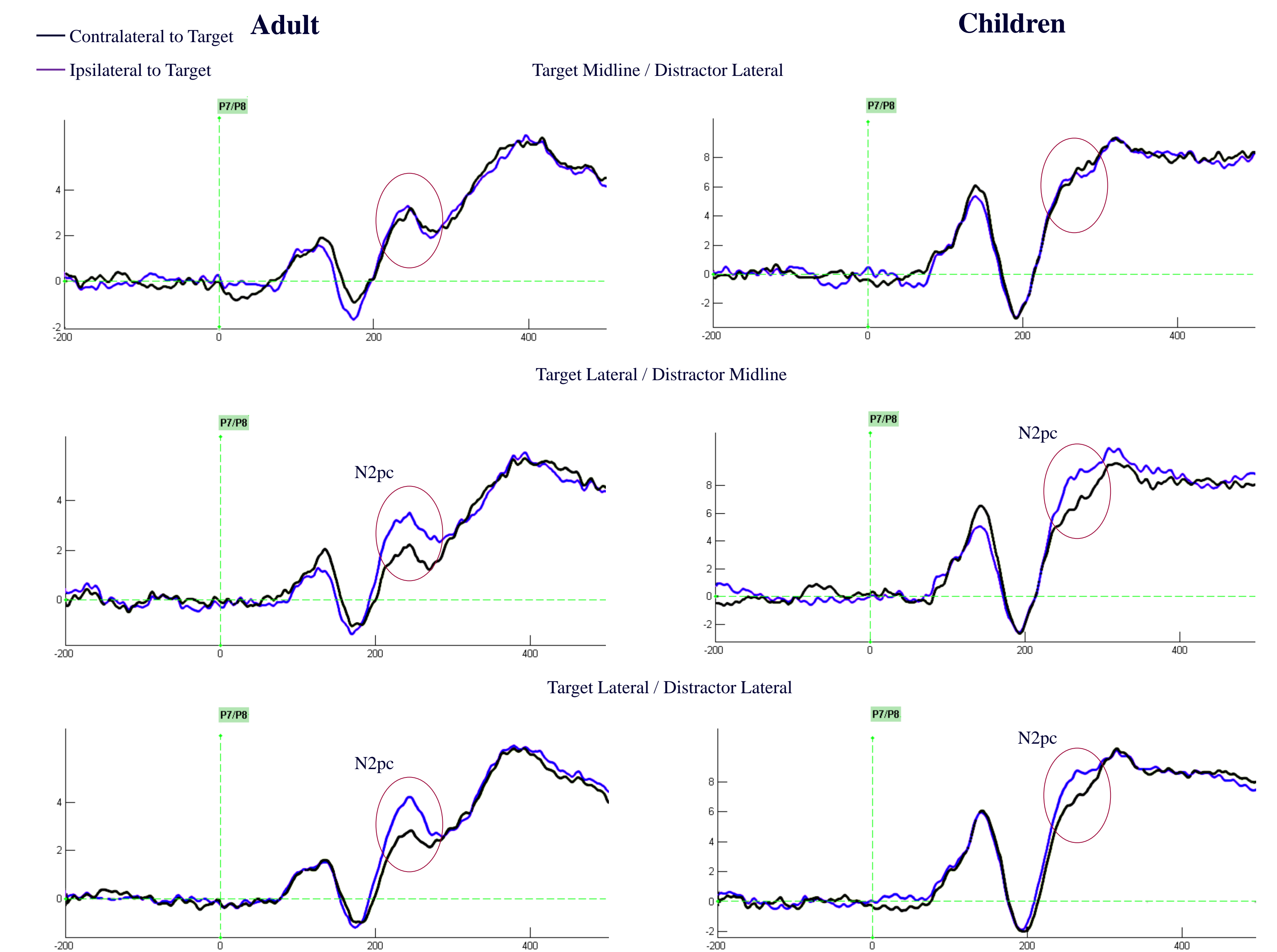
### Children

- Significant N2pc for Target Lateral/Distractor Lateral Condition
  - $t(13)=-2.61, p=.021$
- No Significant N2pc for Target Lateral/Distractor Midline or Target Midline/Distractor Lateral

### Adults

- Significant N2pc for Target Lateral/Distractor Midline
  - $t(19)=-3.35, p=.003$
- Significant N2pc Target Lateral/Distractor Lateral
  - $t(19)=-4.69, p<.001$
- No N2pc Target Midline/Distractor Lateral

## Results (cont.)



## Discussion

• Behavioral data suggests that children perform this task similarly to adults, effectively using visual selective attention to perform this visual search task.

• ERP data show that while children have greater activity as compared to adults overall, there are few differences between children and adults in stimulus processing as a function of selective attention during the visual search task.

- Overall there were no significant differences in the conditions that elicited an N2pc between adults and children.
- However, follow-up analyses suggest that while adults showed a significant N2pc both when there was a lateral target paired with a lateral distractor as well as when there was a midline distractor, children showed a significant N2pc only when there was a lateral target paired with a lateral distractor (although this may be due to low power).

=> This study suggests that children, like adults, use top down attentional mechanisms during stimulus processing in the presence of a distractor as seen at the N2pc. This further supports previous research (e.g. Couperus 2011) which suggests visual selective attention functions similarly in adults and children by early childhood.

### Further Information

For further information on projects in this lab visit the website at

<http://helios.hampshire.edu/~jwcCS/JCouperus.htm>,

or contact the first author at [jcouperus@hampshire.edu](mailto:jcouperus@hampshire.edu).

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