# A new acted emotional body behavior database

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**Abstract.** In this paper, we describe our new acted emotional body behavior database composed of 3D motion capture data as well as synchronized video. The movements of 11 actors (6 female and 5 male) were captured while they expressed 8 emotional states (Joy, Anger, Panic Fear, Anxiety, Sadness, Shame, Pride and Neutral) described with 3 scenarios and performed through 7 different actions (Knocking at a door, walking, walking with an object in the hands, sitting down, lifting, throwing and moving objects on a table). Each action was performed several times to capture a wide range of data.

**Keywords:** Body movement, emotional behavior, motion capture, database

## 1 Introduction

*Humans, whether in individual or interactive setting, display a rich mosaic of actions, gestures, and postures with their bodies* [1]. Body movement has been studied for several objectives such as trying to understand or to reproduce complex behaviors. The common point of these researches is their need of a natural bodily human movement database. Most existing databases are geared to specific research issues. Their use is often limited to the purpose of their study. Indeed, it is complex to create a common database able to be used to study a large span of research questions. Studying the expression of internal states through body movements is a particular field of research that received recently more attention.

The study of bodily emotional behavior requires exploring of a large set of emotional states and body actions type to better understand body features used to express different internal states. So far, scholars tend to focus on a very limited set of discrete emotional states mainly the six basic emotions [2]. Similarly only a limited range of actions, mostly reduced to one action, is studied [3].

In this paper, we describe the collection of our new acted emotional body behavior database. The collection of a new database was motivated by the lack of a rich multimodal corpus of body movements for the analysis and synthesis of emotional bodily behavior. Although a majority of the actors who participated to the collection of our database followed a theater formation for several years, they all followed several training sessions with a professional acting director that we recruited for our project. These training sessions aimed to show them how body movement express emotions through daily action and to avoid exaggerated or expressiveless behavior.

In the following, we will describe the steps used for the collection of our database. We will describe as well a brief description of our definition of body movement features for the analysis of emotional body movement.

## 2 Method

In this section, we will begin first with the description of the instructions that we gave to the actors and the training sessions that they followed with a professional acting director. Then, we will describe the daily actions that the actors performed. Finally, we will describe scenarios that were presented to the actors to help them to better express emotions.

**Actors:** The actors were eleven (6 females and 5 males) graduate students. The mean age was 26 ranging from 23 to 28. They were motivated to participate to the construction of our database and they gave informed consent that their motion capture data as well as their video could be used and published for research purpose. Although most of them have received theater courses since long time, a professional acting director (actually working in SUPINFOCOM Valanciennes, France) gave them 7 training sessions regarding the use of body movements to express emotional states. Each training session lasted three hours in which the acting director tried to keep them at ease as much as possible. A principal purpose of those sessions was to show the actor the ability of body movements to express affect through actions we perform in our daily live; thus to help them to use their whole body in nonverbal communication. The acting director was aware of the objective of the database collection but we didn't give him any instruction about the features found in the literature to analyze and recognize emotional bodily behavior neither any specific bodily behavior pattern related to emotional states. The acting director as well as the actors were free to imagine how they could better express emotions through their body movements. Most of the training sessions were based on mimicry game.

**Actions:** We tried to capture a wide range of daily actions that involve the whole body (like walking, sitting down) as well as upper body and arms in particular (like knocking at the door, lifting and throwing objects). However, we always recalled the actors that they were free to use a part or their whole body to express affects even through the actions that involve mainly hand gestures. Walking was divided into a simple walk and a walk with an object in hand to capture two types of arms behavior during walking action. Some of those actions were already used in past studies and considered as relevant to discriminate between different styles of the same movement type [3] [4]. Since the use of machine learning approach for data analysis and modeling requires many samples per class, we asked the actors to perform each action with multiple repetitions to capture a large set of data. Thus, the actors were informed that each action had to be repeated four times with a brief pause between successive repetitions. A continuous sequence consisting of the series of all the actions with just one trial per action was also recorded.

**Emotions:** The emotions used in our study are Joy, Anger, Panic Fear, Anxiety, Sadness, Shame, Pride and Neutral. Those emotions were used to cover a significant difference along the arousal and valence dimensions. It has been shown in previous works that the expression of those emotional states can last a period of time [5], which makes their expression through body movement more or less easy unlike reactive emotions such as surprise.

A scenario-based approach was adopted for data induction. Four different scenarios were proposed for each emotional state but only three of them were used to help the actor imagine a real situation for each emotion. The fourth element was used to replace another scenario when the actor didn't feel comfortable with it or unable to imagine the specific situation. Most of the scenarios that we used were adapted from those used in the study of Dael et al. (2012a) [5] and Scherer et al. (1991) [6]. The other scenarios were validated through an informal perceptive study where 10 participants had to attribute an emotion chosen from a closed list to each scenario. The major difficulty for the actors was to imagine a relationship between the proposed scenarios and the actions that they were asked to perform. Thus, another purpose of the training sessions was to help the actor to abstract the scenarios and imagine a virtual relationship with the actions. Two scenarios used respectively for Anger and Sadness emotion are provided here as examples:

"I hoped to sleep late on Sunday morning, but my neighbor started very noisy work in his house at 7am. I felt so angry that I decided to go and scold him."

"I got a call to tell me that my favorite aunt suddenly died."

During the recording sessions, the order of emotions, scenarios as well actions was randomized from one actor to another. We tried to limit the instructions and the conditions given to the actors in order to keep them more at ease.

## 3 Data recording

The motion capture took place in our institute, Telecom ParisTech in France. For each sequence of body movements, we recorded 3D motion capture file as well as video file. In this section, we describe briefly the technical approach of data recording.

**3D motion capture:** We used the inertial motion capture system Xsens [7] to record the 3D motion data of the whole body. The MVN Mounting straps were used, as the straps are useful for interchanging setups between subjects. 17 sensors were used to capture the movements of 23 body segments. The orientation and the position information are obtained for each segment.

**Video acquisition:** Besides the 3D motion capture data obtained for each sequence, we obtained four mxf video files of full HD resolution (1280*720) from four cameras placed in all the corners of the studio. Two cameras were dedicated to capture a general view of the room while the other two cameras were placed

carefully to capture the face and the upper body when the actor performs actions involving mainly upper body. Canon XF100 cameras were used for this purpose.

**The synchronization of video and 3D motion capture data:** The video files were synchronized with the motion capture files through some specific hardwares. The Rosendahl nanosyncs HD, a professional video and audio sync reference generator, was used to generate a common time code. The generated time code is read from the cameras through the outlet Genlock/TC. The Alpermann card PLC PCIe is used to read the time code in the computer. Using the MVN time code plug-in with the MVN Studio software that comes with the Xsens system, we were able to read the time code from the Alpermann card. Thus, the mvn motion capture files contain the same time code as the mxf files generated from the cameras.

As the principal aim of the database recording is the modeling of bodily emotional behavior, the definition of the features that describe body movements is a primordial stage. Body movement features can be based on implicit analysis that includes low-levels parameters computed directly from the raw data [3] or on explicit analysis where the definition of features is provided in advance [4]. While using implicit low-levels features to model the different styles of motion through machine learning techniques allows to create realistic and natural stylized behavior, the definition of each style of motion remains unclear. The explicit definition of body features aiming to characterize stylized movement allows us to identify body cues that define the style of the motion. In the next section, we will describe our approach for the definition of body features aiming to characterize expressive movements.

## 4 Body features for expressive movement characterization

Our aim is to characterize expressive body movement using a large set of body features enabling the study of behaviors related to several emotional states for different action types. We classify body features along different description levels: for example features aiming to describe body posture vs. features aiming to describe the dynamic properties of a movement.

In the particular domain of bodily emotional behavior characterization, body movement description strategies can be based either on movement types or on movement characteristics. Coding systems based on movement types tend to decompose the body movement into a set of body actions and/or postures units[8]. The type of movement can be then defined in function of the action (like manipulators or adaptors which refer to actions in which one body part touches another body part), or as the form of the movement with respect to the anatomic and directional level (like Left arm action upward).

Coding systems based on movement and posture characteristics focus on how body movements are performed [9] [10]. They consider body shape, postural changes and dynamic features. We adopted a movement characteristics approach for body movement description for two reasons. The first is its ability to describe different action types using the same set of features. The second is that previous

researches showed the effectiveness of using movement quality based features to describe emotional bodily behavior [11], [10].

Based on the work described in [8] and the adopted body movement description strategy, we proposed three global description levels: anatomical dimension, directional dimension and static/dynamic dimension (See Figure 1). Anatomical

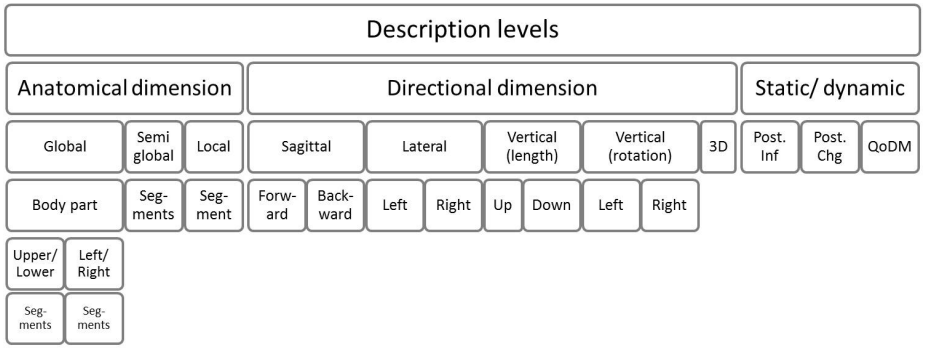


**Fig. 1.** Body movement features description levels (Post. Inf stands for Postural Information, Post. Chg stands for Postural Changes and QoDM stands for Quality of Dynamic Movement)

description level defines the body parts or modalities involved in the movement. It is described along three sublevels which are global (upper body part, left body part..), semi global (relationship between body segments) and local (considering only one body segment). The directional description level defines the spatial direction in which movement is possible. It is defined through five possible directions (sagittal direction, lateral direction, vertical direction defining vertical length of body shape, vertical direction defining left or right rotation and finally 3D information). The third dimension aim to describe the postural information, postural change and variation, and dynamic of movement. All proposed description levels and sublevels aim to give a more comprehensive definition of body movement features. A first proposed set of body movement features is explained in [12]. Applied on expressive walks, we showed that the proposed set of features was able to discriminate between five styles of walking behavior.

## 5 Conclusion and future work

In this paper, we describe the collection of a new database of emotional body behavior. We have collected not only a large variety of 3D motion capture data but also synchronized video with full HD resolution. The collection of emotional body movement database involves many steps starting from the definition of data induction approach and representative actions to the technical recording of

data and finally data post-processing. The instructions given to the actor, the chosen actions and emotions as well as a technical description of data recording were provided. An overview of the description levels to describe body features was also given in this paper.

Currently, we are continuing with the segmentation and the organization of data. A perceptive study will be conducted to validate acted emotional behavior from recorded videos and from motion captured data reproduced on an avatar. We will make available this database and its segmentation to the research community. We foresee that this database could be used for different purposes; in computer animation for the generation of new stylized movements and motion transition, in the perception of biological motion and in emotional behavior analysis to study the body features that describe expressive body movement.

**Acknowledgments.** A special thanks to all the actors, the acting director Mr Robert Bennett, Mr Giovanni Nolli from Xsens support, Mr Gilbert Pappalia for his help to resolve technical issues and finally Mrs Janina Breidaka who helped us to organize and segment a large part of data. This research is supported by the National project Anipev1 (FUI Acteur Virtuel).

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