Sources of attention-sensitive visual event-related potentials

A paper by Carlos M. Gomez, Vincent P. Clark, Silu Fan, Steven J. Luck, and Steven A. Hillyard

Starting-point

- People can focuse voluntarily attention upon particular locations in the visual field without making overt eye movements.
- Recent studies say that stimuli presented within the focus of attention elicit larger sensory-evoked responses than stimuli presented at unattended locations.
- Recent ERP study reported that attention was found to influence the P1 and N1 components (ca. 110 and 170 ms), but not the earlier C1 component (ca. 80 ms).

Questions & Hypothesis

- Questions:

1. Does this discrimination performance result either from changes in early, sensory-level processing or from changes in postperceptual stages such as short-term memory and response selection?
2. At which stage does attention begin to affect processing? The present study aimed to provide information about the attentional sensitivity and neural generator location of the C1, P1 and N1 components.

- Hypothesis:

ERP will produce data of a highly focused state of selective attention.

Methods

- **Procedure:**

14 subjects / (6 m, 8 f) / (18-24 yrs)

- **Stimuli:**

v Color video monitor (75cm distance).

v Fixation point in the middle.

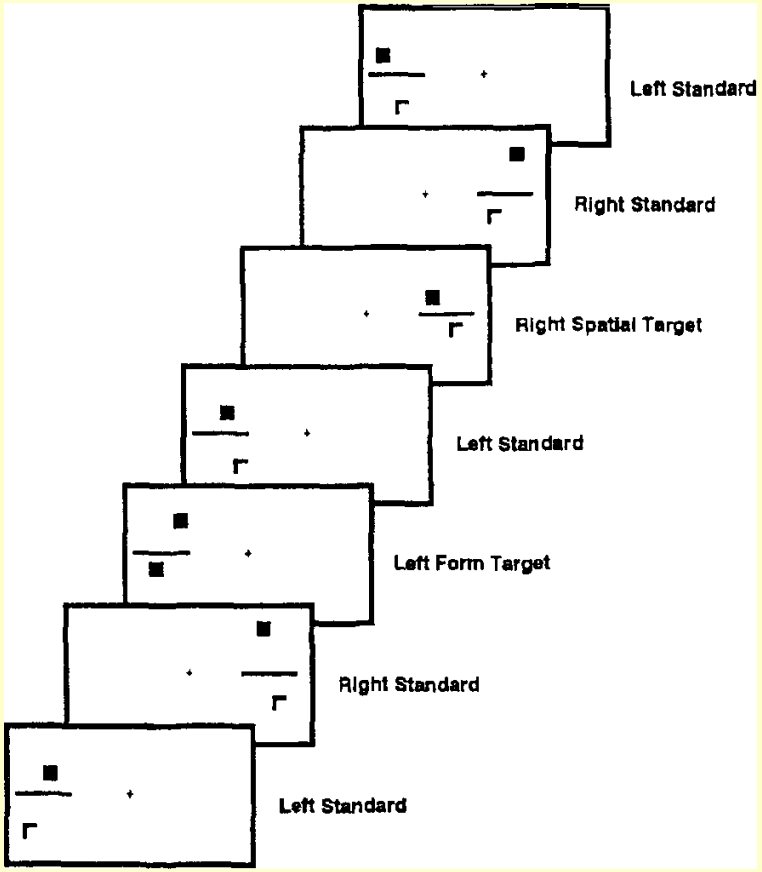
v Stimulus duration was 250 ms.

v 120 stimulus patterns; 60 in the left visual field, 60 in the right.

v The interval varied between 650 and 900ms.

v The subjects should press the left or right button.

v Deviations in eye position were discarded later.



Experimental design

- UV: Stimulus for attention / interval
- AV: ERP / interval
- ERP was recorded from 29 scalp locations. In order to remove the overlapping ERP waveforms arising from previous and subsequent stimuli, the ADJAR correction procedure was used.

Results I

- Subjects were faster at detecting the form targets than the spatial distance targets.
- Subjects were faster for left visual field targets than for right visual field targets.
- The sensory-evoked P1 and N1 components were larger for attended stimuli than for unattended stimuli.

Table I. Reaction time (in ms) and accuracy (percent misses) for left and right visual field targets in the form discrimination and spatial distance discrimination conditions.

Condition	RT	Accuracy
Form Discrimination, Left	539	96.4
Form Discrimination, Right	525	96.9
Distance Discrimination, Left	565	94.0
Distance Discrimination, Right	573	95.0

Table II. Component amplitudes (in uV) for attended and unattended stimuli, measured at lateral occipital (P1 and N1) or perimidline (C1) electrode sites (standard errors in parentheses).

	C1	P1	N1
Attended	-0.13	0.82	-1.85
	(0.12)	(0.22)	(0.31)
Unattended	-0.16	0.40	-0.73
	(0.09)	(0.17)	(0.21)

Results II

- The areas of spatial attention are: V4 and IT (extrastriate areas).

1. ERP shows that P1 and N1 components were larger for attended than for unattended stimuli =>spatial attention influences processing at an early,sensory level.
2. No significant effects of attention were observed for the C1 component, suggesting that spatial attention operates after visual information has passed through striate cortex, where the C1 is hypothesized to be generated.

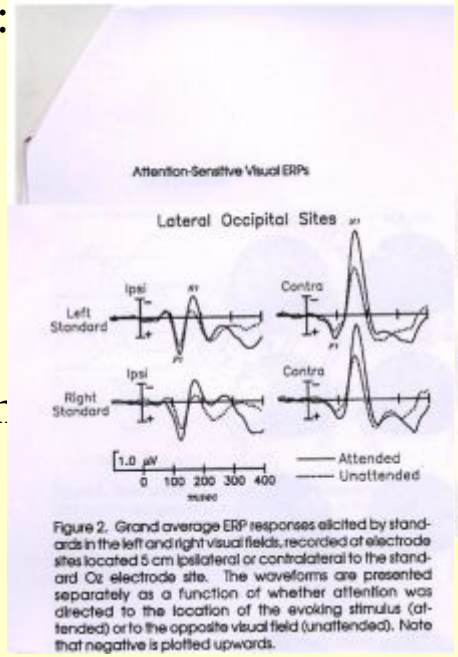


Figure 2. Grand average ERP responses elicited by standards in the left and right visual fields, recorded at electrode sites located 5 cm ipsilateral or contralateral to the standard Oz electrode site. The waveforms are presented separately as a function of whether attention was directed to the location of the evoking stimulus (attended) or to the opposite visual field (unattended). Note that negative is plotted upwards.

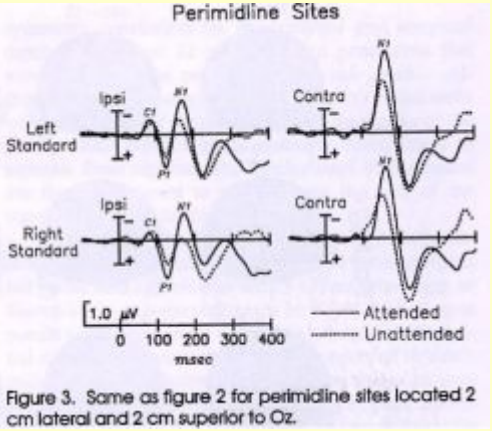


Figure 3. Same as figure 2 for perimidline sites located 2 cm lateral and 2 cm superior to Oz.

Conclusion

- Visual-spatial attention begins to affect sensory processing at the time information reaches the cerebral cortex (the same goes for auditory attention).

Reference

- Carlos M. Gomez Gonzalez, Vincent P. Clark, Silu Fan, Steven J. Luck, and Steven A. Hillyard (1994): Sources of attention-sensitive visual event-related potentials. *Brain Topography*, Volume 7, No.1