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Impact of elicited mood on movement expressivity during a fitness task

Tom Giraud [a,*], Florian Focone [a], Brice Isableu [b,c], Jean-Claude Martin [a], Virginie Demulier [a]

[a] Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, rue John von Neumann, Orsay 91403, France
[b] CIAMS, Université Paris-Sud, Université Paris-Saclay, 91405 Orsay Cedex, France
[c] CIAMS, Université d'Orléans, 45067 Orléans, France

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ABSTRACT

The purpose of the present study was to evaluate the impact of four mood conditions (control, positive, negative, aroused) on movement expressivity during a fitness task. Motion capture data from twenty individuals were recorded as they performed a predefined motion sequence. Moods were elicited using task-specific scenarii to keep a valid context. Movement qualities inspired by Effort-Shape framework (Laban & Ullmann, 1971) were computed (i.e., Impulsiveness, Energy, Directness, Jerkiness and Expansiveness). A reduced number of computed features from each movement quality was selected via Principal Component Analyses. Analyses of variance and Generalized Linear Mixed Models were used to identify movement characteristics discriminating the four mood conditions. The aroused mood condition was strongly associated with increased mean Energy compared to the three other conditions. The positive and negative mood conditions showed more subtle differences interpreted as a result of their moderate activation level. Positive mood was associated with more impulsive movements and negative mood was associated with more tense movements (i.e., reduced variability and increased Jerkiness). Findings evidence the key role of movement qualities in capturing motion signatures of moods and highlight the importance of task context in their interpretations.

1. Introduction

The complex relation between human movements and affects was already acknowledged more than hundred and forty years ago by Charles Darwin (Darwin, 1955). During the last ten years, pushed by the progress of embodied cognitive sciences (Clark, 1999), this topic has received a renewed interest from various research domains such as Psychology (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), Neurosciences (De Gelder, 2009) and Computer sciences (Kleinsmith & Bianchi-Berthouze, 2013). In this paper, we present a study which investigated how affects elicited within the context of a fitness task impact movement expressivities of a fitness coach.

Movement can be defined as position variations of body parts in space and time characterized by kinematic parameters (e.g., amplitude, velocity, Hess, 1943). One intrinsic property of human movement is its variability: comparisons of human movements collected in the same task inevitably reveal differences. Various factors are at the origin of these human move-

* Corresponding author.
E-mail addresses: tom.giraud.utc@gmail.com (T. Giraud), florian.focone@u-psud.fr (F. Focone), brice.isableu@u-psud.fr (B. Isableu), martin@limsi.fr (J.-C. Martin), demulier@limsi.fr (V. Demulier).

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ment fluctuations. One major source of intra-individual variability in human movement is affect. Several researchers have considered body expressions in a discrete manner proposing coding schemes for hand gestures (McNeill, 2008) or full body postures (Bull, 1987; Dael, Mortillaro, & Scherer, 2012). However, movement variations induced by affect as continuous changes have received less attention (Gross, Crane, & Fredrickson, 2010).

An affect is a relatively brief multicomponent episode (cognitive, motor, physiological, and phenomenological) which facilitates a response to an event of significance for the organism (Davidson, Scherer (Klaus Rainer), & Goldsmith, 2003). Emotions, moods and affects are concepts often used interchangeably and some authors advocate for a sharper discrimination. For example, for Davidson et al. (2003) moods last longer and have lower intensities than emotions and affect is a more global encompassing term. Affects are studied through a wide variety of conceptual frameworks. Discrete approaches consider affects as separate states: Ekman (1971) identifies six basic emotions (i.e., happy, sadness, surprise, fear, disgust, and anger), and Jack, Garrod, and Schyns (2014) propose a four basic emotions model (i.e., happy, sad, fear/surprise and disgust/anger). Dimensional approaches define them according to several continuous axes (Coan & Allen, 2007), valence and arousal being two major dimensions. Dominance as a third dimension is often considered (Mehrabian, 1996). Although the discrete framework of affect is the dominant approach (more in accordance with the study of discrete facial expressions), body expressions of affects have been meaningfully interpreted through the use of affective dimensions (Kleinsmith & Bianchi-Berthouze, 2013). Going more continuous in the analysis of affects and behaviors appears more in line with theoretical interpretations based on emotions' action tendencies components (Frijda, 1987) or the description of affects as dynamic changing states (Sheets-Johnstone, 2010).

The joint analysis of affects and body movements necessitates to consider methodological aspects related to affect elicitation (Coan & Allen, 2007). The first issue is to decide about the way to enact an affective episode in a controlled setup. Some authors collect affective expressions portrayed either by professional actors (Omlor & Giese, 2007; Pollick, Paterson, Bruderlin, & Sanford, 2001) or non-professional actors (Bernhardt & Robinson, 2007). Alternatively, experimental procedures have been designed to induce more spontaneous affective phenomena (James A. Coan & Allen, 2007) such as the Velten mood induction procedure (i.e., reading and trying to feel the suggested affect using sixty sentences, Velten, 1968), the use of music (Van Dyck, Maes, Hargreaves, Lesaffre, & Leman, 2012), film clip (Rottenberg, Ray, & Gross, 2007), autobiographical recall (Brewer & Doughtie, 1980), hypnosis (Bower, 1981), gifts (Nummenmaa & Niemi, 2004), pictures (Ito, Cacioppo, & Lang, 1998) and odors (Ehrlichman & Halpern, 1988). Overall, positive affects appear to be more difficult to induce than negative affects (Westermann, Spies, Stahl, & Hesse, 1996). With the specific aim of studying movement variations instead of discrete static expressions, studies have less focused on stimulus-response type procedures with the use of the autobiographical memories paradigm (Barliya, Omlor, Giese, Berthoz, & Flash, 2013; Crane, Gross, & Rothman, 2009; Gross et al., 2010; Kang & Gross, 2011), music (Michalak et al., 2009; Van Dyck et al., 2012) and video games (Savva & Bianchi-Berthouze, 2012). Illustrating the importance of felt affects in movement variations, Kang and Gross (2011) observe that participants' kinematics are different between trials in which affects are felt. The notion of felt affects should be distinguished from other common dichotomies of elicitation protocols such as acted versus non-acted conditions or portrayed versus natural protocols: these distinctions suggest that acting intentionally an affective episode is artificial proposing a somehow false affective expression while spontaneity would be related to true and authentic affects (Scherer, 2013). However, everyday affective episodes in social situations are subject to regulatory processes in order to manage impressions (Goffman, 1959). As a result, an affective expression is always a trade-off between push effects (i.e., internal factors which are reactive and related to adaptive behaviors) and pull effects (i.e., external factors which are constraining and related to cultural expectations) (Scherer, 2013). In this perspective, a voluntary affective expression is considered as an affective episode with a dominant pull effect where the affect can be felt.

The circular causality existing between movements and affects is also an element to acknowledge when making the choice of the experimental induction task to elicit affects. Studies demonstrating the one-sided influence of affect on motion are numerous (Kleinsmith & Bianchi-Berthouze, 2013), revealing that the experience of an affective episode involves perceptual, somatovisceral and motor feedback aspects (Bosse, Jonker, & Treur, 2008; Niedenthal, 2007). Conversely, in accordance with the James-Lange theory, the impact of movement on experienced affects has been evidenced through various protocols (Laird & Lacasse, 2014): motor actions influence the evaluation of affective stimuli (Dru & Cretenet, 2008) or the remembering of affective memories (Casasanto & Dijkstra, 2010). Hence, the nature of the movement performed during the experimental task should be considered according to the research purpose. A common approach to control movement influences on a participant's affective state is to use functional tasks where movement has an ordinary purpose. Such actions are, for example, walking (Barliya et al., 2013; Crane et al., 2009; Karg et al., 2009; Omlor & Giese, 2007; Roether, Omlor, Christensen, & Giese, 2009; Venture, 2010), knocking (Bernhardt & Robinson, 2007; Gross et al., 2010) or drinking (Pollick et al., 2001).

Body movements are characterized in a high dimensional configuration space with many interrelated degrees of freedom. Defining the level of analysis to characterize these motions impacts results and their interpretability. A low level approach to movement provides objective measures of kinematic features (e.g., joints angles, segments positions, joints and segments velocities and accelerations). Precise and continuous in essence, their collection is demanding (high cost of motion capture systems) as well as difficult to interpret due to the complexity of human movement. A high level analysis is more qualitative and requires videos and observers for manual coding. Observers can provide subjective annotations of different features (e.g., types and frequencies of behaviors). Subtle variations of positions, velocities or orientations (taken in isolation or combined) can be misperceived but are closer to the human perceptual realm facilitating interpretations. Several authors have introduced the notion of movement qualities (Wallbott, 1998) which can be considered to be located at an intermediate level