Facial Kinematics of Spontaneous and Posed Expression of Emotions

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Introduction

Research on emotion expression has been extensively conducted during passive observation of posed static pictures obtained from standardized databases (for a review, see Calvo & Nummenmaa, 2016). However, posed expressions have lower ecological validity since they differ in timing from spontaneous ones. A fine-grained 3-D analysis of temporal parameters such as the apex period and movement time of facial expressions might then allow unveiling the secret syntax of emotional language.

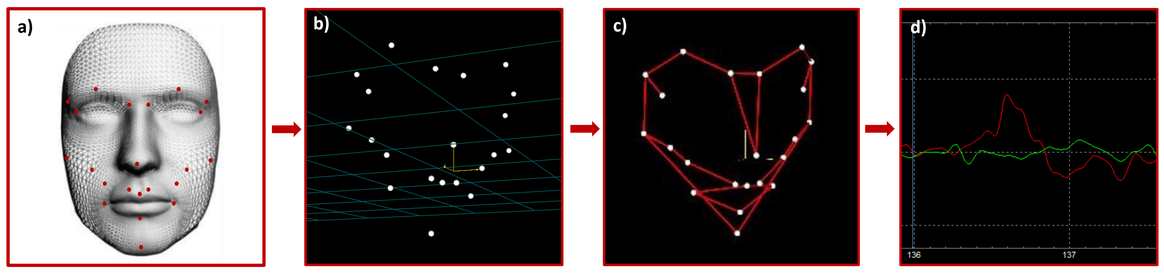


Figure 1. a) Definition of key points of the face for the expression of emotions. **b)** Motion capture. **c)** Reconstruction the face movement by tracking a full set of 22 markers. **d)** Development of a new protocol analysis that permits quantifying the speed, the distances, and the time of the movements on the considered anatomical landmark.

Methods

Naïve Participants (N=40, n_{male}=16) were requested to watch videoclips which triggered **spontaneous** expression of emotions. Then, they were asked to deliberately reproduce the same expressions without video support (**posed** expressions).

Twenty-two reflective hemispherical markers, each 3 mm in diameter, were used to acquire motion data. For both spontaneous and posed expressions, kinematic profiles of facial movements were recorded by means of six infra red cameras using a 3 D motion analysis system (Figure 1).

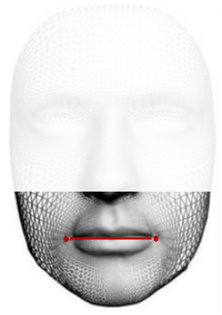
Linear Mixed Effect Model was run having the two Conditions (spontaneous expression and posed expression) as within fixed effects, and Individuals as random effects.

Dependent Measures related to the **corners of the mouth**:

MDM: Maximum Distance reached by the corners of the mouth

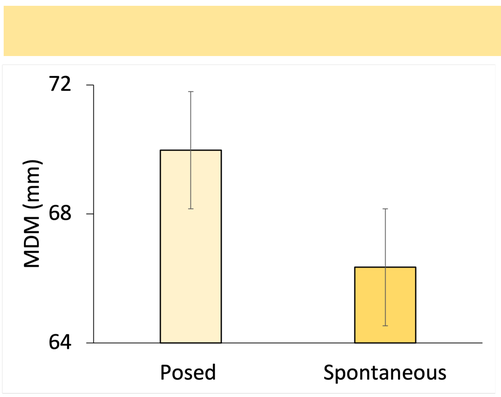
MVM: Maximum Velocity reached by the corners of the mouth

TMDM%: Time in which Maximum Distance is reached by the corners of the mouth, in percentage

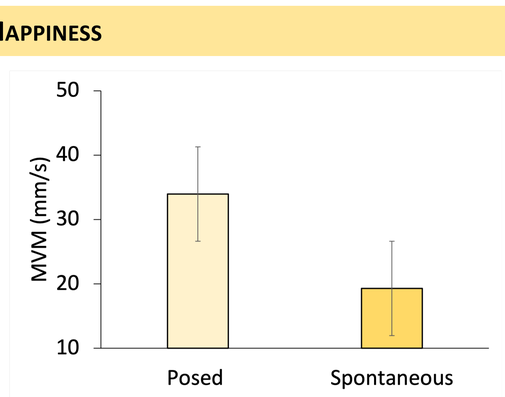


Results

Happiness

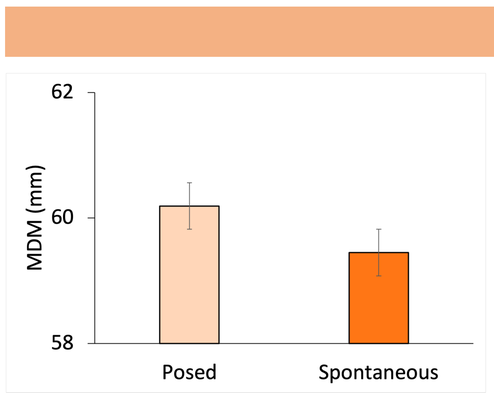


$F_{(1,16)} = 17.721$; $p < 0.001$

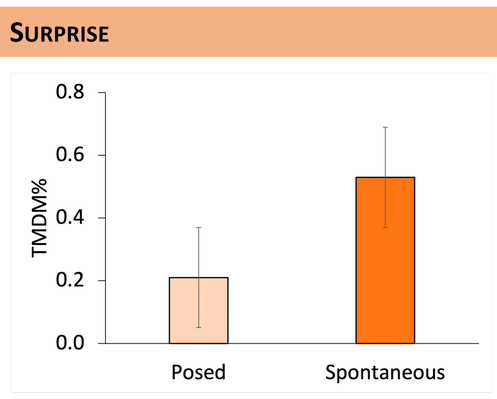


$F_{(1,16)} = 16.966$; $p < 0.001$

Surprise

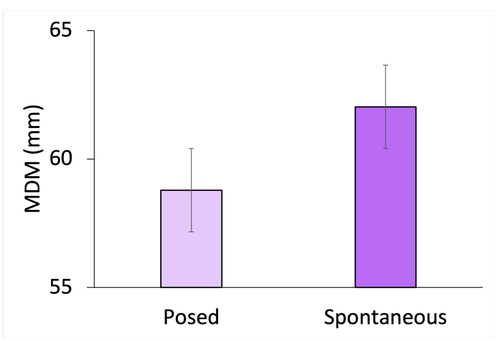


$F_{(1,11)} = 0.614$; $p = 0.450$

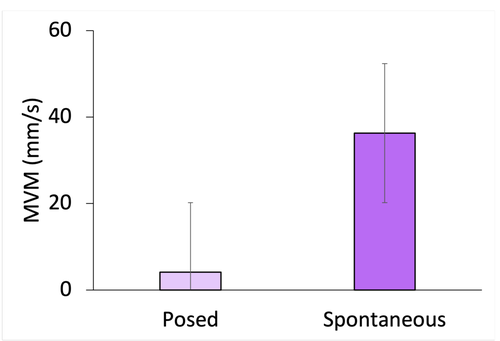


$F_{(1,11)} = 10.879$; $p < 0.005$

Fear

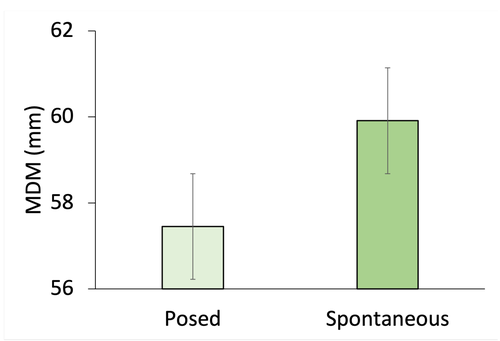


$F_{(1,12)} = 17.723$; $p < 0.001$

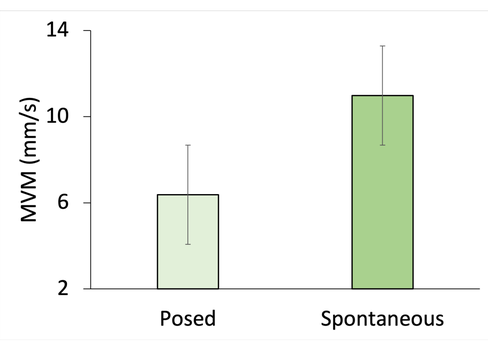


$F_{(1,12)} = 20.505$; $p < 0.001$

Disgust



$F_{(1,6)} = 13.248$; $p < 0.02$



$F_{(1,6)} = 2.023$; $p = 0.181$

Conclusions

The expression of spontaneous and posed emotions is subserved by two different systems in the brain. In fact, spontaneous emotions are usually less intense, more subtle, and much more difficult to detect than those used in laboratory (Tcherkassof et al., 2013).

The results show that spontaneous expressions of:

- **Happiness**_Decrease mouth widening and peak velocity
- **Fear**_Increase mouth widening and peak velocity
- **Surprise**_Delay max mouth widening
- **Disgust**_Increase mouth widening

These results will provide a step forward for the detection of facial deceptive cues and the creation of a database of spontaneous and posed expressions for multidisciplinary future studies.

The development of a gold standard 3-D model will also allow investigations throughout life span from childhood to old age as well as in clinical population.

References

Calvo, M. G., & Nummenmaa, L. (2016). Perceptual and affective mechanisms in facial expression recognition: An integrative review. *Cognition and Emotion*, *30*(6), 1081-1106.

Tcherkassof, A., Dupré, D., Meillon, B., Mandran, N., Dubois, M., & Adam, J. M. (2013). DynEmo: A video database of natural facial expressions of emotions. *The International Journal of Multimedia & Its Applications*, *5*(5), 61-80.

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