Digitizing the Moving Face During Nonemotional Expressions:

The Emotion Priming Hypothesis Re-visited

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ABSTRACT

We previously reported that the left side of the face " moves more" during dynamic expressions of emotion such as fear, anger, happiness (Richardson et al., 2000). The purpose of this study was to learn whether "nonemotional" facial expressions also induce asymmetric movement changes over the face. **Methods**. Forty-eight dextral college students were videotaped while they made six target nonemotional expressions (e.g., show teeth, raise brow, etc.). We then used novel computer imaging techniques, developed in our laboratory, to quantify movement changes during the temporal course of the expression for distinct regions of the mo ving face (i.e., upper/ lower; right/left). **Results.** The major finding was a significant movement asymmetry over the lower region of the face ($p<0.01$), w hereby more movement occurred over the left than right lower face. This result directly corresponds to our previous findings with emotional exp ressions. No movement asymmetries occurred in the upper face. **Discussion.** Our findings of dynamic movement asymmetries during nonemotional expressions raise two distinct possibilities. First, even " nonemotional" expressions may be emotional and involve hemisphere specific emo tional priming of the left hemiface. A second possibility relates to recent TMS findings that the left side of the face receives more cortiocobulbar input than the right side of the face (Triggs, Bowers, Gokcay, 2002). The current findings do not distinguish between these possibilities.

BACKGROUND

Facial expressions are complex signals caused by rapid changes in the face muscles that occur over relatively brief periods of time. We recently reported that more movement occurs over left than right lower face during emotional expressions. The most popular explanation for this expression asymmetry involves emotion priming of right frontal motor systems (see below).

Proposed Mechanism: Emotion Priming Hypothesis

Emotion Priming of Right Hemisphere Motor Systems

1. Right hemisphere important for emotional processing
2. Each hemisphere has motor control of lower 2/3 of contralateral face

Thus, emotion processing "primes" right frontal lobe motor systems, resulting in more movement over the left hemiface

HYPOTHESIS: If the emotion priming hypothesis is correct, then no movement asymmetries should occur when individuals make "non-emotional" facial movements.

SUBJECTS

48 right handed college students

No history of learning disability, head injury, neurologic , or psychiatric illness; No clinical depression or anxiety based on self report measures (Be ck, STAI)

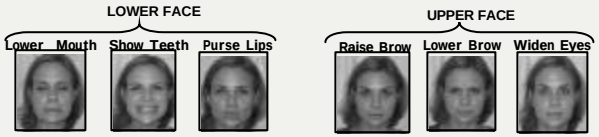
PROCEDURES

Overall Design

Videotape subjects → Capture video frames *digitize* → Analyze Facial Expressions *custom software"*
a. Define face landmarks
b Extract regions of interest
c. Quantify local expression

VIDEOTAPING 'NONEMOTIONAL' EXPRESSIONS

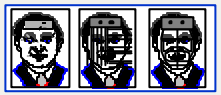
Participants were videotaped making six different "nonemotional" facial expressions. See below.



The initial 30 videoframes of each gesture were digitized and saved on the hard drive of a computer. Each frame was 30 ms in duration and represented 640 X 480 pixel array at 256 levels of grey scale.

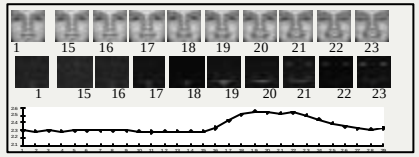
LANDMARKING THE FACE

Sixteen anatomic landmarks were placed on the face using a mouse. This was done on the 1st frame of an expression sequence. Custom soft-ware in PV Wave (CHEES) used these landmarks to automatically compute geographic boundaries or regions of interest (ROI) that were applied to all images of a particular expression.



COMPUTING MOVEMENT CHANGE (ENTROPY)

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 of the region of interest (See below). Custom software, developed by Gokcay , was then used to compute total entropy, a quantitative index of movement change over the face during the course of the entire expression.



Change of expression and entropy frame by frame

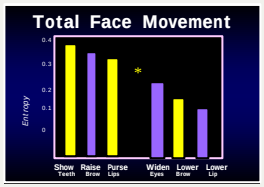
RESULTS

Analyses:

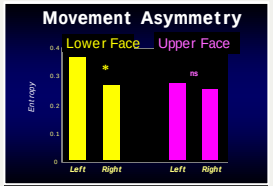
Entropy (movement) scores were obtained for each expression, both globally and across different face regions (R, L; upper, lower). These data were independently analyzed using repeated measures ANOVA's.

Results

1. ***Entropy Varies with Specific Expressions*:** See graph below ($p < 0.0001$)
2. ***Movement Asymmetry in Lower Face*:** **Significantly greater movement changes occurred over the left than right lower hemiface ($p < 0.02$). No movement asymmetries were present in the upper face.**



As expected, certain facial expressions were associated with significantly greater entropy or facial movement changes than others. This varied across the upper v s lower face.



Overall, significant movement (entropy) asymmetries occurred in the lower 2/3 of the face, whereas no movement asymmetries occurred in the upper face.

CONCLUSION

We used a sophisticated computer imaging technique to quantify dynamic non-emotional facial expressions as they were voluntarily produced by college students. Significantly more movement occurred over the left lower face than the right. This result directly corresponds to our previous finding of left sided movement asymmetries during emotional expressions.

The basis for the dynamic movement asymmetries during non-emotional expressions is unclear. One possibility is that so-called "non-emotional" expressions may be emotional, thereby inducing hemispheric priming mechanisms. A second possibility relates to recent TMS findings that the left side of the lower face receives more corticobulbar input than does the right side of the face (Triggs, Bowers, & Gokcay, 2002). As such, facial movements may be slightly more asymmetric over the left face, regardless of emotionality. Future studies may distinguish between these possibilities.