Body Language for Mood Induction Procedures

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ABSTRACT
According to the principles of positive psychology (PP), social learning, therapeutic robotics and mood induction procedures (MIPs), we have developed an application to be used as part of a positive MIP in a psychological treatment context. We have used the inexpensive humanoid robot Nao because of its ease of use, which allows the proper interaction with therapists to help them on a regular basis. Our hypothesis is that a rich body language set can compensate the lack of facial expressions in such robots. We run a pilot study in the context of cognitive behavioral therapy for the treatment of Fibromyalgia. This work introduces a new way to contribute to MIPs and to the human-robot interaction (HRI).

Categories and Subject Descriptors
J.4 [Computer Applications]: Social and Behavioral sciences - *Psychology*; I.2.9 [Computing Methodologies]: Robotics - *Commercial robots and applications*

General Terms
Design, Experimentation

Keywords
Mood Induction Procedure; Human-robot interaction

1. INTRODUCTION
Therapeutic robots are social robots that are used to care people with behavioral, emotional or motor disorders, chronic disease or use in rehabilitation therapies [3]. As social robots, they must follow the human social behavior rules established. Paro, Keepon, Cosmobot, Kaspar and Kismet are some examples of such robots.

In recent years, affordable medium-size humanoids such as Nao have also begun to be used as therapeutic robots to improve social interaction [11]. To the best of our knowledge, no such robot system has specifically been devoted to MIPs. We present here the development of such a system for the induction of positive emotions, and its implementation on Nao.

2. BACKGROUND
Firstly, we based our approach on the PP, especially on the concept of empathy, which is the ability to tune emotionally with others. According to Vircikova and Jerga [8], it is possible to build robots that appear to show empathy. Secondly, based on studies about social interaction and HRI, we have decided to follow the social learning theory of Bandura [1]. Lastly, we focused on MIPs which are experimental procedures whose aim is to provoke a transitory emotional state in an individual in a controlled manner. Experimental research in this field is mainly grouped into the following classes: Velten, Imagination, Autobiographical memories, Film/Story with and without instructions, Music with and without instructions, Sounds, Visual, Feedback, Social Interaction, Gift, Facial Expression, and Combined [10].

3. DEVELOPMENT
The main aim of this work is to implement an emotional system that allows a humanoid robot to increase positive mood of participants by means of bodily postures.

3.1 Methods
According to the previous sections, the teacher-learner method is the most popular social learning procedure in HRI, which is based on imitation [1]. So, our hypothesis is that if we observe a positive mood in a humanoid robot it causes a positive mood in us.

Experts confirm that the majority of human communications are made nonverbally (50-80%) [13]. Consequently, the main goal of this work is to find out how a humanoid robot can express positive emotions through body language, but without facial expressions, since our target implementation is a commercially humanoid, such as Nao, that can easily be used by therapists.

3.2 Requirements
Based on our hypothesis, our system was primarily designed to be applied in a Film MIP with instructions. In this way, the robot must be able to:

- Speak in an understandable and comprehensive way to explain the instructions of the film.
- Move according to the verbal message with its own words or heard in the video.
- Recognize some instructions or sentences to communicate with others.

3.3 Implementation
To make the system affordable for its use by therapists, we have selected for our application a medium-sized humanoid robot, such as Nao [12].

As Naoqi runs on the robot and controls it, we have used its libraries. To speak in an understandable and comprehensive way the TTS library has been used as the principal module. Changing the speed, the pitch and the volume parameters of the speech a positive natural oral communication can be achieved. Speech recognition is also used in order to manage a dialogue with humans. To match Nao's body language with the verbal message in its own words, or those heard in the video, we used different positive poses and movements based on the experiments described in [2, 5-7, 9] as well as further research done in general body language [13]. They need to be synchronized with the rhythm of the speech or the video through the timeline pane of the Choregraphe tool. Once the simulations confirmed the stability of the gestures and movements they were implemented in the robot. An example of the robot postures is shown in Fig. 1.a).

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4. EXPERIMENTS AND RESULTS

7 patients with Fibromyalgia completed measures pre-induction. A video in virtual reality as the Film + instructions MIP used here was made inspired in [4]. Nao told them to concentrate on the screen and to maintain an open attitude to what it offered. Following these instructions the mood induction began. Nao contributed here moving according to its instructions (see Fig.1. b). Then, Nao said goodbye. After induction, the patients completed post-induction measurements. Additionally, an auto-scale regarding the ICTs profile of the participants and the agreement to the performance and the social interaction with Nao were done.

To analyze the effect size of the differences between the pre-post session results we used the statistical test ‘Cohen’s d’ (Table 2).These results show a moderate effect size in the motivation of the patients and demonstrate that the session with Nao induced a positive effect resulting in a higher motivation after the session. All the results of the experiment are shown in Table 1.

On the other hand, it can be concluded that the use of Nao was very pleased for the patients (6 of 7 patients preferred the use of Nao versus using the video without Nao, and totally agreed with the global satisfaction of using Nao and feeling so good using it in the session) despite they do not usually have a good knowledge about technologies (71.43%). With respect to the qualitative aspects of the robot, the scores are also high (all patients evaluated these aspects equal or above 4 in the 5-point scale in most of the cases, and only the tone of the voice and the volume of the voice are qualified with a 3 in the 5-point scale by only 1 person) suggesting that the performance of the system is robust and pretty appreciated by the patients. Furthermore, it is worthy to note that Nao is perceived as a co-therapist (all patients evaluated this point with a 4 or 5 in a 5-point scale) and as a member of the group (all patients evaluated this point with a 4 or 5 in a 5-point scale) which suggest the great social interaction with Nao.

5. CONCLUSIONS

The key point here is to use body language as the main means to induce positive mood using the robot Nao. The results confirm that this MIP motivate patients with Fibromyalgia because of a Cohen´s d 0.69 demonstrate a moderate effect between pre-post session. So, this study shows preliminary the utility of using Nao in a clinical setting to support psychological treatments.

Table 1. Experiment results

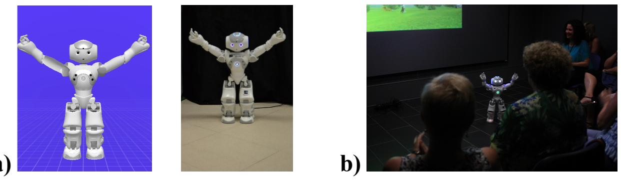
Meaning and range are: ID (identification number), A (age), ExpT (Technology skills, 0-4), FeelT (Feeling well using technology, 1-7), Naoc (Consider Nao as a co-therapist, 1-5), Naog(Consider Nao as a member of the group, 1-5), Naof (feeling well using Nao, 1-7), Naop (Nao preference, 0-2), Naos (satisfaction with Nao, 1-5), Mpre (Motivation pre-session, 1-7), Mpos (motivation post-session, 1-7), Svm (voice-movements synchronization, 1-5), Smm (music-movements synchronization, 1-5), movF (fluency of the movements, 1-5), vT (tone of the voice, 1-5), vV (voice volume, 1-5), InvV (instruction speed), Int (intelligence, 1-5), Apar (appearance,1-5), Expr (expressiveness, 1-5), Comp (comprehension, 1-5), mV(movements speed, 1-5).

ID	01	02	03	04	05	06	07
A	67	60	58	59	60	40	61
ExpT	2	2	2	2	3	2	1
FeelT	6	7	7	6	7	5	3
Naoc	4	5	5	4	5	5	4
Naog	5	5	5	4	5	4	5
Naof	7	7	7	6	7	7	7
Naop	1	1	1	0	1	1	1
Naos	5	5	5	4	5	5	5
Mpre	8	10	4	6	10	8	9
Mpos	9	10	10	6	10	9	10
Svm	5	5	5	4	5	5	5
Smm	4	5	5	4	5	5	5
movF	5	5	5	4	5	4	5
vT	5	5	5	4	5	3	5
vV	4	5	5	4	5	3	5
InvV	5	5	5	4	5	5	5
Int	5	5	5	4	5	4	5
Apar	5	5	5	4	5	5	5
Expr	5	5	5	4	5	3	4
Comp	5	5	4	4	4	4	5
mV	4	5	5	4	5	5	5

Table 2. Motivation effectiveness pre-post induction

Meaning and range are: where AMpre (Average motivation pre-session), AMpos (Average motivation post-session), SMpre (SD motivation pre-session), SMpos (SD motivation post-session), d (Cohen´s d), r (correlation coefficient).

AMpre	AMpos	SMpre	SMpos	d	r
7.86	9.14	2.19	1.46	0.69	0.17



a) b)

Figure 1. a) Simulated and real robot with a positive body pose. b) Pilot study session with Nao.

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