# Hemispheric Specialization for Horizontal and Vertical Manipulations of the Eye Region in Faces

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## Introduction

Face perception involves encoding configural information (relationships among features) rather than features *per se*. Here we explore hemispheric specialization for the processing of configural information in a same/different task.

• Mondloch, Maurer, and Ahola (2006): Adults and 8-year-olds viewed faces with small differences in feature spacing. Detection of differences for children and adults was similarly better for upright faces compared to inverted faces. Initial face display duration was 200 ms, probe duration was until response. RTs were not reported.

• Goffaux and Rossion (2007): Participants viewed pairs of faces with manipulation of eye position (eye moved outward by 15 pixels or down by an equal amount). Sensitivity to vertical eye displacement was significantly affected by inversion but sensitivity to horizontal displacement was not in d' measures. Initial face display duration was 900 ms, probe duration was until response. No RT costs were seen in upright faces.

• Goffaux, Rossion, Sorger, Schiltz & Goebel (2009): Used the same set of faces as in Goffaux and Rossion (2007). Participants viewed initial faces and probe faces for 400 ms, while blood flow was measured via fMRI. Significant behavioral accuracy and RT deficits were found for inverted faces relative to upright faces. Vertical displacement of the eyes resulted in significant hemodynamic effects only in the right Fusiform Face Area. Importantly, the magnitude of the right hemisphere (RH) hemodynamic response to inversion for vertical displacement faces was correlated with the behavioral inversion effect across participants.

• Sekunova & Barton (2008): Participants viewed 3 consecutive face photographs and were required to identify the different face. Faces were either inverted or upright and manipulations were made to the eyes or the eye and brow. In the former case, presumably only local relations were affected, while in the latter more global configural relations were affected. While in inverted conditions, there was support for the notion that vertical changes of the eye region are more salient because of social relevance, there were no RT differences as a result of their face manipulations for upright presentations.

## Same/Different Task

In the present study, we examined the processing costs in judging two faces as the same identity when manipulations were made to the briefly-presented second face. Manipulations were of the eye plus brow or the eye alone, vertically or horizontally, by 5 pixels.

• We hypothesized that vertical manipulations would be more disruptive to processing than horizontal manipulations.
• We expected that movements of the eye and eyebrow would be more disruptive to processing than movements of the eye alone; especially when moved vertically.
• We hypothesized that manipulations of the eye plus brow on the left side of the face (initial presentation to the RH) would be more disruptive in RT costs to correctly say "same" identity than after manipulations to the right side.
• We expected that manipulations of the eye on the right side of the face (initial presentation to the LH) would be more disruptive in RT costs to correctly say "same" identity than after manipulations to the left side.

## Method

*Stimuli*:
Example stimuli are shown below. Four female faces and four male faces were used. Face probes were displayed so that the eye manipulation was 5 degrees to the left or right of central fixation.


• Participants saw 300 trials.
• 8 faces X 9 manipulation conditions – Eight conditions created by the factorial manipulation of the direction, type, and side of movement conditions, and a 9th condition was the Unaltered condition.
• 32 trials in each of these conditions: 20 "Same" trials in which the initial and probe face were the same identity and 12 "Different" trials in which the initial and probe face were different identities.
• 44 Unaltered trials: 20 were "Same" identity trials.
• For each trial, the initial face was always an unaltered stimulus; there were no eye manipulations.
• For same identity trials, half of the faces were male and half were female.

## Method (continued)

*Participants: :* 47(14 male) right-handed college students.

*Procedure:* Exposure durations shown below. Probe faces were larger than Initial faces.


## Results—RT Analysis

•Main effect: manipulation direction $F(1,45)=7.52$, $p<.01$.
•Horizontal manipulations ($M$=13 ms $SD$=90 ms) resulted in a higher cost than vertical manipulations ($M$=-7 ms $SD$=78 ms).

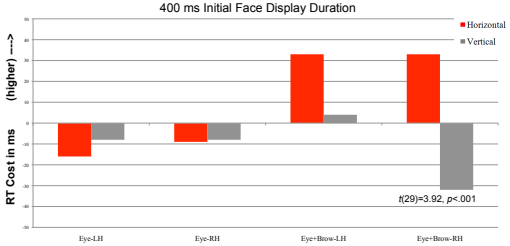
•The effect of manipulation direction was subsumed within a significant interaction of eye manipulation type and manipulation direction $F(1,45)=8.21$, $p<.01$.

| Eye Manipulation Type X Direction of Manipulation Interaction | | | |
|---|---|---|---|
| Eye Plus Brow | Horizontal | 29 ms | → $t(46)=4.02$, $p<.001$ |
| | Vertical | 11 ms | |
| Eye Alone | Horizontal | 5 ms | → *ns* |
| | Vertical | 6 ms | |

•Movements of the Eye Plus Brow horizontally resulted in significantly higher costs than vertical movements.

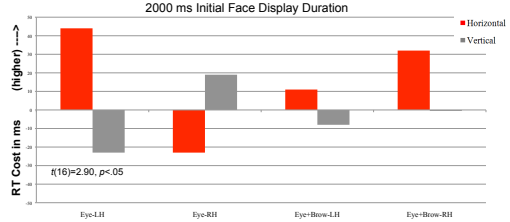
•Interaction: display duration X side X eye manipulation type X manipulation direction, $F(1,45)=4.69$, $p<.05$.

400 ms Initial Face Display Duration




•Short initial display: horizontal eye and eyebrow movements presented to the right hemisphere were more disruptive than vertical movements presented to the right hemisphere.

2000 ms Initial Face Display Duration




•Long initial display: horizontal movement of the eye alone presented to the left hemisphere was more disruptive than vertical movement of the eye alone presented to the left hemisphere.

## Results—Accuracy Analysis

•A marginal main effect of eye manipulation type accuracy emerged, such that movements of the eye and eyebrow resulted in lower accuracies than movements of the eye alone, $F(1,45)=3.73$, $p=.06$.

| Eye Manipulation Type Accuracy | |
|---|---|
| Eye Plus Brow | -.04 |
| Eye Alone | -.02 |

•A main effect of direction of manipulation accuracy emerged, such that horizontal movements resulted in lower accuracies than vertical movements, $F(1,45)=7.51$, $p<.01$.

| Direction of Manipulation Accuracy | |
|---|---|
| Horizontal | -.04 |
| Vertical | -.02 |

## Discussion

The results offer marginal support for the hypothesis that global changes would result in greater processing disruption than local changes alone. Though not significant in the RT analyses ($p$=.06), the data show a trend toward global changes (i.e. the eye and eyebrow together, without a local component) causing greater response time costs than local changes (the eye).

The results did not support the hypothesis that vertical movements of the eye and eyebrow or eye alone would be more disruptive than horizontal manipulations. Rather, the opposite was observed; horizontal manipulations resulted in significantly longer response latencies than vertical manipulations in both display duration conditions.

An unexpected interaction of eye manipulation type and eye manipulation direction was detected. When the eye and eyebrow were moved together, horizontal manipulations caused more disruption than vertical manipulations. This effect was not present for manipulations of the eye alone. This finding is contrary to what we expected. Previous research using inverted faces has demonstrated that vertical changes of the eye region are more difficult to distinguish upside-down. We know very little outside of an inversion paradigm as to what to expect, and indeed in their odd-face detection task Sekunova & Barton (2008) found no reaction time costs in upright faces after eye or eye and eyebrow manipulations.

Analysis of accuracy data revealed that participants were less accurate in judging face pairs as the same identity with horizontal manipulations of the probe face than with vertical manipulations of the probe. Participants were also less accurate when the eye and eyebrow were moved together than when the eye was moved alone. These effects indicate the absence of a speed/accuracy trade-off.

Our findings offer support for hemispheric differentiation in the processing of faces. Not only are the right and left hemispheres differentially sensitive to global versus local changes, but they are also affected by the display duration of the stimulus. When given longer to study a stimulus, participants may employ more feature-based strategies resulting in better – more "memorial" – part encoding, and therefore experience a cost in performance when local manipulations are presented initially to the left hemisphere. Conversely, when given only a short time to view a stimulus, participants may rely on automatic configural processing and therefore experience an RT cost when global manipulations are presented initially to the right hemisphere. We feel these result fit well with Rossion, Dricot, Devolder, Bodart, Crommelinck, Gleder & Zoontjes (2000), although in that study there were explicit instructions and in ours there were no such instructions.

For future research, we would like to explore different display windows – how long is long enough to "memorize?" Furthermore, we will seek ERP evidence in the LH and RH for the time course of automatic and strategic processing of face features and configuration in this type of same/different task.

## References

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