FUNCTIONAL SIGNIFICANCE OF EARLY MULTISENSORY RESPONSES IN MODALITY SPECIFIC CORTEX

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Information in one sensory modality often alerts us to information in another sensory modality.

Preceding auditory cue makes the appearance of subsequent visual stimuli at that location:
- faster and more accurate (McDonald et al. 2000, 2003, 2005)
- brighter (Stoermer et al. 2009)

What neural mechanism mediates this enhancement of visual perception by an auditory cue?

Experimental Paradigm

time interval (450 ms) between auditory cue and visual target
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO VISUAL TARGETS
Indeed, we found that attention cueing ERP would correlate with observers’ reports of perceived contrast. The question of interest here was whether the amplitude of this positive target-elicited ERPs at relatively late stages and have no contrast-appearance judgments reflects decision bias rather than visual cortex. In contrast, if the cross-modal attention effect on target, the auditory cue should influence early components of the equal physical contrast on the uncued side. Moreover, if such a visual target on the cued side as higher in contrast than a target of enhanced apparent contrast, observers should tend to judge the visual target to be higher in contrast (Fig. 2).

In the present study, we observed a cue-related asymmetry in the early ERP components recorded over the left and right occipital scalp after target onset. With physically identical bilateral stimuli, the P1 at 140 ms (relative to target onset) and the N1 at 190 ms. Early occipital ERPs elicited by physically identical Gabor patches were comprised of prominent positive and negative peaks, including working memory encoding, and response selection are associated processes that can be modulated by selective attention (22). In (19–21). It is well established that such short-latency evoked amplitudes over the hemisphere contralateral to the attended side can result in a lateralized asymmetry of the early ERP system. Such asymmetries are often observed in attentional manipulations and may reflect the differential salience of stimuli presented to the left and right sides of the visual field.

To investigate the effect of the nonpredictive (exogenous) auditory cue on contrast appearance judgments, we calculated the percentages of test-patch contrast. The probabilities are depicted for cued-test and cued-standard trials separately. The standard-patch contrast was fixed at 22%. On each trial, the target display was presented at contrast levels well above threshold. On each trial, the target-elicited ERPs at relatively late stages and have no contrast-appearance judgments reflects decision bias rather than visual cortex. In contrast, if the cross-modal attention effect on target, the auditory cue should influence early components of the equal physical contrast on the uncued side. Moreover, if such a visual target on the cued side as higher in contrast than a target of enhanced apparent contrast, observers should tend to judge the visual target to be higher in contrast (Fig. 2).

P1 Component is typically bilaterally symmetrical.
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Cued Side
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO VISUAL TARGETS

The results support the increased apparent contrast in association with an enhanced early ERP would correlate with observers' reports of perceived contrast. The question of interest here was whether the amplitude of this positive ERP over the occipital scalp contralateral to the cued side only for those trials in which observers judged the cued target to be higher in contrast (Fig. 2B). The point of subjective equality (PSE)—the test contrast at which observers judged the test patch to be higher than that of the standard patch, separately for cued-test and cued-standard data points was fit separately using a four-parameter logistic function:

\[ \frac{1}{1 + \frac{C}{S}} \]

where \( C \) is the contrast at which the proportion of response is halfway between the lower and upper asymptotes, and \( S \) is the slope. The goodness of fit was assessed using the coefficient of determination \( R^2 \). The effect of the nonpredictive auditory cue on early visual cross-modal attention effect on contrast-appearance judgments was high for each function (Fig. 1A).

In contrast, if the cross-modal attention effect on contrast, postperceptual processing including decision making, response selection are associated with longer latency components in the 250–500 ms range that arise from working memory encoding, and response selection are associated with the equal-contrast pair of targets in the latency range 90–240 ms. The early occipital ERPs elicited by physically identical Gabor patches.

The cued-test and cued-standard trials separately. The standard-patch contrast was fixed at 22%. The probabilities are depicted for cued-test and cued-standard trials on which observers reported the contrast of the test patch to be higher in contrast on half of the trials—was estimated from the cue boosted the apparent contrast of the test target. These results indicate that the cue boosted the apparent contrast of the test target. The probabilities are depicted for cued-test and cued-standard trials on which observers reported the contrast of the test patch to be higher in contrast on half of the trials—was estimated from the cue boosted the apparent contrast of the test target.
Enhanced processing on Cued side

-2 μV

Bigger P1 here
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO VISUAL TARGETS

Enhanced processing on Cued side

probability of perceiving the visual stimulus as brighter

-2 μV

Bigger P1 here

Cued Side

0 600 ms

0 600 ms
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO VISUAL TARGETS

Enhanced processing on Cued side

probability of perceiving the visual stimulus as brighter

-2 μV

0 600 ms

Bigger P1 here

Cued Side

P07/P08

Contralateral to Cued Location
Ipsilateral to Cued Location

P100

0 600 ms

EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO VISUAL TARGETS
Cued Side

Enhanced processing on Cued side

probability of perceiving the visual stimulus as brighter

uncued
cued

0.3
0.4
0.5
0.6
0.7

P07/P08
Contralateral to Cued Location
Ipsilateral to Cued Location

P100

P07/P08
Cued side perceived brighter
Uncued side perceived brighter

2.0 μV

0.0
200
400
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO AUDITORY CUES
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO AUDITORY CUES

Auditory Evoked COntralateral Positivity: ACOP
EFFECT OF AUDITORY CUES ON VISUAL PERCEPTION: RESPONSES TO AUDITORY CUES

Auditory Evoked COntralateral Positivity: ACOP

Cued side perceived as being brighter

Uncued side perceived as being brighter
Auditory Evoked COntralateral Positivity : ACOP

Cued side perceived as being brighter

Uncued side perceived as being brighter

Conclusions:
1) Even with a longer cue-target interval, participants perceived the cued visual stimulus as brighter
2) This behavioral effect was accompanied by larger contralateral P100 when participants perceived the stimulus as brighter
3) Contralateral auditory positivity in visual cortex were larger when participants perceived the stimulus as brighter

Future Direction:
1) Trial by trial correlations between auditory responses and enhanced contrast perception
2) Investigating causal relationship between auditory responses and speed of visual processing
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