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SUBJECTIVE METRICS OF HOSTILE AND FRIENDLY FACIAL EXPRESSIONS: AN ISSUE WITH SCHEMATIC FACES.

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Abstract

Visual search studies employing threatening and friendly schematic faces have been justified on the ground that strict geometric control of visual features can thereby be achieved. The happy face advantage (lower RTs) observed with realistic photos has accordingly been attributed to perceptual uncontrolled factors, while the opposite threat advantage obtained with schematic faces was taken to reveal an evolutionary "preparedness" for threat detection. We surmise that such claims can only be properly addressed through an approach distinguishing between value-perceptual and importance-emotional parameters. Eyebrows, eyes and mouth were taken as factors in two integration tasks with schematic faces asking for judgments of "expression intensity" and "friendliness-hostility". An averaging rule was found in both cases. Functional measurement was used to estimate independent "value" and "importance" parameters. Outcomes disavow the perceptual fairness of schematic stimuli, while still revealing higher importance of hostile features. General implications are pinpointed to the study of facial expressions.

The threat advantage effect documented with schematic facial expressions in visual search tasks (the face-in-the-crowd paradigm) has been taken to imply a threat detection module established by evolutionary pressure and relying closely on the circuit of the amygdale (Öhman et al., 2001; 2007). However, this influential interpretation must come to terms with the opposite finding of a happy face advantage arising with realistic photos of faces (Juth et al., 2005). The most often heard account of the happy advantage is that uncontrolled perceptual factors (e.g., greater distinctness) are actually concealing a true attentional advantage of threatening faces, mediated by emotion (Öhman et al., 2001; Juth et al., 2005). The argument turns into a methodological defence of schematic stimuli as a way to achieve perceptual control, meaning the equalisation of geometrical deviations from "neutral" across different emotion expressions (Kirita & Endo, 1995; Lundqvist et al., 1999).

We contend herein (1) that spatial-geometrical control is not perceptual control and confuses physical and subjective metrics. Also, (2) we claim that the whole matter of "emotion-based" versus "perceptual-based" advantages needs recasting in a framework where the psychological notions of "value" and "importance" become both central and operationally distinguishable. Specifically, we suggest that "perceptual" in the debate is referring to the perceptual scale value of the stimulus (feature or whole face), while "emotional-attentional" is used to refer to importance (in Öhman's evolutionary account, biological/survival importance) of the stimulus.

In the following, we illustrate the use of functional measurement (FM) methodology to obtain independent estimates of scale values (perceptual) and weights (importance) of three schematic features widely employed in the "face-in-the-crowd" setting, as regards conveyed intensity and conveyed threat. Previous attempts at measuring those features relative importance have treated measurement in dissociation from a substantive model of their integration in compound expressions (Lundqvist et al, 1999; Lundqvist et al., 2004); largely as a consequence, they were made to rest on invalid indices of importance (η^2 and regression β-weights), unable to achieve proper separation of weights and scale values. The framework of Information Integration Theory (and FM as its measurement counterpart) is adopted here as a way to overcome these problems.

Method

Subjects

A total of 40 under-graduate students at the University of Coimbra participated in the experiments. 18 subjects were assigned to a task where they judged the "affective intensity" of facial expressions (*Intensity Experiment*); the other 22 were required to judge the friendliness/hostility of the same set of expressions (*Threatening-Friendly Experiment*)

Stimuli

Schematic faces obtained by the factorial crossing of three levels (kinds) of eyebrows, eyes and mouth (see Fig. 1). The component features (eyebrows, eyes, mouth, and a "constant" nose) and overall faces shape were careful replicas of the schematic stimuli employed by Lundqvist et al. (1999). A complementary set of faces was produced by combining facial features two by two and also presenting each feature in isolation (nose always included).

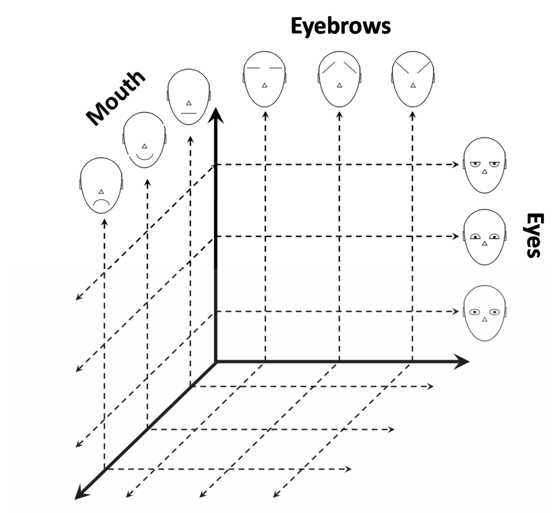

Figure 1 – General diagram of the main design, embodied by the factorial crossing of three schematic facial features (eyebrow, eyes, mouth) within an invariable oval shaped face contour.

Design and Procedure

A full factorial 3 (*eyebrows*) x 3 (*eyes*) x 3 (*mouth*) repeated-measures design with two replications was employed in two separate experiments. All two-way and one-way sub-

designs were added, interspersed, to the main design. This allows performing a free-scale test between adding and averaging and, in case integration by averaging verifies, to achieve uniqueness in the estimation of the model parameters (i.e., functional measurement of scale values and weights) (Anderson, 1981; 1982; 2001).

Intensity Experiment. Subjects sat circa 60 cm away from a computer screen. Stimuli were randomly presented at the centre of the screen, with no time limited imposed on response. Responses concerned judged "affective intensity" conveyed by faces (irrespective of the kind of emotion or feeling), to be expressed on a 0-20 rating scale by inputting the corresponding numbers on a keyboard.

Threatening-Friendly Experiment. Participants were now requested to locate (through placing the mouse cursor and clicking a button) each schematic expression on a bipolar visual analogue scale. The scale consisted of a line extending horizontally for 400 pixels at the bottom of the screen, end-anchored with the words "friendly" (on the left for half the subjects) and "threatening" (respectively, on the right for half the subjects). 40 equal space intervals of 10 pixels were defined which allowed the automatic translation of pixel coordinates into a bipolar 0-40 category scale.

Results

"Intensity" Experiment

Data were analysed through repeated-measures ANOVA performed separately for main design and two-way subdesigns. Plots for two-way subdesigns exhibited strong parallelism, buttressed by non-significant interactions in all cases ($F < 1$). This supports both the linearity of the response scale and an additive integration model for the pairing of all factors. As for the main design (3 factors), besides main significant effects for all factors, an *eyebrows* * *mouth* interaction was found (p = .007), associated with a significant *linear* x *linear* contrast (p = .007). Together with the supported assumption of a linear response scale, this was compatible with an averaging integration of the factors. Analysis of two-way plots across the levels of the third factor (see Anderson, 1982; Weiss, 2006) was consistent with a differential-weight averaging model with increased weights on the "emotional" levels. This model was tested with the AVERAGE program, which was fitted on an individual subject basis (Zalinksi & Anderson, 1987). Repeated measures ANOVA performed on the residuals revealed no significant effects from any source, thus supporting the averaging rule and the estimates of scale (functional values) and weigh parameters provided by the model.

Derived functional values are presented in Figure 2. Scales are at an interval level (conventional zero provided by the lowest zero) and possess a common unit, which makes legitimate to compare intervals across them. Having been derived on an individual basis, distributions of values allow for statistically comparisons. The major observed difference occurs for *mouth* and favors the "hostile" feature (downward corners) (p =.004). The second major difference occurs for *eyebrows*, and identically favors the "hostile" level (statistical difference at best marginal: p =.072). Finally, the scale location of "hostile" and "friendly" *eyes* is rather close and associates with a clear non significant result.

Derived weights are presented in table 1. Being on a ratio scale, they could be lawfully compared within and across factors. Higher importance of the "emotional" levels is apparent: differences between "friendly" and "threatening" levels within *eyebrows* and *mouth* were not significant, but both levels differed significantly from "neutral" (p = .000). Concerning *eyes*, "threatening" was significantly more important than "friendly" (p = .032). The "threatening" and "friendly" levels did not differ across *eyebrows* and *mouth*, although for the later level the difference comes close to significance (p = .06).

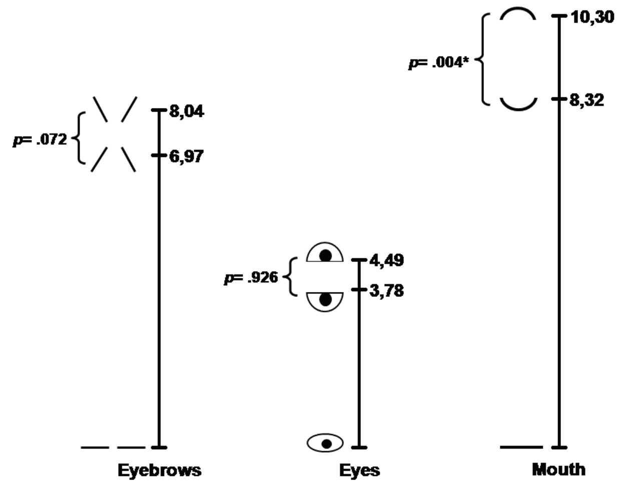

Figure 2 – Functional (psychological) scales of intensity for each schematic feature (factor)

Eyes had significantly less weight at all levels than the other factors ($p < .018$). By taking weight means for each factor as a gross index of its overall importance, *mouth* emerges as the most important feature (comparison with *eyebrows* has an associated *p* value of .017).

Table 1 - Estimated weights from the intensity task (differential-weighting model)

W_i	Eyebrows	Eyes	Mouth
Neutral	3.7	1.8	5.0
Friendly	9.8	3.9	12.1
Threatening	10.3	6.2	12.0
Means	7.9	4.0	9.7

"Threatening-Friendly" Experiment

The same data analysis procedure was followed. Two-way subdesigns again exhibited overall parallelism and no statistical interactions, supporting the linearity of the response scale. As one difference regarding intensity, data from isolated presentations of each feature produced crossing lines once added to the plots, which rules out adding and favours an averaging account of the interplay of factors taken two by two (Anderson, 1981; 1982). Significant *eyebrows* * *mouth* ($p = .000$) and *eyes* * *mouth* ($p = .000$) interactions were found in the main design, compatible once more with a differential averaging model which was tested with the AVERAGE program. At closer scrutiny, a major subgroup of subjects was found responsible for this pattern (a second subgroup provided no main effects for *eyes* and no significant interactions). The fit of the model was thus performed only for that subgroup (n=12). Despite a significant *eyebrows* * *mouth* interaction left in the residuals (which cancelled out on exclusion of mouth's "friendly" level from the analysis), the fit was taken to be good enough to use estimated parameters as functional measures of value and importance. These are given, respectively, in Figure 3 and Table 2.

Conclusions regarding the perceptual imbalance (indexed by functional scale values)

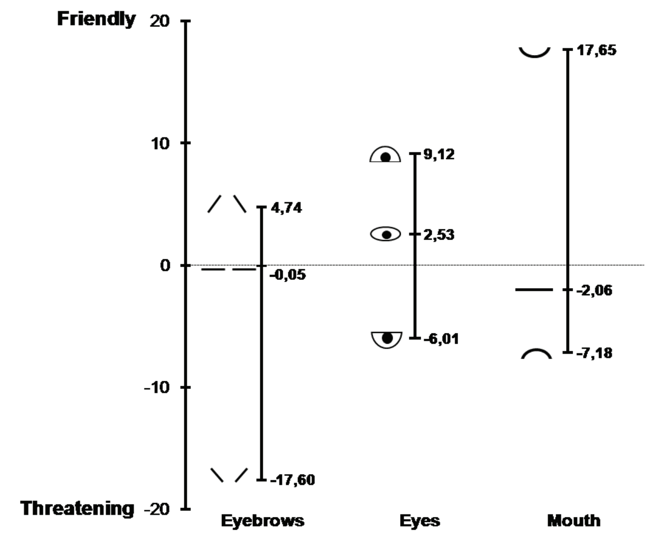

Figure 3 – Functional scales of "friendly-threatening" for each schematic feature (factor)

in the current set of stimuli are not as straightforward as for intensity, since *eyebrows* and *mouth* provide a symmetrical pattern of deviations from neutral. While "threatening" is significantly favoured in the former ($p = .001$), "friendliness" is significantly favoured in the later ($p = .000$). The much larger importance of the "threatening" level of *eyebrows* as compared to the "friendly" level of mouth implies that the threat-oriented imbalance has a much larger contribution to the overall judgments issued by participants.

Concerning estimated weights, higher importance of "threatening" levels was again found for *eyebrows* and *eyes*, but not for *mouth*, where "neutral" becomes as important as "threatening". This outcome should be qualified by noting the placement of mouth's "neutral" level on the threatening side of the response scale. The weighting pattern for *mouth* can thus be fairly described as a contrast between high importance "threatening" values and low importance "non-threatening" values. The same can actually be said of the other factors, where "threatening" differs from both "neutral" and "friendly" levels ($p = .000$), which do not differ among themselves. As an overall index of importance, weight means designate *eyebrows* as the most important factor (however, difference towards *mouth* is not significant).

Table 2. Estimated weights from the *friendly-threatening* task (differential-weighting model)

W_i	Eyebrows	Eyes	Mouth
Neutral	4.1	3.3	11.0
Friendly	5.5	1.2	5.0
Threatening	19.0	10.8	10.1
Means	9.5	5.1	8.7

Discussion

Concurring with the distinction between physical and perceptual control, outcomes do not confirm perceptual fairness of the current set of schematic stimuli, either as regards "affective intensity" or "friendliness-threat". Differences in conveyed intensity that favor "hostile" features might thus be the cause of differential outcomes regarding friendly faces. The same can be said of the found perceptual differences favoring threat (in the *eyebrows* feature). Even granting that the two sorts of differences are not independent, they may plausibly reinforce each other in determining a perceptual threat advantage in the current set of stimuli.

Irrespective of these perceptual differences, significantly higher importance of "threatening" as compared to "friendly" levels was established for every schematic feature. This outcome agrees with Öhman's claim of a higher psychological significance of threat (and thence, of fear), but it is independent from any assumptions regarding perceptual matching of the stimuli. Therefore, it does not imply that the threat advantage arising in visual search with schematic faces rests on an emotion-based mechanism, nor that the happy advantage for photographed faces has a perceptual origin. To establish that would require suitable perceptual control (still, the present approach illustrates how functional measurement sets proper requirements to achieve such a control).

Finally, just as the importance of schematic features could be measured independently from scale values, so can the importance of facial features of realistic faces be similarly dealt with. The generality and ecological significance of findings obtained from schematic stimuli could thereby be more directly (and quantitatively) assessed.

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DISCRIMINABILITY AND PERCEIVED EMOTIONALITY OF FACIAL EXPRESSIONS: THE ROLE OF THE PARTICULAR FACE STIMULI

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Abstract

The purpose of this study was to examine the perceived emotionality of a set of standard faces. Seventy participants rated 90 pictures of facial expressions (presumably angry, happy, and neutral) from the NimStim Set of Facial Expressions (Tottenham et al., in press) on angriness (Block 1), happiness (Block 2), and perceived emotionality (Block 3). Neutral faces were rated as somewhat angry in Block 1 and as somewhat sad in Block 2. In Block 3, angry faces were rated as only slightly more emotional than happy faces. However, happy faces differed more from neutral faces than did angry faces in terms of the specific emotion (Blocks 1, 2). Together with Pixton's (2007) results, this suggests that d' *is dependent only on the intensity of emotion, not on the kind of emotion; therefore, the greater discriminability for happy faces, found in the literature, might be due to the particular stimulus faces used.*

Although emotional expressions are not discrete but have endless variety, six basic emotions have been identified: happiness, sadness, disgust, anger, surprise, and fear. These six emotional expressions are considered not to be culturally bound, but universal (e.g., Darwin, 1872/1998; Ekman & Friesen, 1971), being recognized across all cultures. There are, however, critics who state that emotional expressions are context dependent, and that there are only broad and not discrete emotion categories; the perception of emotional expressions varies across culture (e.g., Russell, 1994) and situation (e.g., Carroll & Russell, 1996).

Therefore, the perception of emotional expressions can be a matter of relativism rather than a matter of absolutism (Russell & Fehr, 1987). When the same facial expression is presented in two different situations the perception of the expression may be interpreted as different expressions. Russell and Fehr suggest that, within an emotional face space, there may be a type of anchor effect against which the other stimuli are rated. When a presumably neutral facial expression is presented in a group of happy facial expressions the neutral expression tends to be perceived as being sad, and when a presumably neutral facial expression is presented in a group of angry expressions the neutral expression is perceived more towards angry. Similar results were found by Lee, Kang, Park, Kim, and An (2008). Carrera-Levillain and Fernandez-Dols (1994) and Shah and Lewis (2003) also suggest that a neutral expression may represent an emotion in and of itself, not a zero-middle point.

If indeed a neutral expression may not be neutral, results that are reported in the literature should be examined more closely. For example, there is a body of literature that discusses a happy-superiority effect (e.g., Leppänen & Hietanen, 2004; Leppänen, Tenhunen, & Hietanen, 2003; Pixton, 2007), where there appears to be a tendency to better identify happy faces compared to other emotional expressions, such as angry and sad. Leppänen et al. discuss the possibility that the advantage comes from the manner in which the stimuli are presented, so that there is a greater advantage when happy faces are presented with angry faces; however, they did not directly examine the potential effects of stimuli in and of