FUNCTIONAL ESTIMATES OF IMPORTANCE OF FACIAL FEATURES AND OCULOMOTOR BEHAVIOR: A STRAIGHTFORWARD OR AN INTRICATE RELATION?

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Abstract

The relative importance of internal features of the face has been a recurrent topic of debate. Two experiments were performed with upright and inverted schematic faces obtained through factorial combination of three internal features. Participants answered on a bipolar graphic scale of expressed hostility -friendliness, while their oculomotor behavior was simultaneously recorded. An averaging model was established in both experiments, which allowed deriving estimates of importance for each feature. Patterns of importance were different for upright and inverse faces. Oculomotor behavior was also different in both situations. However, no simple correspondence between estimated importance and oculomotor indices was observed. Outcomes suggest some trend for an inverse relation between importance and number/ duration of fixations, but also show that this sole trend cannot account for the whole of data.

Attempts at assessing the relative importance of internal features of the face through patterns of eye movements have been made in the past. However, whether indices of oculomotor behavior do reflect the importance of looked at features is mainly the subject of reasonable assumptions (e.g., larger number of received fixations = more importance). Improving on this requires pitting them against legitimate psychological measures of importance. Information integration theory (IIT: Anderson, 1981; 1982) can provide such measures based on the averaging model of integration, which rests on a two parameter representation of the stimulus: its scale value (magnitude), and its importance (weight).

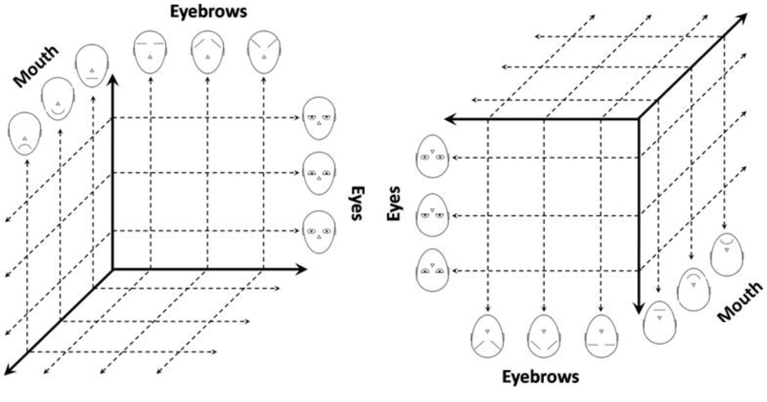

Figure 1 – General diagram of the main design, embodied by the factorial crossing of three schematic facial features (eyebrow, eyes, mouth) within an invariable oval shaped face contour. Points in the intersection of lines correspond to faces (27). *Left:* Upright faces. *Right:* Inverted faces

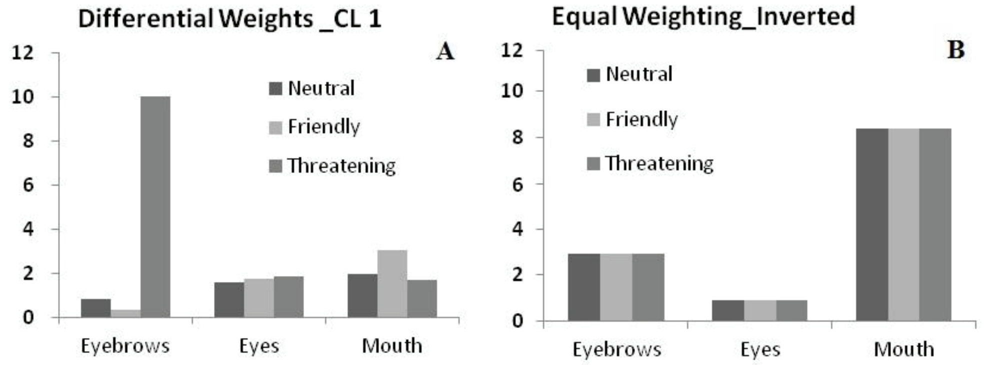

Figure 2 – Weight estimates performed with the R-Average program. Left: Differential-weighting model (14 out of 22 subjects in the up-right condition). Right: Equal-weighting model (all 12 subjects in the upside-down condition).

The data here presented come from two studies on the integration of features of schematic faces whose results have only been partially reported before (Oliveira et al., 2008; 2009). In those studies, an averaging model for the combination of 3 levels of an *eyebrows* factor × 3 levels of an *eyes* factor × 3 levels of a *mouth* factor was found both in upright faces and upside-down faces (see Figure 1), however with differential weighting in the former case (for a major cluster of participants) and equal weighing (i.e., same weight across the levels in each factor) in the latter case. Estimations of importance were extracted with the R-Average program (Masin & Vicentini, 2007), which are shown in Figure 2 (estimations in the up-right faces condition are only presented for the differential-weighting cluster of participants).

While subjects performed on the task of evaluating each face on a bipolar graphic scale of hostility (left pole)-friendliness (right pole), their eye movements and fixations were recorded with an eye-tracker device (Arrington Research). Regions of Interest (RI) in the screen were defined according to the places where the mouth, eyes and eyebrows of the schematic faces would be displayed, and the number and duration of fixations occurring within these regions was averaged across participants. These aggregated indices are presented in Figure 4, with the 27 faces arising out of the factorial design in the abscissa (see Figure 3 for the correspondence between a face number and a given combination of components).

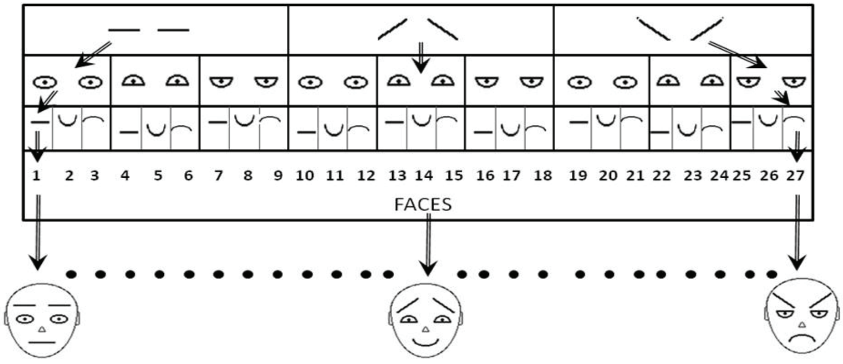

Figure 3. Guidelines for the reading of all graphs presented below: specific combinations of features (eyebrows, eyes, mouth) that each face number (1 to 27) stands for.

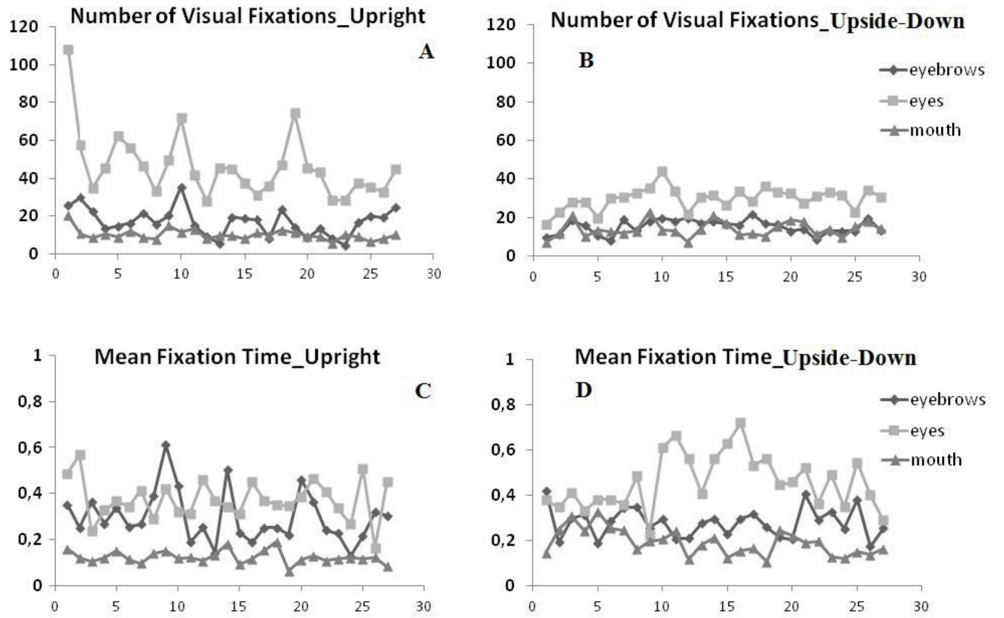

Figure 4. Top Row: Mean number of fixations (ordinate) per feature (curve parameter) in each face (abscissa). Bottom Row: Mean fixation duration in seconds (ordinate) per feature (curve parameter) in each face (abscissa). Left Column: "faces up-right" condition (differential-weighting averaging). Right Column: "faces upside-down" condition (equal-weighting averaging).

Discussion

Just as the integration model for the ratings, oculomotor behavior differs between the upright and upside conditions. Eyes get the larger number of fixations in both conditions, but this number is much larger (and more distinctly above that for the other facial features) in upright than in inverted faces (cf., Figure 4 A and B). A trend for a larger number of fixations given to eyebrows than to mouths can also be seen in the upright faces (where the two lines overlap), but not in the inverted ones. As for the mean fixation durations, they are higher overall in the upside-down than in the upright condition. The major reason for this difference in durations between conditions is the "eyes", which become the target of rather long fixations in inverted faces when "affective" levels of eyebrows (V- or inverse V-shaped) are involved. As a whole, these results indicate more and shorter fixations in upright faces, suggesting that the ocular exploration of upright faces is quicker and finer-grained (which may be the basis for the more complex differential-weighting averaging model).

No simple, straightforward match between the features relative importance as estimated by Functional Measurement (Anderson, 1981; 1982) and the oculomotor indices was observed. Eyes were found to be, on the whole, the less important feature in both conditions (see Figure 2, A and B), while they get the largest number of fixations and the longer fixation durations in both conditions. The distinctive importance of the "threatening" level of eyebrows in the upright condition, which occurs in faces 19 to 27, is not reflected in any way in the plots for either number of fixations or fixation durations (see Figure 4, A and C). Also, the large difference in importance between mouth an eyebrows in the upside-down condition is not obviously marked by any of the oculomotor indices (except for a very slight tendency for longer fixation durations to eyebrows).

Overall, a tentative inverse relation between importance and the derived oculomotor indices is all that can be suggested, whereby the less important factors (eyes) receive more and longer fixations, and the more important factors (such as mouth in the inverted faces) tend to receive less and shorter fixations (not the case in upright faces, though). This might be interpreted (conjecturally) as a link between functional importance and more efficient information processing (non-attentive, pre-attentive?). However, the inverse relation account cannot fit in some of the noticed data (e.g., the absence of an oculomotor effect of the "threatening" level of eyebrows in the upright condition). Given the proposal that different processing mechanisms are called upon by upright and inverted faces (holistic/configural and featural), it cannot be excluded that patterns of relation between psychological importance and oculomotor indices might vary with the kind of facial processing at work.

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