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Power Poses Affect Risk Tolerance and Skin Conductance Levels

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***Abstract* — Humans are used to express their feelings of self-confidence/powerfulness or their distress/sadness through either expansive postures that occupy as much space as possible or closing postures occupying as less space as possible to avoid contact. This conduct suggests that feelings of self-confidence/powerfulness or distress/sadness change our body expressions/postures. It can be interesting to assess whether the reverse is also true, i.e. the way we arrange our body at a given moment would affect our feelings. The present research reports an investigation on such argument. To this aim, 50 subjects (25 females) aged between 23 and 31 years were requested to adopt either an expansive (high-powered) or contracted (low-powered) posture for as long as 3 minutes and then asked to bet money in a dice game. The results show that assuming high-power poses favors risk tolerant behaviors and rises feelings of powerfulness. This is not true in the case of low-power postures, which engender a sense of stress, sustained by a significant increase of skin conductance levels. Considerations are made on how to exploit these results for psychotherapy and rehabilitation purposes, as well as, for the implementation of artificial intelligent systems operating as tools for well-being and coaching.**

Keywords* — *High-power and low-power poses, skin conductance levels, feelings, risk tolerant behaviors, decision making, embodiment.

I. Introduction

For long time, cognitive sciences regarded the mind as a processor of abstract information whose connections with the surrounding physical and social environments, were not meaningful for the understanding of cognitive processes (Newell, 1980). It was argued that our mental representations are abstract, symbolic, and a-modal structures that behave and function independently from our sensory and perceptive modalities (Fodor, 1975). In this context, any observed event in our surrounding environment is translated into a semantic and abstract representation, while the visual, auditory, and kinesthetic traces of it are completely discarded. This conception has been debated during the last twenty years by the Embodied Cognition theory that emphasized the role of human sensory and motor functions, as well as their interaction with the surrounding environment, asserting that reasoning, thinking, acting, speaking and representing concepts, depends on the way we perceive, relate, and interact through our sensory-motor systems and body, with the physical and social environments (Caruana and Borghi, 2013).

Instead of emphasizing formal operations and abstract symbols, the Embodied Cognition theory give significance to the fact that cognition is rather a situated – grounded – enacted activity (according to the three main theoretical approaches describing by the Embodied Cognition theory)[1], and suggests that thoughtful human beings are at the outset, behaving human beings. This imply that human cognitive processes are deeply rooted in the interactions of their bodies within the world. Therefore, emotional states are expressed not only by words, but, and perhaps even more convincingly, by body behaviors.

The recent collected data have provided enough support to the Embodied Cognition theory, to the extent that its theoretical fundaments are no longer under discussion. What remain to be investigate are the potentialities of the theory, its many facets, and, above all, its advantages with respect to the classical cognitive approach. The fundamental and essential prerequisite is that any research on cognition that provide explanations on human behaviors without taking into account

[1] See Fisher et al. (1984) for the "situated", Varela et. al (1991) for the "enacted", and Barsalou (1999) for the "grounded" Embodied Cognition conception. Despite the three labels, differences between these theoretical positions are minors. The concept of "grounded" focuses more on the sensory aspects of cognitive processes, the concept of "situated" on the importance of motor patterns, and the concept of "enacted" proposes a unique model integrating perceptions and cognitions within actions.

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the interaction of the body with the surrounding environment is, in the best case, incomplete.

This paper aims to report on body behaviors in order to relate them to emotional states through a biunique correspondence that see emotions expressed through precise bodily patterns and body patterns to arouse specific emotional states. This conception had implications on the way we develop assistive technologies and AI (Artificial Intelligent) algorithms for the implementation of emotionally, socially and believable ICT (Information Communication Technologies) interfaces and human centered-machine interactions (Esposito & Jain, 2016a, 2016b).

This paper is organized as follow: Section II reports on related works proposed in literature, Section III describes the material and procedures adopted for the proposed experiment; Section IV reports the results obtained for the variables under examination, i.e., changes in the skin conductance levels (not considered before as a side effect of body expressions), availability to take risks (in our case availability to bet the money earned for participating to the experiment), and arousals of positive or negative feelings. Finally, Section V and Section VI discuss the results providing considerations for their exploitation of artificial intelligent systems operating as tools for well-being and coaching.

II. Related Works

We usually smile, and assume expansive postures, when something beautiful and exciting happens. Similarly, we curl up and bow our head when we are sad, depressed, or something is wrong.

In the last century, many researchers have tried to investigate the relationship between specific body postures and feelings, hypothesizing that body expressions are not only rendering our mood and sensations, but also the cause of them (Riskind & Gotay, 1982).

The idea that emotional states are the consequence of bodily states - we smile and assume expansive postures, consequently, we realize that we are happy - was first proposed by James (1884) and re-proposed by Laird (1974). By then, extensive research has been conducted to investigate how bodily expressions, such as facial expressions, head movements, and body postures, affect the way we act and feel and produce physiological changes (such as changes in heart rate, skin conductance values, and neuroendocrine profiles of testosterone and cortisol hormones).

As for facial movements, Strack et al. (1988) noted that subjects invited to adopt a forced smiling expression (due to the fact that were requested to hold a pen between their tooth) produced positive judgments when requested to assess (filling a questionnaire) their well-being, and reported to sense more pleasurable feelings when watching child cartoons compared to a control group invited to hold the pen between their lips. These results were furtherly supported by experiments proposed by other researchers (Bodenhausen, et al., 1994; Erber, 1991; Martin et al., 1992; Zajonc, et al., 1989).

Wollmer et al. (2012) found that patients with major depressive disorders who underwent a treatment of glabellar frown lines with botulinum toxin displayed significant clinical improvements of depression symptoms compared to the placebo group. Finzi & Rosenthal (2014) replicated the same study in a randomized, double-blind, placebo-controlled trial. They observed that more than half of depressed patients undergo to a 50% reduction of depressive symptoms, and 27% of patients who received botulinum toxin achieved clinical remissions, providing clinical evidence for the concept that facial musculature not only encodes our moods but also regulates them.

As for head movements, it has been shown that nodding or shaking the head may affect the perceived confidence in one's own positive opinions and produce changes in attitudes.

Wells and Petty (1980) demonstrated this concept asking subjects to nod vertically or shake horizontally their heads while listening music and a pressman's commentary over headphones, under the cover story they were participating in a market research aimed at testing headphone's quality. At the end of the experiment, subjects provided an evaluation of the music, headphones, and pressman's commentary. Subjects who nodded were more in agreement than those who shook their head with the pressman's message suggesting that head movements affect the evaluation of a message.

Tom et al. (1991) replicated the experiment substituting the commentary with a pen laying on the table while subjects were listening the music through headphones. They found that nodding resulted in increased preferences for the original pen, whereas shaking leads to increased preferences for a new pen.

Binol and Petty (2003) furtherly confirmed these results proving that head nodding increases self-confidence while head shaking undermines it. In agreement with these research results, Osugi and Kawahara (2017) showed that nodding head motions significantly increased the ratings of subjective likability and approachability attributed to virtual agents, whereas these effects were not observed for the shaking and control procedure.

When it comes to postures, several studies had shown that depressive symptoms are often accompanied by a closed posture with bowed shoulders and folded arms in order to occupy as little space as possible (Peper et al., 2012, Canales, et al., 2010), while feelings of pride are accompanied by upright and relaxed shoulder postures (Stepper & Strack 1993). In line with these assumptions, other researches, have given greater emphasis to postures and related body movements.

Stepper & Strack (1993) have shown that people assuming an upright body position experienced more intensely the emotion of pride than those asked to assume a hunched posture.

Michalak et al. (2015) manipulated the walk of participants using a motion capture system. The participants were not informed of experimental aims, and were requested to walk in two different styles: a) with slow, hunched and rigid movements (depressed configuration) and b) with an expanded gait, swinging arms, and very long steps (happiness configuration). Participants were then asked to recall words from a previously presented list that included both happy and sad words. The results showed that participants who had been asked to walk in the happy style recalled happy words three times more than those requested to walk in the depressed style.

Cuddy et al. (2012) tested whether body postures enacted before an interaction may also affect how perceivers evaluate and respond to actors. To this aim, participants were asked to adopt high power (open, expansive postures) or low power (contractive postures) poses prior a mock job interview. The postures were not maintained during the interview and participants were free to assume the posture they wanted. The results show that participants who had taken expansive poses before the interview turned out to be more prepared, less anxious, and more likely to be selected by interviewers than those who had taken contracted poses.

Nair et al. (2014) investigated the hypothesis that erected postures may improve the response to stressing situations. The study involved 74 healthy participants randomly asked to sit in a contracted (bent back, bowed head, and curvy shoulder) or upright posture (straight shoulders and erect back). While seated they were administered the Trier Social Stress Test (Kirschbaum et al., 1993) in order to induce psychological stress through imagining they were being interviewed for the job of their life and had 5 minutes to convince evaluators that they are the best candidate. The results showed that subjects in the upright posture reported more self-confidence, better mood, and lower levels of fear than those in the contracted posture. Moreover, subjects who assumed the contracted posture, produced more negative words during their interview compared to the group who assumed the upright posture.

A minority of studies have also reported for high and low power poses physiological autonomic changes such as decreased venous pressure, increased heart rate, as well as, increased temperature and variations in neuroendocrine profiles of testosterone and cortisol hormones (Nicholson & Barbara, 1987, Carney et al. 2010, Nair et al. 2014),

The proposed experimental research takes its inspiration from the study conducted by Carney and colleagues (2010). The authors proposed an experiment involving 42 students who were taken to the laboratory and asked to leave a sample of saliva. Later they were randomly divided into two groups. The first group was requested to adopt for 2 minutes, 2 high-powered postures (1 minute standing up, arms resting on the desk, and legs apart; 1 minute sitting down on a chair, with open arms, hands crossed behind the neck, ankles crossed, and legs on the desk). The second group was asked to take for 2 minutes 2 low-powered postures (1 minute seated down on a chair, head bowed, and arms folded; 1 minute standing up, legs crossed, arms folded, narrowed shoulders, and head bowed). Participants were blind of the experimental aims and were told that the adoption of such postures was needed for the recording of physiological data, measured through sensors placed on their bodies. Each subject, during the 2 minutes, was left alone. Immediately after the 2-minutes, the investigator returned, rewarding the subject with two dollars as previously agreed, and asked whether she/he wants to bet the two dollars in a dice game with 50% of chances to double or lose them. In alternative, the subject was left free do not bet and keep the earned dollars. Then, participants were asked to fill a Visual Analogic (VAS) questionnaire (Wewers & Lowe, 1990) assessing their feelings, requested to leave again a sample of saliva, and let free to go. As predicted, salivary analyses showed that high-power postures led to an increase of testosterone (associated with dominant behaviors) and a decrease of cortisol (associated with stressful feelings). The opposite occurred for low-power postures. In addition, subjects assigned to high power poses were more inclined to bet the earned reward (86% vs 60%), and (according to the VAS results) felt more powerful and dominant than those who had adopted low-power postures.

Huang and colleagues (2011) partially replied this experiment confirming that participants in expansive powerful poses (compared to hunched and closing poses) felt more powerful and more inclined to risky wagering. The authors conjectured a connection between physical postures and psychological states, to the extent that from one hand, feelings of powerfulness are linked to the adoption of expansive postures and such postures will increase the personal self-esteem prompting dominant behaviors, such as an increased risk tolerance. More importantly, they observed that a person can perceive the psychological experience of powerfulness through adequate bodily changes regardless of her/his social or occupational role (Adam & Galinsky, 2012).

The proposed research aims to provide further support to the hypothesis that the adoption of expansive body postures would help to feel better when we feel sad and/or powerless, and check whether high and low power postures may affect skin conductance levels, to align with recent work showing that stress is bi-univocally connected with an increase of skin conductance levels (Boucsein, 2012).

III. MATERIAL AND PROCEDURE

A. Participants

50 Participants (25 females) aged between 23 to 31 years (mean age=26,82; standard deviation=±2 yeas) were recruited via web advertisements in the area of the city of Salerno, Campania, Italy. They were adults, in good health, and volunteered their participation, receiving as reward 2 euro. The 2-euro reward was provided at the beginning of the experiment in order to arouse in the subjects a sense of ownership of the earned money. Participants were asked to sign an informed consent and were made aware of the European general data protection regulations and Italian laws about privacy and anonymity. One participant was indeed excluded by the data analysis, since it scored high at the South Oaks Gambling Screen questionnaire (Leisieur, 1987), revealing himself as a pathological gambler.

B. Poses

The two postures exploited in the proposed experiment of powerfulness (high-powered posture) and powerlessness (low-powered posture) respectively, were among the 10 proposed by Carney et al. (2010).

In particular, the selected high-power posture refers to a standing position, with legs apart, hands on the hips with extended arms to occupy space around, and straight forward gaze. The low-power posture refers to a sitting position, with crossed ankles, closed arms, hands in the middle of the knees, and bowed head and shoulders. Both postures are illustrated in Fig. 1.

Fig. 1. – The two postures exploited in the proposed experiment: on the left, the high-power, and on the right, the low power posture. High-power poses are supposed to arouse feelings of pride and dominance, and low-power poses feelings of unpleasantness and increased discomfort.

C. *Procedure*

The experiment was conducted into a 5x5 squared meter room, air-conditioned at 23° Celsius degrees. The room temperature was kept unvarying over all the experimental phase. Each participant, on her arrival, was rewarded with a 2 euro, asked to sign the informed consent, and was told that the experiment included the recording of physiological data, in particular skin conductance levels. It was also told that to fulfill this condition, a precise posture must be adopted. In this way, participants were made blind to the meaning of the postures.
Before the adoption of the required posture, each subject was asked to fill a simple two items Visual Analogic Scale questionnaire (VAS) assessing, through a Likert scale from 0 (not at all happy / not at all powerful) to 10 (extremely happy / extremely powerful) both their baseline feelings of happiness and powerfulness. The subject was then invited to sit in a comfortable position and disposable electrodes were placed by the experimenter, on her/his left-hand fingers, i.e., the distal phalanx of the index and the middle finger.

In order to set the baseline skin conductance sensor's values and be able to correctly compute the averaged physiological data over each subject's posing time, a list of simple and neutral questions was proposed to each participant during the following 10 minutes before the adoption of the requested posture. The administered questions were similar to those adopted in the adjustment procedure of the polygraph test (Larson, 1932). After the 10 minutes, the experimenter asked the subject to adopt and maintain one, and only one, of the two proposed postures (a high or low power pose) for the next 3 minutes, and left her/him alone. After the three minutes, the experimenter returned in the room, disengaging the subject from the adopted posture and from the skin conductance sensors, and re-administered the 2 items VAS questionnaire. The subject was then asked whether she/he wanted to bet the rewarded 2 euro in a dice game to double and win 4 euro or lose everything (odds of winning were 50%). As final step, the subject was asked to fill the South Oaks Gambling Screen questionnaire (Leisieur, 1987) to exclude pathological gamblers and was let free to go. Skin conductance levels were measured with the ProComp Biograph sensors (http://thoughttechnology.com/index.php/biograph-infiniti-software-upgrade.html).

IV. RESULTS

Statistical analyses were conducted through the statistical package for social sciences (SPSS), v.23 (Pallant, 2013). Repeated measure ANOVAs were conducted on the skin conductance levels and VAS scores before and after the adoption of one of the two possible proposed postures. Chi-square tests were conducted on risk tolerance (disposal to assume risky behaviors such as to bet the two euro just earned). Significance was set at $\alpha<.05$.

A. *Skin Conductance*

A repeated measure ANOVA was conducted on the skin conductance values, after transforming the data in order to normalize the sample distribution, using a log-transformation procedure (McDonald, 2014). The between variables were the gender of participants (two levels: male, female) and the adopted posture (high vs. low power posture). The within variables were the skin conductance values measured before and after the adoption of one of the two proposed postures.

The ANOVA results show no significant main effects of both the participant's gender ($F\ (1,45)=.389$, $p=.536$) and adopted posture ($F\ (1,45)=.230$, $p=.634$), and no interactions between gender and posture ($F\ (1,45)=.003$, $p=.960$) was found.

For the within variables, significant differences were found in skin conductance values before and after the adoption of one of the two proposed postures ($F(1,45)=36{,}165$, $p<<.01$), and a significant interaction was found between skin conductance levels and posture types ($F(1,45)=10{,}264$, $p<<.01$). LSD (Least Squared Difference) post hoc tests revealed that these differences were due to significant differences between skin conductance values before (mean=2.722) and after the adoption of the low power posture (mean=2.957, $p<<.01$), suggesting an increase of the perceived stress and therefore a feeling of discomfort and unpleasantness. These results suggest that subjects who adopted the low-power pose reacted with a more intense level of stress than those who adopted the high-power pose, which were calmer and more relaxed.

Fig. 2 illustrated the skin conductance trends of each group (the one adopting the high power and low powered pose respectively) during the three minutes spent adopting such postures. The graph shows 2 mean skin conductance trends, derived exporting, directly from the Biograph Infiniti Software, each subject's skin conductance value measured during the 3-minutes pose treatment, and sampled at 8 samples for second, for a total of 1440 samples for each participant. The subjects' data were then averaged over each of the two groups (those adopting the high-power or the low-power posture), obtaining the average skin conductance trend for each group. The two acquired skin conductance trends were composed, in turn, by 1440 averaged values, each corresponding to the average skin conductance level at a specific instant of the pose adoption period. As it can be observed in Fig. 2, while maintaining the low power pose the skin conductance values increase along the time (the blue line) whereas they decrease while maintaining the high power pose.

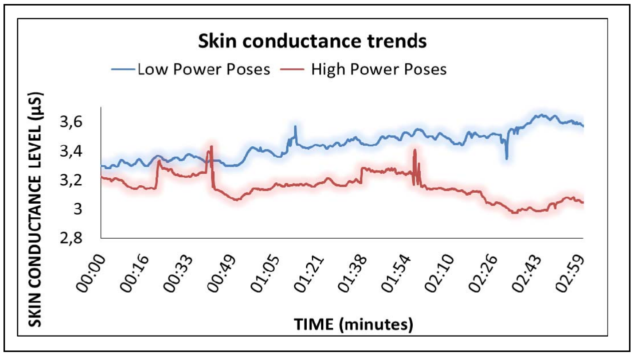

Fig. 2 - Skin conductance averaged trends of the 2 proposed postures during the 3-minutes pose treatment. The high-power pose trend is in orange, with an initial skin conductance value of 3,22 µs and a final one of 3,04 µs. The low-power pose trend is in blue, with an initial skin conductance value of 3,29 µs and a final one of 3,57 µs.

B. Risk Tolerance

Chi-square tests were conducted on risk tolerance (disposal to bet the 2 earned euro). The two nominal variables were the posture (high vs. low powered) and the decision to bet (yes or no). Consistent with Carney et al. (2010) predictions, a significant difference was found between high-power and low-power posers $\chi 2(1, N = 49) = 4{,}838, p < .05$). In particular, 92% of the high-powered posers (23 on a total of 25 subjects) accepted to gamble the two euro just earned, against 66,7% of the low-powered posers (16 on a total of 25 subjects). These data are illustrated in Fig. 3 for sake of clarity. No significant main effects were found for the participant's gender, $\chi 2(1, N = 49) = .005, p=1$). These results suggest that the high powered pose arouses more feelings of risk tolerance than the low powered one.

C. VAS Questionnaire

A repeated measure ANOVA was conducted on the VAS questionnaire scores. The between variables were the gender (two levels: male, female) and the adopted posture (high vs. low powered posture). The within variables were the 2 feelings (happiness/powerfulness) measured before and after the adoption of one of the two proposed postures.

Results show no significant main effects of both the gender ($F (1,45) =1{,}213$, $p=.277$) and the adopted posture ($F (1,45) =1{,}226$, $p=.274$), and no interactions were found between gender and posture ($F (1,45) =.762$, $p=.387$). No significant differences were observed among participants for the happy feeling scores before and after the adoption of one of the two proposed postures ($F (1,45) =1{,}205$, $p=.278$).

Significant differences among participants were found for the feeling of powerfulness before and after the adoption of one of the two proposed postures ($F (1,45) =7{,}915$, $p<.01$), and a significant interaction was found between the feeling of powerfulness and the adopted posture ($F (1,45) =5{,}237$, $p<.05$). LSD post hoc tests revealed that these differences were due to significant differences between powerfulness scores before (mean=5.947) and after (mean=6.554) the adoption of the high-powered posture ($p<<.01$), and to significant differences in the female powerfulness scores ($p<.05$) before (mean=6.021) and after (mean=6.479) the adoption of any of the two postures.

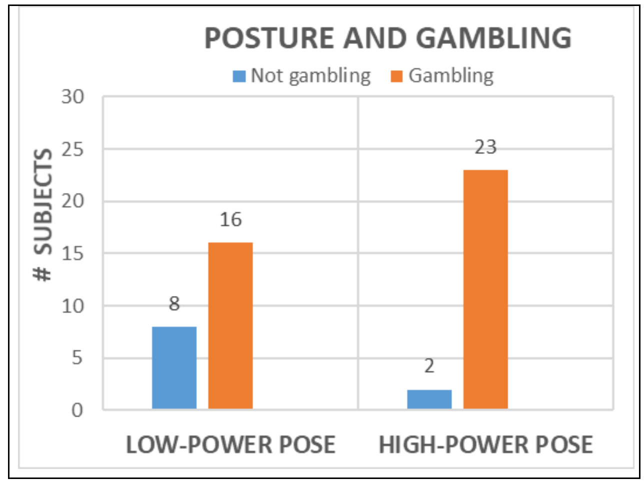

Fig. 3 – The effects of postures on risk tolerant behaviors. Participants who did not take the risk in gambling the earned euro are reported in blue. They were 8 among the low-powered posers and 2 among the high-powered ones. Participants who accepted to risk the earned reward are reported in orange. They were 23 among the high-powered posers and 16 among the low-powered ones.

These results suggest an increase of the feeling of powerfulness in accordance with the sense of dominance associated to the high-power posture, and also a gender effect, where females seem to be more comfortable in doing the experiment.

V. DISCUSSION

The data reported in this paper had shown that adopting an expansive and opened posture arouses less stress and a higher feeling of dominance and powerfulness, and favors risk tolerant behaviors, suggesting that body poses affect psychological, physiological, and behavioral patterns.

This seems not to be fully observed when our body adopts hunching poses, even though stress levels increase in accordance to an increase of the skin conductance values. What was not observed in subjects adopting low-powered poses was an increase of the risk aversion as observed by Carney and colleagues (2010). These differences between our and Carney et al. study may have a possible explanation tied to cultural and or social beliefs. It could be possible that Italian participants, in particular those that adopted the low power poses, may have considered the two earned euro as an exiguous amount of money and may have not felt great concerns in gambling them, or otherwise, may have felt so sad to attribute no importance, or positive values to the earned money. Therefore, risk aversion behaviors in participants adopting low-power poses would increase when the amount of money to gamble is significant to them, or otherwise, feelings of sadness may arouse different conducts depending on cultural and individual traits.

VI. CONCLUSION

The results discussed in the proposed research show that assuming high-power poses favors risk tolerant behaviors and rises feelings of powerfulness, while low-power poses engender a sense of stress, sustained by an increase of skin conductance levels.

These results may lead to a different methodological perspective in facing a difficult event or a challenge. Given the agreement of the data obtained by the present experiment with other experiments reported in literature, it can be comfortable to assume that pretending to adopt a high-power posture in daily difficult situations, may arouse positive feelings linked to a sense of supremacy and dominance, that can assist in handling such situations (Carney et al., 2010; Cuddy et al., 2012; Finzi & Rosenthal, 2014; Nair et al., 2014; Michalak et al., 2015; Cuddy et al., 2015; Korner & Petersen, 2017; Miragall et al., 2018; Peper et al., 2017). As an example, it can be imagined that depressed subjects, persons having a difficult life period, or needing to face a major challenge (such as a stressful exam, a job interview, etc.) may exert some control on their feelings of stress and powerlessness adopting a high-power posture and, in three minutes, feel more relaxed and ready to face the daily circumstances.

The dream would be that in only 3 minutes, our body postures can be used to improve our feelings. However, it would be crucial to know how many and specifically which high-powered postures are more effective than others in producing relaxation and dominant feelings. This is one of the aspects that remain to be investigated. Another aspect remaining to be investigated is whether the awareness of adopting such postures will deliver the same outcomes.

The present study is, to our knowledge, the first one reporting skin conductance data and showing they are directly linked to low-power rather than high-power postures, suggesting different physiological changes for different body postures. This was not observed in the previous studies and open the way for further investigations.

As further outcome, these data suggest to therapists, psychologists, and psychotherapists to exploit body postures to coach their patients when they are depressed, sad, scared, or are feeling bad for some reasons. Posture changes can be introduced as a therapy in everyday situation, in order to let patients to feel better and react positively to difficult events.

It must be noted that the low-power posture exploited in our experiment (Fig. 1) evokes the pose usually adopted when utilizing the smartphone, nowadays increasingly used in a continuous way (Guan et al., 2016). Based on the reported data, it can be assumed that phone-dependent people are more subjected to unwitting stress caused by such posture. In order to avoid such consequences, it would be beneficial and positive to develop smartphone applications that warn their users when they are making an excessive use of the smartphone, suggesting them through notifications to stand up, and making them aware of the correct posture to assume. Along these lines, the already developed applications from the Center Road Software (2013) known as "Posture Aware" (itunes.apple.com/us/app/posture-aware/id775391897?mt=8), and "Stand Up! The work break timer" from the Raised Square company (2018), (www.raisedsquare.com/standup/) are efficacy tools helping users to improve their posture, including step by step trainings. This new perspective could be managed as an innovative introduction in the field of assistive technology.

These data are of great interest in the field of Artificial Intelligence (AI) dealing with computer vision applications and corresponding automatic interpretations of the seen world in order to undertake automatic decisions. As humans, we frequently recognize other people's moods, intents, and actions by looking at them. Among the aims of AI there is the attempt to transfer these human abilities into ICT technologies. Along these lines of reasoning it could be beneficial to have intelligent cameras monitoring major depressed patients sending alerts whether they adopt low-powered postures for long time in order to provide immediate comfort and induce relaxation. These devices can serve as additional tools to the pharmacological and psychological therapy, for providing further assistance to the patients and contribute to their well-being. These applications can be improved conducting more deep investigations on the effects of adopted postures and physiological and psychological changes they generate, and serve as a therapy tool to reduce stress, and arouse feelings of comfortableness and self-confidence.

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