Mediated eye-contact is determined by relative pupil position within the sclera

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Introduction

It is well-known that Mona Lisa’s gaze follows you around as you walk by her portrait. Perception of gaze direction has gained renewed interest in the context of videocommunication. In the first experiment we investigated people’s tolerance for eye contact while looking at slanted images of a female face. In the second we measured how people perceive depicted gaze directions.

Experiment 1

Method

15 subjects had to adjust the displayed eye-turn until eye-contact was lost (de-centering task) or eye-contact was restored (centering task). Image slant was systematically varied from -60 deg to 60 deg.

Results

The region of eye-contact is approximately 7 deg across and it shifts horizontally with image slant. The Mona-Lisa effect predicts no effect at all.

Sclera ratio model

These results are most easily explained by the non-linear effect of image slant on the relative pupil position within the sclera.

Experiment 2

Method

15 subjects had to judge the depicted gaze angle (γ) by holding a Flock-of-Birds sensor (Ascension Technology) in the apparent line of sight. The image’s position (-20, 0, 20 cm), head orientation (-20, 0, 20 cm) and gaze direction (-20, -10, 0, 10, 20 cm) were varied, where a distance of 20 cm corresponds to 11.3°.

Results

The depicted gaze angle γ is overestimated by a factor of 2. This slope is fairly constant across conditions (upper right panel). However, the offset depends on both head position and head orientation (lower right panel).

Geometrically, the perceived gaze angle should be identical to the depicted gaze angle: γ = γ. The Mona-Lisa effect holds that eye contact (γ - α = 0) occurs whenever the depicted gaze is straight out of the picture (γ = 0). To compare between models we fitted the following linear model to the data:

\[ y = a_0 + b_0 + b_1(x - x_{\text{gt}}) \]

Slope perceived angle

\( a_0 \quad b_0 \quad b_1 \quad b_2 \)

Geometric

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<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
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Mona Lisa

<table>
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<th>c</th>
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<tr>
<td>1</td>
<td>&lt;3.5°</td>
<td>?</td>
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Data fit

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<tr>
<td>0.7</td>
<td>-0.5°</td>
<td>2.0</td>
<td>-0.25</td>
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Discussion and Conclusions

Perception of depicted gaze is largely consistent with the Mona Lisa effect although it is highly overestimated (Anstis, Mayhew & Morley, 1969). This is consistent with the idea that people use the sclera ratio to judge the gaze angle and ignore image slant. According to Todorovic (2006) the depicted gaze direction is the sum of the depicted eye-turn (λ) and head orientation (ϕ). However, we find γ = 0.75 k + λ.

References
