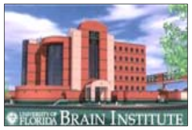
Investigating Facial Movement Asymmetries in the Spontaneous Expression of Positive and Negative Emotion



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Study Objectives

The present study is the third in a series investigating the underpinnings of asymmetry in facial expression. Here, we use objective methodology (i.e., software analysis of dynamic, spontaneous expressions) to determine…

(1) …whether asymmetries in facial expression movement are present during the display of spontaneous emotion.

(1) …these patterns correspond to those observed previously in posed expressions (i.e., L > R).

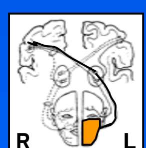
Background

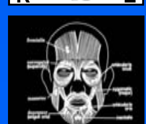
Facial Expression Asymmetry

Since Sackheim's (1978) seminal article in *Science*, extensive experimental research has supported the claim that *emotions are expressed more intensely on the left* than the right side of the *face. This phenomenon is predominant for right-handers,* occurs for both positive and negative emotions, and has even been reported in non-human primates such as the rhesus monkey (for review, see Borod et al., 1997). The finding is more consistently shown when subjective methods are used (e.g., judgments of photos). We have previously used objective, computerized video analysis to demonstrate that this asymmetry holds during real-time facial movement in voluntary (i.e., posed) expressions (CHEES).

Interpretations

The most popular neuropsychological interpretation of this phenomenon is that facial asymmetry in emotional expression reflects a *right hemisphere advantage in emotional processing*. Using single-pulse transcranial magnetic stimulation, we have shown this asymmetry is also due at least in part to *stronger leftward corticobulbar motor projections*, independent of emotion (Triggs, Ghacibeh, Springer, & Bowers, 2005).





Spontaneous Expressions

Relative to posed expressions, much less is known about the neural circuitry underlying involuntary (I.e., **spontaneous**) emotional facial expressions. Spontaneous expressions seem to be initiated from *subcortical regions*, e.g., thalamus, basal ganglia, or limbic regions such as the nucleus accumbens (see Okun et al., 2004). Mixed evidence has suggested that these types of expressions might be asymmetric as well. This finding has been mostly supported by studies using *subjective* techniques as mentioned above (for review, see Borod et al., 1997).

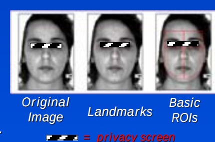
CHEES

This section describes the "Computerized Human Expression Evaluation Software" (CHEES) used to analyze facial expression asymmetries in the present study (see Gokcay et al., 2000).

(1) Videotaping and Digitizing Frames

Facial expressions are captured by an analog video camera and VCR. Each expression is converted into a 2-second, digitized video clip and saved to a computer. Video clips consist of 60 frames, each temporally spaced at 33 ms and representing a 640 X 480 array of pixels with 256 shades of gray.

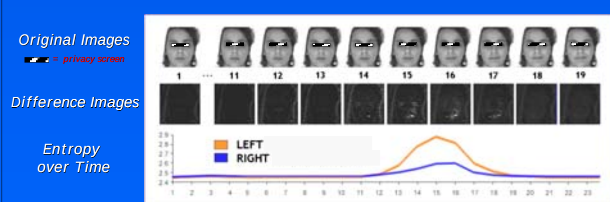
(2) Landmarking the Face



Sixteen anatomic landmarks on the face are then placed on the 1st (neutral) frame of an expression sequence. Custom software in PV-Wave (CHEES) uses these landmarks to automatically compute geographic boundaries (*regions of interest; ROI → Left, Right, Upper, Lower*) applied to all images of a given expression.

(3) Entropy (Movement Change) Calculation

For each expression, pixel intensities of adjacent frames were subtracted to obtain difference images over time (see below). On these difference images, we plotted histograms for each ROI (See below). Custom software, developed by Gokcay (2000), was then used to compute *% change in entropy*, a quantitative index of movement change for *each ROI* during the course of the expression.



Frame-by-frame change of hemifacial expression and entropy

Participants

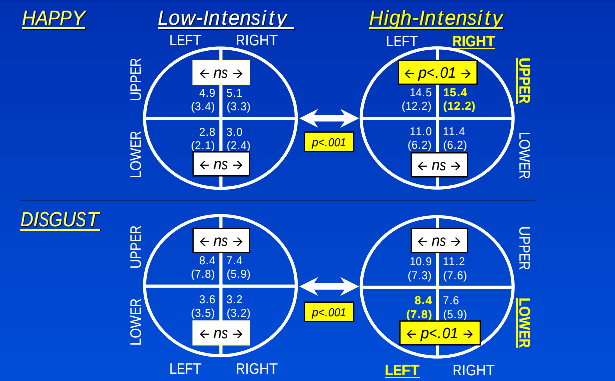
N = 49 (24 male, 25 female) right-handed, college-aged, neurologically and psychiatrically *normal participants*, as determined by interview and clinical measures.

[*Variable*, Mean (SD)]: *Age* 21.2 (2.6); *Edu* 14.6 (2.0); *BDI-2* 3.3 (2.9); *STAI-S* 27.7 (7.0); *STAI-T* 31.8 (6.7).

Procedure

1. After providing *informed consent*, participants completed *demographic questionnaires* and *clinical measures*.
2. Participants were videotaped while viewing a pseudo-randomized series of *short, emotional video clips* previously rated as containing *humorous* (e.g., Robin Williams stand-up comedy), *neutral* (e.g., nature documentaries), or *disgusting* (e.g., *en vivo* eye surgery) content.
3. Independent, blinded raters categorized all generated expressions as *positive* or *negative* in valence and as *low* or *high* in emotional expressiveness (intensity).

Results



DV: % change in entropy per ROI, *Analyses*: ANOVA → corrected post-hoc paired t-tests

Conclusions

- *Lower-left peak facial speed is greater than the right during high-intensity, spontaneous expressions of disgust.*
  - This finding adds a dimension to the previous literature indicating that peak intensity / expressiveness is greater in the left hemiface, as determined by ratings of static pictures. It suggests that these findings are not due to morphological differences in the left vs. right hemifaces, and provides converging evidence for this phenomenon in spontaneous expressions of emotion.
- *Upper-right peak facial speed is greater than the right during high-intensity, spontaneous expressions of happiness.*
  - The basis for this pattern is unclear given that the upper face is bilaterally innervated (whereas the lower face is largely contralaterally innervated). This asymmetry may reflect stronger left-frontal input from areas mediating positive emotion, consistent with the valence hypothesis of emotion. Upper face expression asymmetries in motor speed will be investigated more closely in future research.

References

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