EFFECT OF FELT AND RECOGNIZED EMOTIONS ON GAIT KINEMATICS

Melissa Gross[1], Elizabeth Crane[1] and Barbara Fredrickson[2]
[1]University of Michigan, Ann Arbor, MI, USA
[2]University of North Carolina, Chapel Hill, NC, USA
Email: mgross@umich.edu, Web: www.sitemaker.umich.edu/mgrosslab

INTRODUCTION

Although emotion is expressed through multiple physiological channels including voice, face, body, autonomic responses and subjective experience, relatively little is known about the biological expression of emotion in body movements. Typically, the effects of emotion on body movement have been studied in actors portraying emotions, and the emotion-related effects have been described only qualitatively, e.g., "heavy-footed" for angry gait (Montepare 1987). A biological basis for bodily expression is suggested by cross-cultural studies in which emotion is recognized in body movements (Hejmadi 2000) and by fMRI studies in which emotional body positions activate brain regions associated with perception of specific emotions (de Gelder 2006). The purpose of this study was to quantitatively describe the biological effects of felt and recognized emotions on body movements during walking.

METHODS

Forty-two undergraduates (22 female, 20 male; 20.1±2.7 yrs) recalled an experience from their own lives in which they felt two positive emotions (content and joy), two negative emotions (angry and sad), or no emotion at all (neutral). After recalling an emotion, participants walked across the lab (5 m) while video and whole body motion capture data (120 Hz) were acquired. To validate that the emotion was actually felt by the walker and not just portrayed, after each gait trial participants rated the intensity of 8 emotions (4 target; 4 non-target) using 5-item Likert scales. Only trials in which participants felt the target emotion with at least moderate intensity were included in the kinematic analysis.

To determine whether the walkers' felt emotions were recognizable in their body movements, video clips of the walkers with blurred faces were randomized and shown to 60 undergraduates (29 female, 31 male; 20.9±2.7 yrs). After viewing each video clip, observers selected one of 10 emotions (4 target, 4 non-target, neutral/no emotion, and none of the above) that they thought the walker experienced during the trial. A trial was recognized if the felt emotion agreed with the observer-selected emotion. A Chi square test was used to determine if agreement differed from chance levels (10%). A generalized linear mixed model with crossed random effects was used to model the binomial response variable (agreement) with a logit link. Fixed effects of emotion, walker gender, observer gender, and video sequence were tested. A linear mixed model with random walker effects and fixed effect of emotion was used to model the mean and range of motion of joint angles, velocity, stride length and cadence.

RESULTS

Walkers felt and observers recognized the same emotion in 140 of 210 gait trials (67%). Walkers felt the target emotions in more than 97% of trials (Table 1). On average, among the target emotion trials that were felt, sad was most recognized (73.8%)

and anger was least recognized (61.9%). Neutral trials were least felt (69%) because walkers reported feeling content at above-threshold levels in some trials. Recognition rates for each emotion depended on walker. The best recognition rates for individual walkers were 93.3%, 73.3%, 66.7%, 53.3% and 53.3%, for sad, anger, joy, content and neutral trials, respectively.

Gait velocity was greatest in high-activation emotion trials (anger and joy), and least in sad trials (Table 2). Velocity was not different among neutral and low-activation emotion trials (content and sad). Emotion-dependent velocity differences were due primarily to changes in cadence rather than stride length.

Both posture and limb motions changed with emotion. In sad trials, the neck was 6.2, 11.5, 10.6 and 9.7 degrees more flexed than in anger, joy, content and neutral trials, respectively. The shoulders were slightly but significantly elevated in sad compared to content and neutral trials (1.6 and 1.8 deg, respectively). Amplitude of arm swing was significantly reduced in sad trials compared to the other emotions. Shoulder and elbow ranges of motion were significantly less in sad (19.2 and 21.7 deg) than in anger (32.1 and 40.9 deg), content (26.5 and 32.2 deg) and joy (30.7 and 40.1 deg) trials. Hip flexion was slightly but significantly reduced in sad trials compared to anger, content or joy trials (2.6, 1.3, 2.2 deg, respectively).

Amplitude of elbow flexion was also greater in the high-activation emotion trials (anger and joy) than in neutral trials (29 and 3.3 deg, respectively). Among positive emotions, elbow amplitude was significantly less in content than in joy trials (2.5 deg).

CONCLUSIONS

Bodily expression of felt and recognized emotions was associated with emotion-specific changes in gait parameters and kinematics. Knowledge of emotion-related changes in gait provides a basis for better understanding of the biological relationship between emotion and body movements.

REFERENCES

De Gelder B. (2006). *Nature Reviews Neuroscience*, **7**, 242-249.

Hejmadi A., et al. (2000). *Psychological Science*, **11**, 183-187.

Montepare, J.M., et al. (1987). *J. Nonverbal Behavior*, **11**, 33-42

ACKNOWLEDGEMENTS

We thank Brady West for his assistance with the statistical analyses.

TABLE 1: Percent of gait trials that were felt and/or recognized

Trials	Anger	Content	Joy	Neutral	Sad
Felt (%)	100.0	97.6	100.0	69.0	97.6
Recognized (%)	61.9	73.8	66.7	83.3	76.2
Felt and Recognized (%)	61.9	71.4	66.7	57.1	73.8

TABLE 2: Effect of emotion on gait parameters.

Gait Parameter	Anger	Content	Joy	Neutral	Sad
Velocity (m/s)	$1.43^{a,b}$	1.23^{c}	$1.44^{c,d,e}$	$1.19^{a,d}$	$1.07^{b,e}$
Cadence (steps/minute)	$122.2^{a,b,f}$	$111.1^{c,f,g}$	$120.8^{c,d,e}$	$111.6^{a,d,h}$	$104.6^{b,g,e,h}$
Stride Length	1.40	1.33	1.42^{e}	1.28	1.24^{e}

Superscripts indicate significant pairwise differences ($p<0.05$)