Leaky Ignoring & Visual Mismatch Negativity In the Flanker Task

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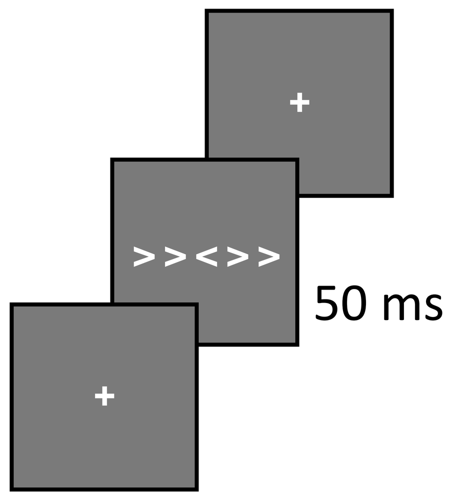
Can people ignore unusual flankers?

The brain is sensitive to events which violate its explicit and implicit predictions about forthcoming sensory stimuli. One result of this sensitivity is the automatic allocation of attention to unexpected events. Further, individuals differ in their ability to control attentional focus, and in their tendency to react to sensory stimuli.

We modified the Flanker Task so that the distractors had either a common or an uncommon (Oddball) form, and measured reaction times and accuracy while people performed the task. We also recorded scalp EEG to investigate the neural correlates of Oddball flankers. Finally, we used temperament scores to assess whether self-reported reactivity predicted vMMN magnitude.

Frequency-Manipulated Flanker Task



Stimuli: Sets of 5 arrowheads, 1 central and 4 flankers, presented for 50 ms.

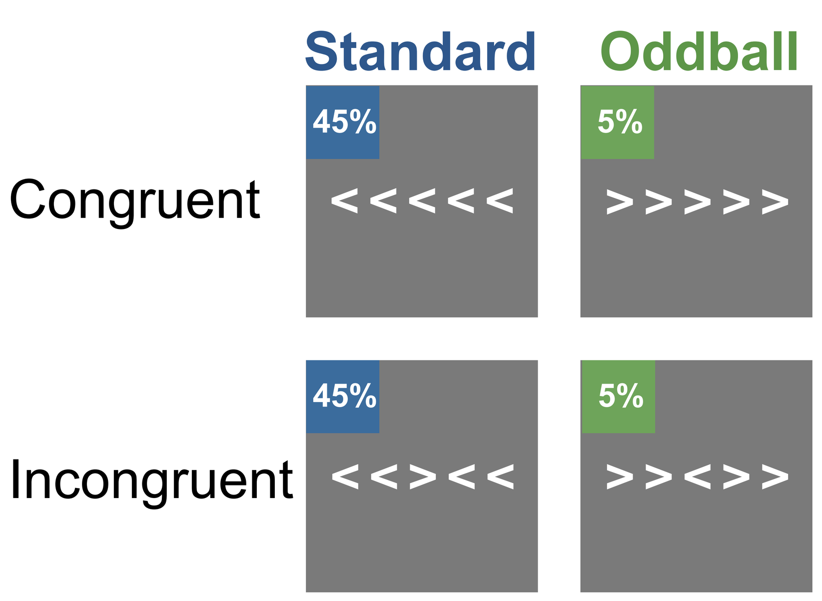
Task: Report direction of central arrowhead within 2 seconds of presentation.

Feedback: Keeping accuracy between 75% and 90%. Subjects were instructed to increase either speed or accuracy.

Flanker direction: 90% of trials had **Standard** flanker direction, 10% had **Oddball.**

Central arrowhead was equiprobably left/right, congruent/incongruent.

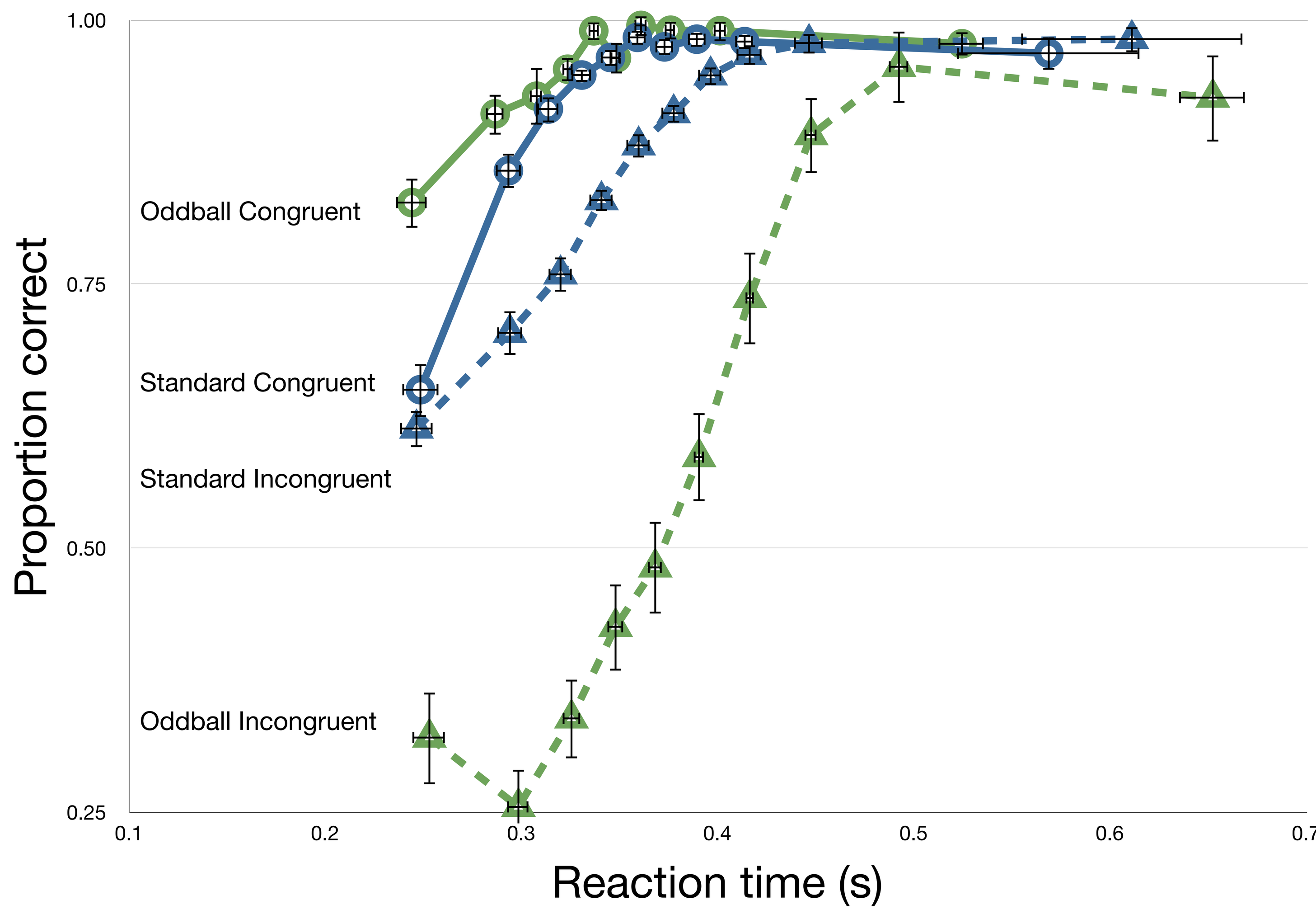
Flanker direction was counterbalanced within subjects.



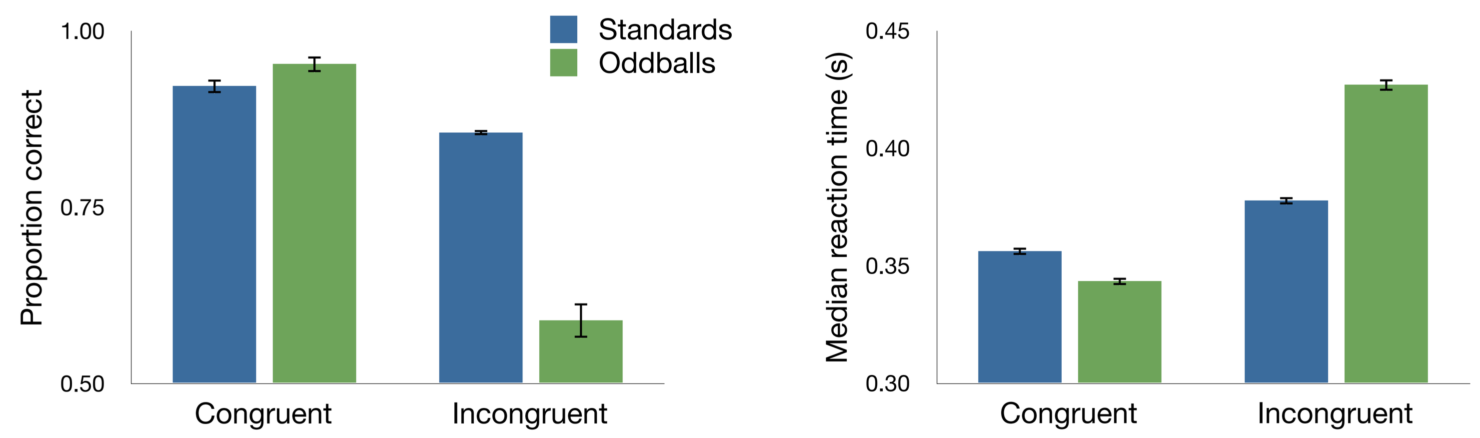
N = 20; 1920 trials per subject.

Temperament measured via Adult Temperament Questionnaire (ATQ, Evans & Rothbart, 2007). Scores on two temperament factors, attentional control and orienting sensitivity, were selected a priori as relevant predictors.

Oddballs Enhance Congruency Effects



Reaction time and accuracy for each decile of trials, binned within subjects. People were faster and more accurate on **Congruent** than on **Incongruent** trials. This effect was substantially larger for **Oddball** flankers than for **Standard** flankers.



Error bars are repeated-measures standard error.

EEG Recording and Analysis Details

High-density scalp EEG was recorded while subjects performed the flanker task. We computed ERPs timelocked to stimulus onset for **Oddball** and **Standard** flankers.

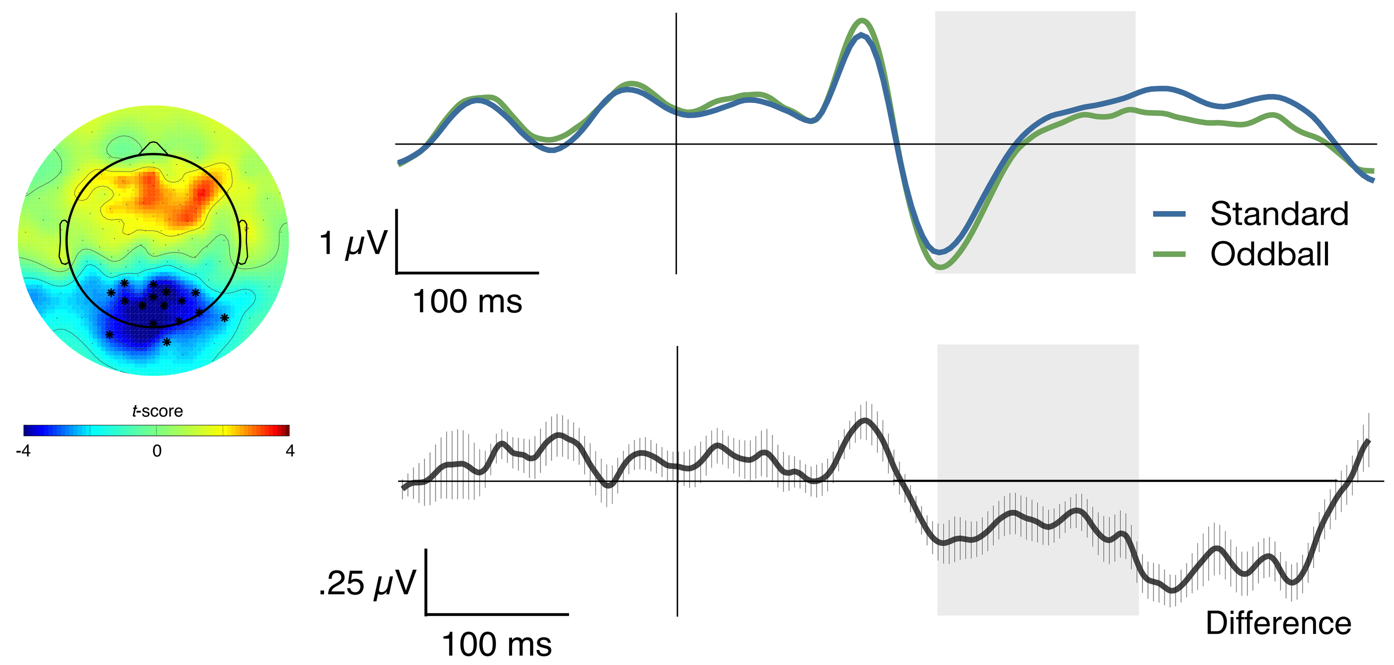
Clustering and permutation-testing (Maris & Oostenveld, 2007) allowed us to identify time windows and electrodes that dissociated conditions.

N200 peak amplitude was the strongest predictor of vMMN magnitude; we partialed out peak amplitude on **Standard** trials before examining individual-differences effects.

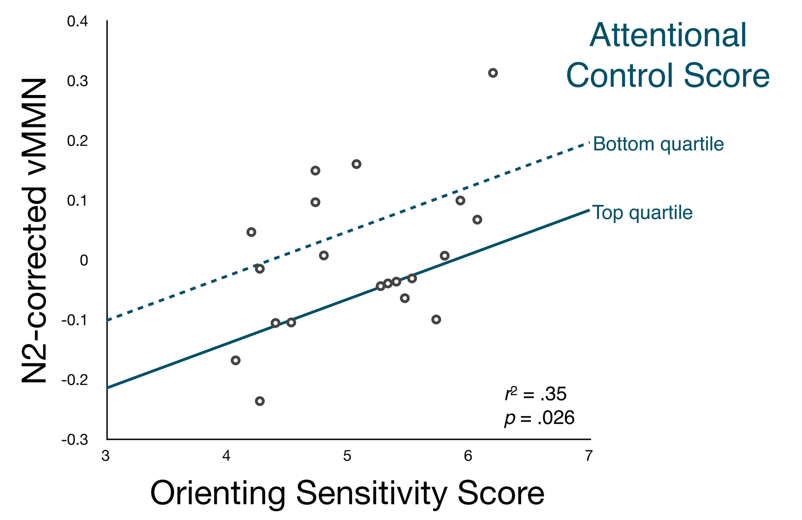
vMMN to Oddball Flankers

The visual mismatch negativity (vMMN) occurs in response to occasional deviant elements in a regular sequence (Czigler, 2007).

We found a significant difference between **Oddball** and **Standard** trials at 16 posterior electrodes, from 180–320 ms after stimulus onset.



Multiple regression showed that individual differences in vMMN magnitude are predicted by two components of temperament. Attentional control predicts larger vMMN; sensitivity predicts smaller.



Oddball flanker directions cause greater interference.

Oddball flankers "leak" through subjects' attempts to ignore them, thereby exaggerating the flanker congruency effect. Attention is obligatorily allocated to unexpected distractors.

Oddball flanker directions elicit a visual mismatch negativity.

ERPs were more negative-going over posterior electrodes for Oddball flankers than for Standard flankers, further supporting the leaky ignoring hypothesis.

Temperament predicts vMMN to oddball flankers

High attentional control may improve ignoring of the Standard flanker direction, leading to larger differences between ERPs to Standards and to Oddballs. Similarly, high orienting sensitivity impairs ignoring of the Standards, reducing such differences.

Czigler (2007). Visual mismatch negativity. *Psychophysiology, 21,* 224-230.
Eriksen & Eriksen (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics, 16,* 143-149.
Evans & Rothbart (2007). Developing a model for adult temperament. *Journal of Research In Personality, 41,* 868-888.
Maris & Oostenveld (2007). Nonparametric statistical testing of EEG- and MEG-data. *Journal of Neuroscience Methods, 164,* 177-190.

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