Illusory Straight Gaze can Induce a Stare-in-the-Crowd Effect

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Abstract

In the present research, we conducted a visual search task for oddly directed gaze and examined whether the high-level information, the perceived gaze direction, was accessed faster than low-level feature information, the pupil location in the eye socket. The results showed that search efficiency was determined not by the low-level information but the high level information of the perceived gaze direction. The advantage of first accessing high-level information is discussed based of this result.

Keywords: Visual Search, Perceived Gaze Direction

Introduction

Contrary to the implications of feature integration theory (Treisman & Gelade 1985), previous research (Suzuki & Cavanagh 1995; Hershler & Hochstein 2005) shows that high-level global information of the face, e.g., facial expressions and "faceness" is accessed as fast as low-level feature information, e.g., the curvature of the eyebrows etc.

Gaze direction is one important social signal conveyed by faces. The primary end of the present research is to investigate whether the global information is preferentially accessed in detecting gaze directions. To examine this, we systematically manipulated high- and low-level information and investigated the influences of both levels of information on visual searches for oddly directed gazes.

To achieve this end, we made use of a famous illusion first invented by William Wollaston (cited in Langton, 2000). He showed that the perceived gaze directions of the identical eye regions could be altered according to the head orientation. This indicates that the perceived gaze direction is influenced by the high-level global information, the relational property of eye region and head orientation.

In the experiment, the participants were presented with an array of stimulus faces, and administered a visual search task. In one condition (0 deg condition), the target and the distracter could be discriminated on the basis of low-level feature information, the image of the eye region, but not in high-level global information (both target and the distracters were perceived to be averted). In the other condition (15 deg condition), the target differed from the distracters not only in low-level feature information, but in the high-level global information (either one of the target or the distracter was perceived to be straight, while the other averted).

If the high-level global information is preferentially accessed in gaze direction, the search should require less time in 15 deg condition than in 0 deg condition.

Method

Participants

Two males and seven females participated in this experiment.

Stimuli

The stimuli set consisted of targets and distractors, which were both created by pasting two eye regions (A and B) onto two head contexts (0º and 15º). In the 15º head context, eye region A induced a Wollaston-type illusory straight gaze, while eye region B did not. In the 0º head context, neither eye region A nor B resulted in the perception of an illusory straight gaze; both were perceived to be averted in the 0º head context condition. Examples of the stimuli are shown in Figure 1.

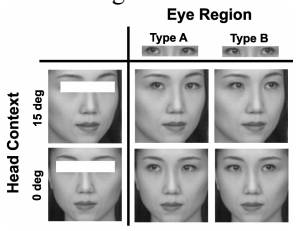

Figure 1: Examples of stimuli

Design and Procedure

In the experiment, a visual search task was administered that consisted of an equal number of target-present and target-absent trials. When a trial began, a 3×3 array of face pictures was presented. Participants were asked to answer if there was a discrepant face with oddly directed gaze in the face array.

In target-present trials, a discrepant picture was inserted in the 3 × 3 matrix as the target. The target and eight distractors differed only in the eye region; head contexts were identical. For example, if type A + 15º picture served as the target, the distractors were type B + 15º pictures. An example of the stimulus display is shown

in Figure 2. Therefore, in the 15º head context condition, the target and distractors differed from each other by both the high- and low-level information, while in the 0º head context condition, participants could only discriminate the target from the distractors by low-level feature information.

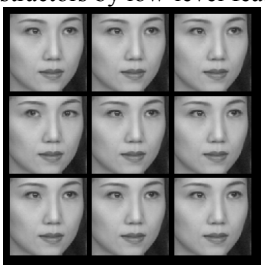

Figure 2: Example of stimulus display

In target-absent trials, the stimulus display was basically the same as the target-present trials, except that the target and distractors were identical. Thus, one of the four pictures appeared in every 3 × 3 matrix in the target-absent trials.

The experiment consisted of two blocks, and there were a total of 240 experimental trials for each block to ensure that every present-absent (2) × eye region (2) × head context (2) = 8 condition was administered 30 times each. The 8 conditions were presented pseudo-randomly, and the positions in which the target appeared in the 3 × 3 matrix were controlled across 8 conditions within each block.

Results

The inter-participant means for median RTs are shown in Figure 3 with standard errors.

A two-way ANOVA was conducted on the RT data of the target-present trials, with within-subject factors of eye region (2) × head context (2). The main effect of the head context approached significance, F (1, 8) =5.07, p<.10. This effect was qualified by a significant interaction between eye region × head context (F (1, 8) =6.94, p<.05). Further inspection of this interaction showed that the simple main effect of the eye region was significant in the 15º head context condition, but not in the 0º head context condition. Moreover, the search for eye region A in the 15º head context, which induced an illusory straight gaze, was faster than any other targets.

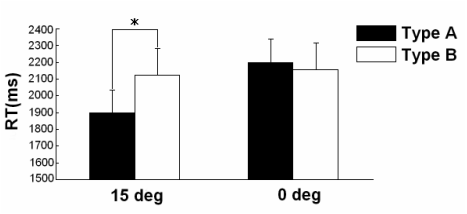

Figure 3: Mean RT and standard error in each condition

Discussion

The experiment demonstrated that type A gaze was detected significantly faster than type B gaze in the 15º head context, but no such search asymmetry was found in the 0º head context. Moreover, the search efficiency for eye region A in the 15º head context, which induced an illusory straight gaze, was higher than any other targets, congruous with the stare-in-the-crowd effect (von Grünau & Anston 1995).

The results of the present research indicate that high-level global information, the perceived gaze direction, was accessed faster than low-level feature information in detecting oddly directed gazes.

If so, what is the advantage of preferentially accessing high-level information? Although the present research is not specifically designed to answer this question, the following explanation seems convincing. Pomerantz (2003) suggested that the human visual system's sensitivity to higher-level properties evolved to efficiently extract useful information, so-called "invariants" (Gibson 1979), by ignoring less useful information, which changes according to viewing conditions. Thus, relying on high-level representation possibly increases the robustness of detecting ability to the variability of environments. Further validation of this line of reasoning awaits future research.

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