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Thermal imaging of facial expressions: investigating thermal correlates of Facial Action Units activities

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Emotional facial expressions can be systematically coded using the Facial Action Coding System (FACS) in order to describe the specific action units (AUs) belonging to a given facial expression. In this study we investigated the thermal modifications concomitant to specific facial movements produced by four FACS expert coders. Contrary to electromyography, thermal imaging of the face can track noninvasively dynamic changes in temperature for any facial movements at any distance (>0.4m), with a high temporal (50-750Hz) and thermal (<20mK@300K) resolution. The aim of this study was to validate this technique as a tool to assess the fluctuations of facial heat patterns induced by facial expressions. FACS experts were asked to display nine different expressions at various speeds and intensities. Using two different approaches (data-driven and region of interest), we were able to show that thermal fluctuations are specific to the activated AUs and are sensible to the kinetics and intensities of the movement. Principal Components Analysis reliably discriminated the AUs recruited by each voluntary facial expression based on their specific topographical thermal maps. Using anatomical regions of interest, we also showed that specific temperature changes correlate with the facial unit contractions. These results open new avenues for studying facial muscle activity in emotion as well as in other cognitively induced facial movements, in a noninvasive manner.

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