

# WHAT CHANGES IN FACE PROCESSING WITH FACE INVERSION AND WITH SHORT PRESENTATION DURATIONS?

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## Abstract

*Inverting faces has been assumed to disrupt holistic/configural face processing. On the other hand, holistic processing is believed to happen at a glance. This later belief concurs with the notion of a holistic-to-analytic transition at successive stages of processing. In a series of studies with synthetic emotional faces, arising from the combination of facial ‘action units’ (AUs) taken as factors, the effects of upright versus inverted versus shortened presentation durations (300 ms), was investigated. Short presentations had similar effects to face inversion, resulting in the weakening, often the nullification, of the effects of one or more AUs, together with the enhanced functioning of another, single AU. The joint functioning of all AUs thus appears to require time, rather than resting on a swift holistic operation. An interpretation of inversion effects in terms of increased difficulty is suggested in view of their found similarity to the effects of tachistoscopic presentations.*

The present study constitutes a follow up to previous experiments on prototypical facial emotion expressions. The overall logic in these prior experiments consisted in using as factors action units of the face (AUs, as defined in FACS: Ekman, Friesen, & Hager, 2002). These AUs were modelled at different intensities according to FACS guidelines in synthetic faces, and could thus be factorially combined at will according to the needs of the experiments. Selection of AUs rested on indications of observational studies as to which AUs consistently associated with each emotion (Ekman et al., 2002, Investigator Guide; Ekman, 2007. All emotions considered belonged to Ekman’s (1993) taxonomy and included Joy/Happiness, Fear, Sadness, Disgust and Surprise. For the design and analysis of experiments the methodology of IIT and Functional Measurement (Anderson, 1981; 1982) was used. Outcomes revealed a widespread additive rule for the combination of AUs as informers in the face when the response dimensions were either “emotional intensity” or “naturalness of the expression”, irrespective of the type of emotion.

The work presented here complies with this same logic. It essentially replicates the preceding studies while adding two distinct variants of stimuli presentation: (1) inverted faces and (2) tachistoscopic (300 ms) presentation of faces. These manipulations were adopted as a means to address a twofold suggestion in the literature that (1) face inversion disrupts holistic/configural processing (Bartlett & Searcy, 1993; Diamond & Carey, 1986; Rhodes et al, 1993; Rossion, 2009), and that (2) holistic processing happens ‘at a glance’, from the very early stages of face processing (Richler, Mack, Gauthier, & Palmeri, 2009; Vinette, Gosselin, & Schyns, 2004).

Under the premise that face processing is primarily holistic, a few simple predictions appear derivable from these claims for studies of face/expression recognition. Recognition accuracy should be impaired for inverted faces, on the one hand, and remain unaffected in time constrained presentations (kept, of course, within a practicable range), on the other. The first prediction is largely unspecific, given that several alternative explanations besides the

holistic/configural one actually predict the same result (e.g., differential feature saliency: Barton, Keenan & Trever Bass, 2001; involvement of mental rotation: Rock, 1974; upright orientation schema: Rakover, 2002).

Predictions are less easy to derive in the case of integration studies like ours, with graded response dimensions and lacking an external accuracy criterion. One possibility would be that inverting the faces would result in a shift in the integration rule, expressing a change in the processing mode from holistic to non-holistic. This model-shift criterion for a change in processing seems to have been adopted by Massaro (Massaro & Cohen, 1996) in studies of the effects of face inversion on bimodal speech perception. From the fact that his FLMP model could be as well fitted to upright as to upside-down faces, he concluded that impairments in the identification of the visible syllables were due to effects of inversion on information, and not on information processing. However, other unspecified possibilities concerning changes of functional parameters (scale values; weight/importance) under a same rule might as well be allowed for. One qualitatively clear/indisputable implication seems nevertheless to be that patterns of results should be considerably more similar among regular upright and tachistoscopic conditions than between any of those and the inverted condition. Data reported below offer a test of this prediction.

## Method

### *Participants.*

An average number of 20 participants per experiment were enrolled in the entire study (for a total of 242). They all were undergraduate students at the University of Coimbra and all volunteered in exchange for course credits.

### *Stimuli.*

Sets of 3-D realistic faces of one male character synthesized in the Poser 7 environment and embodying the factorial combinations of AUs pertaining to the considered emotions. For each of the five emotions considered, different experiments (between-subjects) were performed corresponding to the three presentation conditions: upright, inverted and tachistoscopic.

### *Design and procedure.*

All experiments obeyed a similar repeated measures design, typically organized as a  $3 \times 3 \times 3$  or a  $4 \times 2 \times 2$  factorial (depending on the number of levels of the involved AUs). Participants were made to evaluate overall “emotional intensity” of each expression on a graphic rating scale end-anchored with “no intensity at all” and “maximum intensity”.

## Results and Discussion

Figure 13 displays the factorial plots obtained in the Fear experiment, the only to be presented here (any other emotion might actually have been used, as the same data trends were found in all). Near parallelism in all plots, buttressed by non-significant interactions, indicates an adding-type integration rule, as had been the case in previous studies. This allows for easy and meaningful comparisons among graphs on the basis of vertical spacing and slopes.

Comparison of rows in the first column (two-way presentations of the obtained data) reveal overall comparable ranges (maximum vertical spacing) for the factors in the curve parameter – AU5 (*eye opening*) on top; AU25, 26 (*lips part, jaw drop*) on the lower rows.

Columns for the tachistoscopic and inverted conditions (middle and right) provide a different picture, with a distinctly smaller range of AU5 regarding the one of AU25, 26. Comparatively to the upright condition, a compression of the range of AU5 and an expansion of the range of AU25, 26 can both be seen in these conditions, which result in the striking difference between the ranges of the two factors.

Moving now to the consideration of slopes, a somewhat reduced functioning (lesser slope) of AU1&2&4 (*inner and outer brow raisers*, combined with *frowning*) as compared to AU5 (bottom row) can be observed in all conditions. However, just as it happened with the vertical compression of AU5, its slope can be seen to diminish in the tachistoscopic and inverted conditions comparatively to the upright condition (horizontal comparisons across the top and middle rows). Taken altogether, inspection of the plots thus suggests increased imbalance in the importance of factors, at the sole advantage of AU25, 26, as the detectable effect of constraining time or inverting faces.

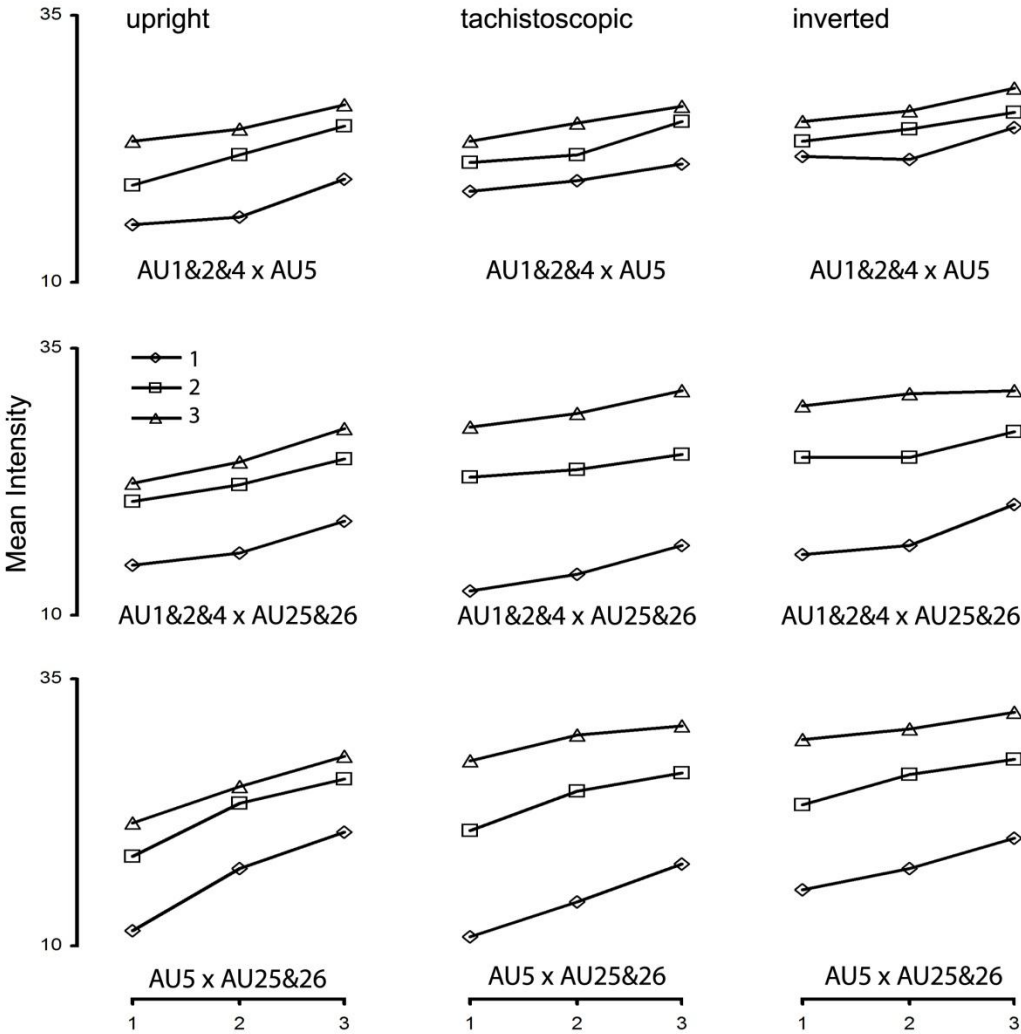


Figure 13. Factorial plots for the 3 (*AU1&2&4*) × 3 (*AU5*) × 3 (*AU25,26*) Fear experiment in the upright, tachistoscopic and inverted conditions (columns from left to right). Rows within a column correspond to all two-way presentations of the data set (third factor not represented in each case).

Similar conclusions arose in experiments with other emotions. This imbalance in importance could go in some cases (e.g., joy and sadness, in the inverted condition) to the point of cancelling out one factor. Contrary to the prediction that regular upright and tachistoscopic presentations would be the most similar, tachistoscopic and inverted conditions were most similar among themselves. Overall, an interpretation in terms of increased perceptual difficulty and its differential impact on the saliency of different facial areas/features appears as the most in keeping with the outcomes found (see Barton, Keenan, & Bass, 2001, for similar conclusions, but stemming from a different approach).

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