Expressions Posturales de Tendances à l'Action

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Résumé :

L'un des enjeux de la recherche sur les agents virtuels est de spécifier l'expression multimodale des émotions complexes. Les recherches sur l'expression d'émotion se sont plus particulièrement focalisées sur certaines modalités : expressions faciales, regard ou gestes. Au contraire, les expressions posturales de l'émotion ont reçu moins d'attention, de même que les autres composantes de l'émotion, telle que les tendances à l'action. Dans cet article, nous proposons une approche pour concevoir et évaluer les expressions posturales des tendances à l'action. Nous avons conçu les expressions posturales des tendances à l'action en utilisant la plate-forme d'animation de personnages virtuels MARC. Ces postures ont été spécifiées à partir des données issues de la littérature et des annotations manuelles d'un corpus vidéo de tendances à l'action. 5 couples d'images d'expressions posturales ont été évalués en termes de tendances à l'action et de catégories d'émotion discrète [20]. Les sujets ont reconnu les expressions posturales des tendances à l'action suivantes: *attend*, *disappear from view* et *exuberant*. La perception des catégories d'émotion a été également conforme aux prédictions. Ces résultats suggèrent que les expressions posturales peuvent être utiles pour exprimer les tendances à l'action.

Mots-clés : Tendance à l'Action, Emotion, Corpus Multimodal, Posture, Agent Virtuel

Abstract :

One of the challenges of virtual character research is the specification of reliable and discriminative features of complex emotions in multiple modalities. Whereas expressions of different emotion categories in facial expressions, gaze, and gestures were explored in several studies, postural expressions of emotion and other components of emotions received less attention. In this paper, we propose an approach for designing and evaluating postural expressions of action tendencies. We designed postural expressions of several action tendencies using MARC, our virtual character animation platform. These postures were informed by data from the literature completed with the manual annotations of an exploratory video corpus. A decoding study tested 5 pairs of static pictures of postural expressions in terms of action tendencies as well as discrete emotion categories [20]. Subjects reliably recognized the postural expressions of the following action tendencies: attending, disappear from view and exuberant. Perception of emotion categories was also consistent with psychological predictions about action tendencies. These results suggest that postural expressions can be useful to express action tendencies in virtual characters.

Keywords: Action Tendency, Emotion, Multimodal Corpus, Posture, Virtual Agent

1 Introduction

An *emotion* can be seen as "an episode of interrelated, synchronized changes in five components in response to an event of major significance to the organism" [29]. These five components are: the cognitive processing (function of evaluation of the objects and of the events), the physiological changes (function of system regulation), the action tendencies (function of preparation and direction of action), the motor expression (function of communication of reaction and behavioral intention) and the subjective feeling (function of monitoring of internal state and organism-environment interaction). *Action tendencies* play a role in the preparation and the direction of action at the motivation level. On the one hand, they consist of a readiness to execute action: they involve the activation of a class of possible responses selected out of a human's response repertoire. On the other hand, they consist of "readiness to achieve or maintain a given kind of relationship with the environment" [29]. Thus, they involve orientation toward a present or forthcoming state.

Although action tendency is an important component of emotions, few studies have explored how they can be simulated and expressed in virtual agents. Yet, this would allow an agent to reveal affect and enable the

user to possibly predict its future actions. Indeed, posture was observed to be a relevant modality to express self reported aversion, openness, irritation, happiness, and self-confidence [34]. Ekman suggests that body actions might provide information about the intensity of the felt emotion [17]. Wallbott observed some discriminative features of emotion categories in both posture and movement quality [34]. Video corpora and motion capture have been collected to get detailed information on the postural expression of emotion but these data were not analyzed in terms of action tendencies [4] [5].

In the study that we present in this paper, we explore whether postural expressions might convey discriminative and reliable features of action tendencies. Our long-term motivation is to consider the perception of body postures and movements in social scenes featuring multiple interacting characters. A secondary more pragmatic goal is to extend the posture library of our MARC platform with postural expressions of emotions. These research goals raise several questions: How to code action tendencies? How to collect postural expressions of action tendencies? Which methodology should be defined to investigate how postural expressions of action tendencies are perceived?

2 Related Work

2.1 Action Tendencies

According to Frijda "action tendencies are states of readiness to execute a given kind of action, and thus an action tendency is defined by its end result aimed at or achieved" [19]. In other words, "action tendencies are states of readiness to achieve or maintain a given kind of relationship with the environment". They aim at achieving changes to the actual situation. Action tendencies are thus "readiness to engage in or disengage from interaction with some goal object in some particular fashion". During social interactions, action tendencies are perceivable structure that is intended to indicate an implicit quality about the people or their environment.

Different action tendencies correspond to different emotions. Some emotion categories might be better represented by appraisals (jealousy, surprise, hope), and others by action tendencies (disgust, despair, anxiety, anger) [20].

2.2 Postural Expressions in Humans and Virtual Characters

Darwin regarded emotions as predispositions to act adaptively and suggested that specific body movements are associated with each emotional state [12]. Ekman suggested that judgments based on the face lead to higher recognition accuracy and higher agreement among viewers when considering the emotion category [16], whereas the body would play a role in conveying the intensity of the emotion [17]. The role of the body in conveying emotions has been reinforced by recent neurosciences studies for example the role of body postures over facial expressions in cases of incongruent affective displays [13].

Ekman and Friesen suggested that static postures are more likely to convey gross affect (e.g. liking), whereas movements of the body are more likely to convey specific emotions [18]. Wallbott observed discriminative features of emotions both in static body postures and in the movement quality [34]. Harrigan suggested that the body posture and the body actions help decoding more subtle facial and vocal affects [22]. Bull reported several studies about postural expressions [7]. Yet, he did not investigate the postural expressions of action tendencies. Finally, the Component Process Model of emotion considers the causal sequences of bodily changes [30]. Scherer predicts a series of bodily posture shifts following a process of multi-level sequential checking. Grammer et al. [21] propose an approach combining traditional behavior observation and modern anthropometric analysis. A set of photographs was taken with 100 actors exposing body postures. The body postures were then transferred to a 3D virtual environment. 50 subjects judged the affective states of people

who expressed postures. Five categories were mainly represented (aversion, openness, irritation, happiness and self-confidence). The authors generalized the body postures per affect category, and reconstructed postures using a virtual environment. The reconstructed postures were validated in a perception test with 50 observers.

Digital corpora have also been recorded to collect detailed information about the expression of emotions in different modalities. The Geneva Multimodal Emotion Portrayal database contains video recordings of portrayals of 18 emotions acted by 10 professional actors [3]. The AffectMe project collected a library of postural expressions of emotions using a VICON motion-capture system [6]. 13 subjects acted anger, fear, happiness and sadness. Their movements were recorded at 32 points of the body. 111 affective postures were collected and presented to 5 subjects who had to judge these postures according to emotion categories and affective dimensions (valence, arousal, potency and avoidance). The authors observed that some postural features provide information about some affective dimensions. For example, openness of the body seemed to be important to arousal dimension of affective [6].

Postural expression was also investigated in virtual characters. Ballin et al. [2] designed the Demeanour system for animating the postural and spatial behaviors of virtual agents for expressing affiliation and dominance. Luo et al. found that adding lower body motion did improve the believability of virtual characters. They added lower body movements including movements co-occurring with gesture, and idle movements that do not occur with gesture [27]. Egges designed an animation model based on a combination of motion synthesis from motion capture and a statistical analysis of prerecorded motion clips [15]. His model includes idle motions that are generated by sequencing prerecorded motion segments organized in a graph. To control the path followed through the graph, he used an

activation-evaluation emotion space, in which different emotional states are represented using a 2-dimensional vector.

Previous work has considered to which extent postural expressions convey emotions, but not its relation to action tendency. In the following sections, we propose an approach to represent action tendency in postural expressions.

3 Design

3.1 Corpus of Postural Expressions of Action Tendencies

TAB. 1 – The action tendencies selected for the study [20] [33].

Action tendencies	Description
Exuberant	I wanted to move, be exuberant, sing, jump, and undertake things.
Attending	I wanted to observe well, to understand, or I paid attention.
Antagonistic	I wanted to oppose, to assault; hurt or insult.
In command	I stood above the situation; I felt I was in command; I held the ropes.
Disappear from view	I wanted to sink into the ground, to disappear from the Earth, not to be noticed by anyone.

As explained in the previous section, the literature is scarce about postural expressions of action tendencies. Thus, we decided to collect additional knowledge by exploiting our PERMUTATION video corpus [9]. This corpus contains 100 video samples of American television comedy-drama series for a total duration of 42 minutes. It contains samples of rich emotional interactions in a variety of social situations. The corpus was presented to 200 participants, who attributed action tendencies based on the nonverbal behaviors of the characters. We selected five action tendencies (Tab. 1) which received a high agreement among subjects [9] (average ratings between 3.4 and 4 on a scale between 0 and 4).

We segmented and annotated the postures

observed in these clips using the Anvil tool [23]. We defined a multi-level scheme for annotating posture based on the Posture Scoring System [8] and on the annotation scheme for conversational gestures [24]. Our scheme includes the annotation of head, shoulder trunk and arm [32]. The annotations resulted in a set of specifications at different levels of body posture. For example, these annotations indicated that the actors tend to lean their shoulders forward while they were judged as "wanted to move, be exuberant, sing, jump, and undertake things". Postures were annotated in 14 videos clips by two coders.

3.2 The MARC Virtual Agent Platform

MARC (Multimodal Affective and Reactive Characters) is the platform that we develop for conducting experimental studies using interactive virtual characters [11]. MARC includes a Body Posture editor. Edited postures are added to a posture sequence in a time line. The postures that we informally specified out of the corpus annotations described in the previous section were saved in an XML library. Animations of the virtual character are then triggered by BML messages at runtime [25]. MARC also features the possibility to include a 3D environment and multiple characters in the same scene.

4   Exploratory Study

Our previous experiment using the PERMUTATION corpus showed that people reliably assign some action tendencies to the video clips [9]. In the present study, we explore if subjects are able to perceive the action tendencies conveyed by postural expressions annotated in the corpus and replicated on the virtual agent Mary in a social interaction setting.

4.1 Stimuli

We designed 12 postures for our study. For each of the five selected action tendencies (Tab. 1), two postural expressions were specified out of the corpus annotations so that we could keep the best recognized posture.

More than two postural expressions would require a larger video corpus of expressions of action tendencies. One pair of neutral postures was also designed to control the experiment.

Action tendencies	Postures	
Attending		
Disappear from view		
In command		
Exuberant		
Antagonistic		
Neutral		

FIG.1 – The target postural expressions designed for the selected action tendencies.

We designed a 3D scene simulating a social interaction between two female characters standing face to face. Only the character facing the camera, displays emotional postures. The other one is visible from the back and is displayed only for helping the interpretation of the social interaction. It stands in a neutral postural expression. Fig.1 presents the set of target postural expressions designed for the selected set of action tendencies. The face was blurred to inhibit the influence of a neutral facial expression on users' perception. Although dynamics of postural expression is quite relevant for emotions [34], it requires additional explorations as we suggest in the future directions section. That is why we used static pictures in this study.

4.2 Participants

20 subjects (7 female, 13 male, aged 21-60, 79% European, 16% African, and 5% Asian) completed a paper questionnaire and supplied information about age, gender and culture.

4.3 Procedure

A questionnaire was set up to assess the extent to which subjects recognize the action tendencies in our pictures of postures. The questionnaire contains two parts. In the first part of the questionnaire we asked subjects to select the pictures of postures that match the written description of each action tendency. The written descriptions are those proposed by Frijda. The order of presentation of the action tendencies was randomized. For each action tendency, we showed 6 images: 2 target images (i.e. supposed to characterize the action tendency specified in the written description), and 4 distracting images (randomly selected out of the other 10 postural expressions). Subjects were instructed to choose one or two images representing the sample description (which means the second response is optional).

In the second part of the questionnaire, subjects were asked to assign one emotional label to each of the 12 postures. For each posture, they had to select one label out of the following list: sadness, joy, anger, anxiety, surprise, fear, irritation, shame, contempt,

guilt, disgust, pleasure, despair, pride. This list of emotion labels was used by Frijda in his study about the relation between action tendencies and emotion categories. This forced-choice method was used in several studies ([14], [17], [18], [31], [34]), in which they found that subjects agree above chance levels. Since different action tendencies correspond to different emotions [20], we expected that our results would be consistent with predictions drawn from psychology studies about action tendencies.

4.4 Results

Posture Recognition. Three action tendencies (*attending*, *disappear from view*, *exuberant*) had success rates above 50% for one of their two target images. The postural expressions designed for the action tendency *in command* was not correctly recognized (69% of the answers referred to other postures that the two target images). Tab. 2 provides for each action tendency the attribution rate for the different postures.

Emotion Attribution. Except for *in command*, we observed that the emotional attribution is quite consistent across the two target postures for each action tendency. The same emotions are attributed to both target posture for each action tendency. For *attending*, subjects mainly ascribed negative emotions like anxiety, anger, or irritation. These results showed that subjects assign related emotions to postures that are supposed to express *attending*. Regarding *antagonist*, we found the same pattern of results. Subjects mainly ascribed irritation, contempt, anger, and anxiety. Regarding *disappear from a view*, subjects mainly attributed shame and guilt. These two emotions are very close to each other in the circumplex model of Russell [28]. For *exuberant*, the emotions *joy, pride* and *pleasure* were selected to describe the two target postures. These emotions are all positive. Finally only for *in command*, we observed contradictory emotional results for the two target animations. The first target animation is perceived as conveying *pleasure*

and *pride*. The second target image is perceived as conveying anger.

TAB. 2 – Attribution rates for target and distracting postures for each action tendency.

	Target posture #1	Target posture #2	Distracters (other postures than targets)	TO-TAL
Attending	**52%**	10%	38%	100%
Disappear from view	**67%**	33%	0%	100%
Exuberant	**54%**	21%	25%	100%
In Command	25%	6%	**69%**	100%
Antago-nistic	**39%**	27%	33%	100%

4.5 Discussion

We observe three main results: 1) Postures of three action tendencies (*attending*, *disappear from view*, *exuberant*) received a high recognition rate, 2) The emotional attribution is quite consistent across the two target postures for each emotion excepted *in command*, 3) The action tendency for which the error rate is the highest (*in command*) corresponds to postures for which subjects attributed few and different emotions categories. The results also suggest that the two parts of the questionnaire provide complementary information and are relevant from a methodological point of view.

Our results are consistent with the results reported by Frijda [20]. Only the results for action tendency *"in command"* are not consistent with those of Frijda [20]. The target postures designed for this action tendency are not well recognized. Subjects selected other postures as representing the action tendency *in command*. Given that the action tendency attribution is not reliable, it is not surprising that the emotional attributions appear inconsistent compared to those of Frijda.

Moreover, there are several possible explanations to lower recognition rates for the second target image. First, in the recognition task, as we explained above, we required the subjects to choose one or two images representing the sample description, which means the second response is optional. This explains why one target image has been more associated to the sample description than the other one.

5 Conclusion and Future Directions

In this paper, we explored the relations between postural expressions and action tendencies. We defined an experimental methodology, and applied it to an exploratory perception study. Results suggest that postures expressed in a social interaction scene might provide information about action tendencies.

We will also work on the synchronization and the dynamics of different body members (probably using subtle slight movements) and consider discriminative features of movement quality as observed by Wallbott [34]. This will enable us to design and test animations of our virtual characters instead of the static pictures of the study presented in this paper. We also intend to use video and motion capture corpora to collect knowledge on such a dynamics. Frijda examined the complementary contributions of appraisal and action tendencies. These contributions might be conveyed by facial expressions of appraisal and postural expressions of action tendencies. We intend to evaluate the perception of congruent and incongruent nonverbal expressions in terms of emotions and cognitive appraisals (combining dynamic facial expressions and body postures). Few studies addressed the emotion perception based on an overview of both facial and bodily dynamic expressions[10]. Finally, posture might also be relevant for expressing other related social behaviors such as attitudes: a mental state of readiness for action that is organized through experience, impacting a directive and dynamic influence on behavior [1].

Acknowledgments

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