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Acting is not the same as feeling: Emotion expression in gait is different for posed and induced emotions

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INTRODUCTION

The past decade has witnessed an unprecedented growth in human–computer interaction. With this progress comes growing demand for computers to sense and recognize users' affective states (Cowie et al., 2001; Pantic & Rothkrantz, 2003; Hudlicka, 2003). Indeed, the development of emotion-sensitive computer systems may have important implications for variety of areas from automatic customer services (Fragopanagos & Taylor, 2005) to early recognition and diagnosis of clinical conditions (Michalak, et al., 2009).

Automated emotion detection has largely focused on facial expressions (e.g., Kenji, 1991), however, whole-body movement carries numerous emotion-related cues, which humans can rapidly detect (e.g., Clarke et al., 2005; De Meijer, 1989; Dittrich et al., 1996; Montepare et al., 1987, 1999; Walk and Homan, 1984; Wallbott and Scherer, 1986). Velocity, for instance, comprises an important cue as to a person's underlying emotional state: faster (high velocity) body movements tend to indicate anger and happiness, whilst low velocity movements are indicative of sadness (Chouchourelou et al., 2006; Edey et al., 2017; Gross et al., 2012; Halovic & Kroos, 2018; Michalak et al., 2009; Roether et al., 2009). Consequently, whole-body cues are increasingly being incorporated into computerized emotion recognition technologies (Janssen et al., 2008; Pantic & Rothkrantz, 2003). However, at present this remains a field which lags behind the advances made in the detection of emotion from face cues.

One issue which has received interest in the context of emotion recognition from faces, but which has been overlooked with respect to whole-body emotion recognition, is the question of differences between posed and induced/spontaneous expressions. Although emotion tracking software typically aims to detect naturally occurring, spontaneous expressions, much of our knowledge of movement kinematics comes from the posed expressions of professional actors (e.g., Jannsen et al., 2008; Roether et al., 2009, Venture et al., 2014). Even when posing is aided by induction methods such as autobiographical recall, the actor remains aware of the effects they are expected to produce, and likely exaggerates particular movement patterns. Consequently, kinematic measures derived from studies using posed expressions alone may not correspond to naturally occurring emotional expressions. Indeed, with respect to facial expressions, preliminary evidence suggests that induced and posed expressions differ with regards to timing and amplitude (Schmidt et al., 2006; Valstar et al., 2006). The current study recorded happy, angry and sad walks, as executed by student volunteers. We compared the velocity of these walks when the emotion was 'posed' and when the emotion was naturally 'induced' by watching emotional film clips.

METHODS

Kinematic data was obtained from 31 healthy participants (24 females) with self-reported unimpaired motor function. All participants gave informed consent to participate and received course credit or a monetary incentive as reimbursement. The study was approved by the University of Birmingham Ethics Committee.

Walking data was recorded using the Zeno™ Walkway (ProtoKinetics LLC, Havertown, USA) gait mat. All participants first carried out a 'baseline' walk for a duration of 120 seconds. Following this, participants watched 3 film clips (average length: 2.5 minutes) which had been selected for their propensity to induce happy, angry and sad emotional states, as assessed in a pilot study. Film-clip order was pseudo-randomized between participants. Between films participants viewed a 1-minute-long filler clip, to reset their mood to neutral. Immediately after each clip, participants walked continuously across the gait mat, stepping off the end to turn around each time. Walks were recorded for 30 seconds, resulting in 7 passes, across the full length of the gait mat, on average. Subsequently, participants rated their current mood (positive – negative), arousal (calm – excited), intensity for the target emotion and 4 other basic emotions (anger, happiness, sadness, disgust, surprise) and the extent to which they felt emotionally neutral on a 10-point scale. After watching all the film clips, participants executed posed walks, simulating happy, angry and sad emotional states according to the instruction … "Imagine you were angry (happy/sad). Walk across the mat how you think you would walk if you were angry (happy/sad)".

PKMAS software (ProtoKinetics LLC, Havertown, USA) was employed to process each walk and calculate the average velocity (distance travelled/ambulation time, centimeters/second (cm/s)) across the walk period (120 seconds for baseline walks, 30 seconds for all other walks).

RESULTS

Emotion induction was successful: emotion rating discreteness (target emotion rating minus average rating of all non-target emotions) scores for each video were significantly greater than zero (*p*s < .001).

A repeated-measures ANOVA with within-subjects factors of condition (posed, induced), and emotion (happy, angry, sad) revealed a significant main effect for emotion (Figure 1; $F(2,60) = 60.09$, $p < .001$, partial eta squared = .67). There was no main effect for condition ($F(1,30) = .041$, $p = .841$, partial eta squared= .00). Collapsing across posed and induced revealed that angry and happy walks were the fastest, and sad walks were the slowest (angry: mean [M] = 118.90, standard error of the mean [SEM] = 3.29; happy: M = 114.96, SEM = 2.34; sad: M = 101.34, SEM = 2.95). Bonferroni-corrected post-hoc t-tests reveal that while there was no difference in velocity for happy and angry walks ($t(30) = 2.49$, $p = .019$) , sad and angry ($t(30) = 9.56$, $p < .001$) and happy and sad ($t(30) = 8.46$, $p < .001$) were significantly different. However, the ANOVA also revealed a significant condition x emotion interaction ($F(2,60) = 38.16$, $p < .001$, partial eta squared= .56). Separate ANOVAs for each condition revealed that, whereas velocity differed as a function of emotion for posed walks ($F(2,60) = 57.39$ $p < .001$, partial eta squared = .66), this was not the case for the induced condition ($F(2,60) = 2.34$, $p =.105$, partial eta squared = .07). Post-hoc tests further showed that, for the posed condition alone, there was no difference in velocity for happy and angry walks ($t(30) = 1.98$, $p = .058$). However, velocities for posed sad walks were significantly lower than those for posed angry walks (sad: M = 92.35, SEM = 3.82; angry: M = 124.50, SEM = 4.33; $t(30) = 9.77$, $p < .001$) and posed happy walks (happy: M = 117.85 , SEM = 2.40; $t(30) = 9.04$ $p < .001$). The equivalent tests, for the induced condition, showed no difference in velocity for sad and angry walks (sad: M = 110.32, SEM = 2.60; angry: M = 113.31, SEM = 2.74 $t(30) = 2.40$, $p = .024$), sad and happy (happy: M = 112.10, SEM = 2.63; $t(30) = 1.10$, $p = .281$) or happy and angry walks ($t(30) = .96$, $p = .343$).

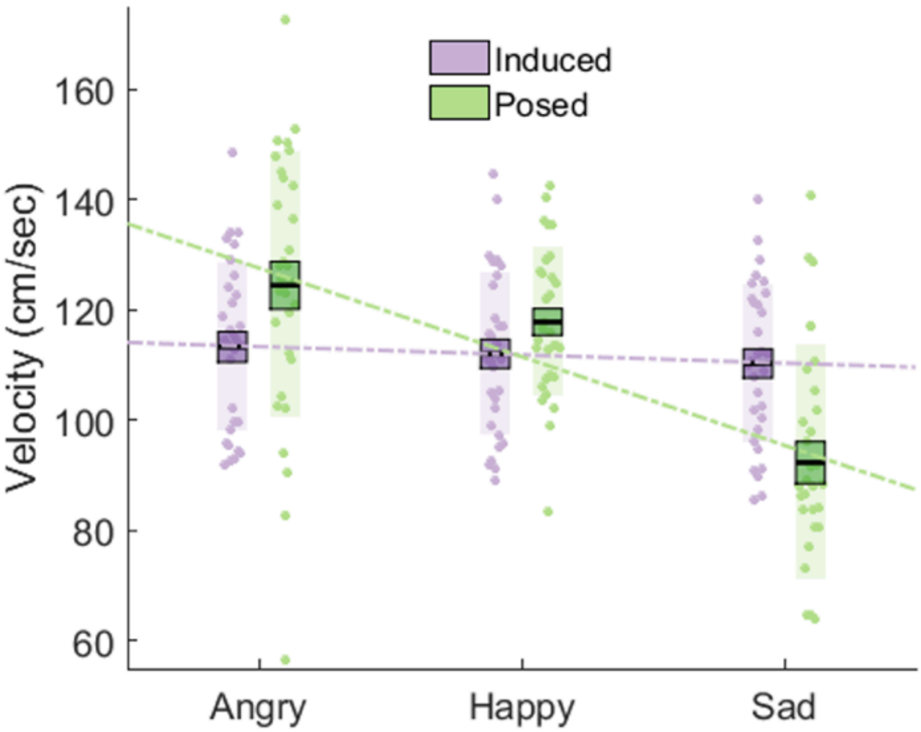

Figure 1. Mean velocity for angry, happy and sad walks in conditions induced and posed. Boxes = standard error of the mean, shaded regions = standard deviation, individual data points are displayed.

DISCUSSION

The current study investigated whether the velocity of happy, angry and sad walks differed for walks that comprised posed simulations of emotion, compared to those that followed emotion induction and thus comprised natural expressions of emotion. Velocity differed as a function of emotion for posed simulations: in line with previous literature we observed faster velocities for angry walks and slower velocities for sad walks. Velocities for posed happiness were also, as expected, faster than sad but slower than angry, albeit the difference between happy and angry was not statistically significant. This pattern of data was not observed for walks that followed emotion induction. Although our emotion induction methods were successful, as evidenced by higher post-film-clip intensity ratings for the target emotion compared to non-target emotions (i.e. if a participant watched a happy video they gave high ratings on the happy scale and low ratings for sad, angry, disgusted and surprised) we saw no velocity differences between happy, angry and sad walks for the induced condition.

These data highlight important differences between posed and naturally-occurring whole-body expressions of emotion, demonstrating in particular that, for induced emotions, gait velocity should not be relied upon to discriminate emotional state. Further exploration is required to identify the gait characteristics (e.g. cadence, step width, force, stride length) that are the best predictors of emotional state for induced, naturally-occurring, emotions. With respect to the further development of computerized emotion recognition methods, our data clearly show that algorithms aiming to detect spontaneous/naturally-occurring emotions should not rely on posed expression datasets for training purposes.

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