Background: Recognition of emotional states from other’s actions is one of key capability for smooth social interaction.

Approach: a computational-theory-level analysis kinematic features for recognition of emotional attributes in human actions represented as point-light display.

Computational processes (hypothesized)

Dynamic cues

- Duration of actions (Pollick et al., 2004)
- Velocity (DeMeijer, 1989)
- Acceleration (2nd order derivative) (Chang & Troje, 2008; 2009)
- Jerk or 3rd order derivative (Cook et al., 2009)

Structural cues

- Body structure (Troje, 2002)

4 levels of recognition of bio. Motion (Troje, 2008)

- Crane & fast
- Tense & slow
- “Screening event”
- “Kicking”
- “Kicking gently”

Behavioral study

- 10 subjects were asked to judge action and emotion types of presented point-light actors.
- Stimuli: Action-emotion stimuli were sampled from the biological motion library (Ma et al., 2006). Nine pairwise combinations of 3 actions (knock, lift, and throw) and 3 emotions (angry, happy, sad) were sampled from each of 3 selected actors. This yielded 27 video clips in total.

Results & Discussion

- Nested models with incrementally higher order features were compared (0-DOF models).
- Velocity model: only velocity profile
- Acceleration model: velocity + acceleration profile,
- Jerk model: velocity + acceleration + jerk (third-order derivative)

Acceleration or Jerk model fits better than Velocity model

Velocity (LL=–93.931, R²=0.810) < Acceleration (LL=–90.051, R²=0.890) < Jerk (LL=–89.116, R²=0.900) (but not A-J)

Action-specific recognizer does not improve fitting

Action-specific Acceleration model: -90.6381 (R²=0.890)

Conclusions: Emotional attributes as in actions as well as action types could be identified by covariance of velocity profiles among multiple body parts.

Implication: Since, despite different velocity profiles in different actions, these features for emotional attributes were found commonly in multiple different actions, it suggests that the action styles may be mediated by an information channel parallel to action types per se.

References


Figures

- Fig. 1: A hypothesized computational process of recognition of biological motion.
- Fig. 2: Perceptron action (on fast in the model and biological test). (a) A temporal profile of right-hand (cheek-shoulder) and right foot and (b) the velocity profile (which is 5 rays) showing kick, hit and throw actions.
- Fig. 3: The sparse logistic regression linking the velocity features to given emotion/action class.
- Fig. 4: The response patterns for each emotion type in human subjects (upper panel) and the velocity model (bottom panel).
- Fig. 5: The variance/covariance in velocity profiles significantly relevant to each emotion attribute mapped on a body scheme. The white and gray cell indicates effective variance/covariance of velocity profile and acceleration, respectively. No lower triangle cells were presented due to its symmetry. The bottom right panel showed the number of effective dimensions for each emotion attribute.