

Emotion regulation for social phobia treatment using virtual reality

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Abstract—Social phobia, described as irrational anxiety elicited by exposure to certain types of social or performance situations, also leading to avoidance behaviour. Exposure therapy is applied to attenuate the anxiety by subjecting a patient to anxiety-producing stimuli in real life situations or by evoking the stimulus in the patient's imagination. The techniques of VR are making it possible to treat patients in the therapist-office, in stead of in real situations in the outside world. Stimuli in a virtual environment can be manipulated, which isnt possible in the real world. The idea that is suggested in this document is to automate the progress of the therapy sessions exposure using virtual reality. This operation gives more time to the therapist, and allows him to take care of other interventions in a better way. We cannot ignore or minimize the role of the therapist, as his presence is still indispensable for a good progress of the sessions.

I. INTRODUCTION

Social phobia is a psychological state of which many people are suffering nowadays and that prevents them from having a happy life. The therapies used are based on putting the person in a gradually hostile environment. The therapist makes the patient go through a series of exercises in order to confront him with his phobias. The objective is to make each person accept and control the phobic situations that are specific to him or her.

The big problem with this therapy is the great number of different situations to generate in the real world and the management of hostility degree. Some works realised in the field of virtual reality for therapeutic objectives of phobias, and specifically social phobias, have shown that the same goals are reached as those of a real situation.

The essential interest in virtual realities techniques makes it possible to choose the scenario as a function of the needs without creating it really and to animate it in order to provide a desired degree of hostility. This is done using a computer programme. In general, the choice of the scenario its content, its hostile character, are defined by a therapist following his/her subjective point of view on the emotional state of the patient.

II. SOCIAL PHOBIA

In general, phobia is a form of anxiety pathology that is characterised by emotional fears that are unjustified or immoderate compared to their cause. Their causes are generally unknown but can either take a genetic character with a family factor or psychoanalytic for which phobia is the result of compromise acting through a displacement of representations of a significant object that is loved and hated towards a less significant one but fearful, or cognitive-behavioural that cognitive psychologists consider as a learned behaviour and reinforced during the patients life.

Therapies used today are of three kinds: using pharmacology to treat anxiety disorders in general, or cognitive-behavioural psychotherapy which consists of suggesting the patient to be gradually confronted to the feared situation with a progressive exposition which results in a decrease of fearful reactions through desensitization or even through psychoanalytic psychotherapy which considers that phobic symptom has a meaning that is supposed to be explained in order to be able to reach the unconscious bases.

There is a great number of phobias among which is the social phobia that we are considering here and which is characterised by an excessive fear that is associated with social situations or by the fact to have to speak in public. It can hardly be minimised and leads towards a risk of confinement. DSM-IV (Diagnostic and Statistical Manuel of Mental Disorders) of the American Psychiatric Association defines social phobia in the following way:

- A persistent and intense fear of one or several social situations or of performing situations during which the subject is in contact with people that are not familiar or in situations where he can eventually be exposed to careful observations from others.
The subject is afraid of acting (or showing symptoms of anxiety) in an embarrassing or humiliating manner.
- Exposition to a feared social situation leads, in a quasi

systematic way, to an anxiety which can take the form of an attack of panic related to the situation or made easy by the situation.

- The subject recognises the irrational or excessive character of fear.
- Social situations or situations of performance are lived with intense anxiety or distress.
- Avoidance, anxious anticipation or suffering in feared social situations or of performance disturb, importantly, the individuals habits, his professional (or school) activities, or his social activities or his relations with others, or the fact of having this phobia is accompanied by a feeling of important suffering.
- For individuals younger than 18, we cannot carry a diagnosis unless it is at least 6 months long.
- Fear or behaviour of avoidance is due neither to direct psychological effects nor to a medical affection and are not better explained by another mental disorder (for example the subject panics with or without agoraphobia).
- If a general medical affection or another mental disorder is present, the fear suffering that has been described is independent of these disorders, for example the subject is not afraid of stammering, etc.
- Among the usual characteristics that are associated with social phobia, one finds hypersensitiveness to criticism, to a negative evaluation or to rejection, a weak esteem of oneself or feelings of inferiority. Subjects having a social phobia are often afraid of an indirect evaluation by others such as taking an exam.

It was not possible to find in literature a precise value of the prevalence but a rate of 4% to 6% of the population is usually admitted. The character that was not visible, at first sight, makes this pathology difficult to quantify. Classically, the disorder that starts during childhood or at the beginning of adolescence is twice as frequent with women as with men.

Intense fear and anxiety can take the form of different physical symptoms before, during and after the feared situation: blushing, mumbling, trembling, perspiration, nausea or feeling sick, heavy and fast heart beats, panic attacks, hypersensitivity.

III. OUR APPROACH

The role of the therapist is to control the progress of the therapy sessions using virtual reality. He observes the state of the patient in order to be able to estimate his anxiety degree, and intervenes in the virtual environment so that he can change the level and type of stimuli. This is to make the patient progress in a continuous and smooth manner[1].

The therapist can also increase or decrease the stimuli intensity or even immediately stop the simulation in the case where the patient doesn't feel well. The idea that is suggested in this document is to automate the progress of the therapy sessions exposure using virtual reality. Its principle is illustrated in Figure 1 on page 2.

The human block represents the phobic patient. He responds to stimuli of the virtual environment through emotional expressions in the form of physical activities (facial expression, gestural expression, voice...) and physiological activities

(heart beat, arterial pressure, temperature...). Stimuli are elements of the virtual environment. They are part of the therapy session scenario.

They are characterized by images, sounds, music, dialogs . The emotion inductor represents the regulator. It generates the necessary stimuli to minimize the error between the desired emotional level and the one found on the patient.

In order to “synthesize” the emotion inductor block, it's necessary to get a model of human. Such a model is quite difficult to obtain, due to the fact that the emotions are related to many different stimuli.

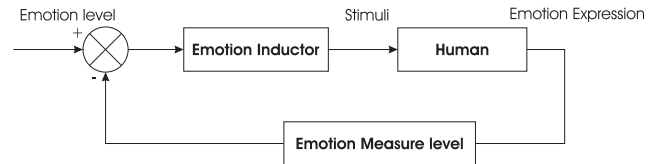


Fig. 1. Principle of emotion regulation

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A. Emotion inductor

The inductor block is used to generate some stimuli to generate a level of anxiety. Our primary intention is to use the OCC¹ model in order to synthesize this block, so it will be implemented as a computer software, the programming code will translate the OCC classification into sequences of -If-Then- procedures. The stimuli generated in this case are some elements of a virtual environment.

The anxiety levels produced by the generated stimuli must be known. In literature, we can find many research works on the development of calibrated stimuli. The International Affective Picture System (IAPS)[2], The International Affective Digitized Sound system (IADS)[3] and the Affective Lexicon of English Words (ANEW)[4] which are collections of normalised affective stimuli, have been developed and distributed by NIMH Center for Emotion and Attention (CSEA) in order to provide standardized materials that are available to researchers in the study of emotion and attention.

Another mean of emotional induction has proven to be effective, MIPs make up a set of experimental procedures capable of inducing positive and negative states of mood. The importance and the specificity of an emotive change depend on the used MIP. MIPs present some limitations, particularly for the success rate which varies too much from one MIP to another and also at the intensity level and the range of the induced moods as well[5].

¹

1) Ortony, Clore and Collins.

B. Human

In this paragraph, we are going to try to present a state of the art on modeling a human emotional process, and also the various computer applications and implementations. In spite of the numerous research projects in psychology that try to explain the nature of emotions, there is no definition or dominant theory up to now.

This is partly because an emotion is a complex phenomenon made of at least three aspects: cognitive, psychological, and somatic. Research works on emotion taxonomies can be divided into two main approaches: the continuous approach and the discrete approach.

1) The discrete approach, supposes that there exists a set of emotions so called basic, universal and innate. The primary emotions could combine and give all the other emotional states. But there is no consensus on the definition of the set of basic emotions, nor on the number nor on the identity of emotions that one can find. Ekman [6], [7], [8] takes the facial expressions as a base in order to distinguish six basic emotions: happiness, sadness, fear, surprise, anger, disgust. Some other authors consider different criteria.

2) The continuous approach, supposes that emotions are the result of underlying dimensions, and is represented in a multidimensional space. The bidimensional approach is the most dominant. Valence represents the first dimension. It allows to distinguish between positive and unpleasant emotions, like anger.

The second dimension is activation, which represents the corporal excitation level (heart acceleration, perspiration). Three-dimensional approach adds a third dimension called dominance, and it allows to differentiate emotions resulting in reactions of approach and combat (like anger) from those giving such behaviors of avoidance and escape (like fear).

1) *The four theoretical approaches of emotions:* In psychology, we can have four theoretical approaches of emotions, from which the existing models have been inspired[9].

- The Darwinian approach is based on emotional expressions, their adaptive function and their universal character. The basic idea is that emotions are progressive phenomena whose survival function is very strong. Starting from this idea, Paul Ekman, showed the universality of facial expressions.
- The Jamesian approach is interested in the emotional experience and the determinant role of corporal changes. William James sees emotions as a direct response to the perception of an event and insists on the changes induced on the corporal behavior of the person.
- The cognitive approach explains how cognitive processes intervene in emotion elaboration. It is the appraisal of an event for the personal well-being that determines the emotional experience. The main idea is that thought and emotions go together. According to Arnold (1960), emotions depend on appraisal. Each emotion is related to a different appraisal process that relates the proper characteristics of a person (personality, temper, physiological

states) to emotions.

- According to the social constructivism approach, emotions are not treated like a biological phenomenon but rather as social and cultural constructions used in social functions.

2) *The cognitive models:* The cognitive appraisal theory. One of the most used theories of emotion aims at explaining what makes the appearance of a particular emotion (i.e. the mental state of an emotion) for a given person.

According to Roseman & Smith [10], appraisal theories embody the following assumptions:

- 1) Emotions are differentiated by appraisals;
- 2) differences in appraisal can account for individual and temporal differences in emotional response;
- 3) all situations to which the same appraisal pattern is assigned will evoke the same emotion;
- 4) appraisals precede and elicit emotions;
- 5) the appraisal process makes it likely that emotions will be appropriate responses to the situations in which they occur;
- 6) conflicting, involuntary, or inappropriate appraisal may account for irrational aspects of emotion; and
- 7) changes in appraisal may account for developmentally and clinically induced changes in emotions. Other tenets of appraisal theory are that appraisals are not entirely conscious, and that they are automated short-cuts that are useful on average, but may also be triggered inappropriately, e.g., when careful consideration would suggest alternative reactions.

Roseman theory, that he exposed for the first time in 1979 [11] has been changed several times, by himself. Sixteen emotions can be generated while classifying events according to the following criteria: motivating or not, self-perception (strong, weak), origin of event (circumstances, oneself, other person) beneficial or not for the person, certitude of event (unknown, uncertain, certain).

Because of their simple structure which can be translated quickly into rules which exactly define which appraisals elicit which emotions, Roseman's models were received very positively in AI circles.

The OCC model [12] has become an imperative standard for the generation of multi-modal signs because it seems to cover a huge set of situations for emotive agents. This model classifies events according to their valence. Ortony, Clore and Collins find twenty two emotions that are generated from the following criteria (Figure 2 on page 4): kind of event (consequence of an event, action of an agent, aspect of an object) the given agent (himself, other person) Desirability (for oneself, for the other) Objectives (realized, not realized) Familiarity with an object.

3) *Computational models :*

1) SHAME [14]

This system is based on the OCC model, that is used as a base for an assisted learning of emotions. The system converts an event in an emotional intensity vector (EIV) with the help of a hybrid neuron network. This architecture is called SHAME: « Scalable, Hybrid Architecture

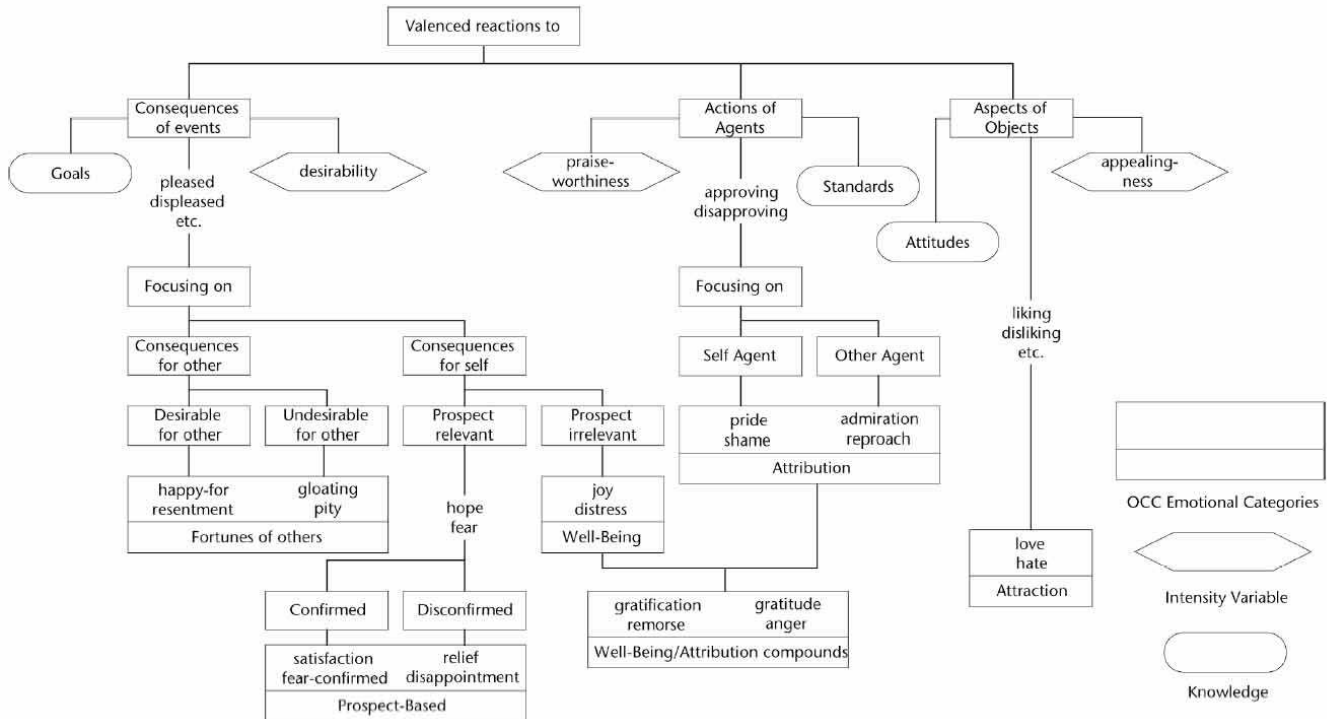


Fig. 2. The original OCC model [13].

for the Mimicry of emotions ». The new emotional state is calculated from the previous state and the emotional vector obtained from stimuli. These parameters are input in the neuron networks, and then we obtain an emotional impulsion vector (EIV) at an output of the network. The global overview of the SHAME architecture is depicted in Figure 3 on page 4.

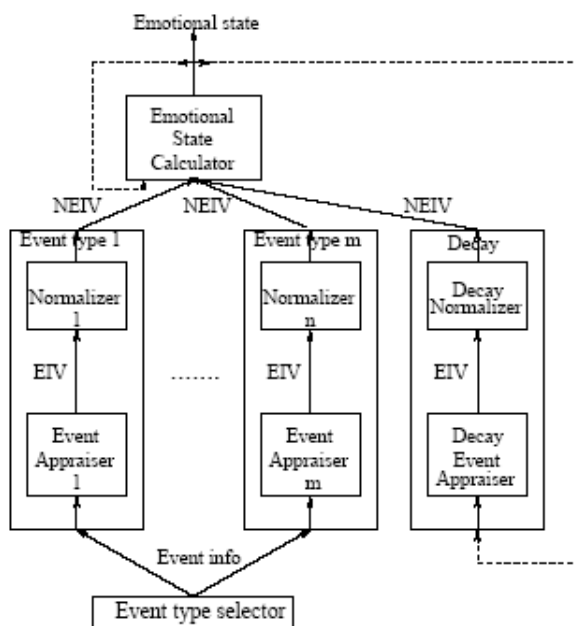


Fig. 3. The SHAME architecture [14].

Each pair of positive and negative emotions, such as for example joy and distress, can be represented by one scalar, the intensity value. A positive (negative) intensity value corresponds to the positive (negative) emotion (Table I on page 4). A decay insures the temporality of emotions. This decay is represented by a specific neuron network whose inputs are vectors of the previous emotions and whose output represents an EIV. Agents are capable of remembering the previous objectives and so can compare them to actual events, or even appraise the result of their actions. This process can give certain specific emotions (ex. Satisfaction, shale, reproach). Personality acts on the duration and the intensity of emotions produced by this modal. But the use of a method for learning depends too much on the context where the latter is realized.

2) Oliveira & Sarmento [15]

O&S have developed a modal whose objective is to show the ostracism phenomenon. This approach has been

Positive emotion types	Negative emotion types
Joy	Distress
Hope	Fear
Satisfaction	Fears-confirmed
Relief	Disappointment
Pride	Shame
Admiration	Reproach
Happy-for	Resentment
Gloating	Pity
Love	Hate

TABLE I

THE POSITIVE AND NEGATIVE EMOTION TYPES.

chosen because the way each emotion interacts with the others was unknown, and they defined priorities for each one of them. They put emotions in three different categories. Specific emotions, mood and personality. The architecture of the modal is based on emotional evaluation functions (EEF) for each emotion that used during the election process including chances for reaching an objective, the state of the environment, and the internal state of the agent. The modal uses emotions defined by Ekman while giving them a positive or a negative weight.

3) Breese & Ball [16]

Emotions and personality are perceived like internal states that are represented by discrete variables hidden in a Bayesian network. Therefore, it is possible to establish relations between these variables, related to stimuli (events) and to output states such as facial expressions, the choice of the vocabulary or even the postures of the agent.

C. Measure of emotion

It is not possible to have a direct measure of emotions. But, we can verify that certain psychological characters (cerebral activities, heart beats, arterial pressure, body temperature, skin conductivity, EMG) and certain physical activities (face, gesture, voice expressions) are related to emotions. Many works [17][18][19] exist on this subject and some interesting results are available now.

Links existing between emotions and psychological signals, and also the direction of variation, have been shown. Since the measure of emotions is not the subject of this paper, we suggest to the reader to refer to literature oriented toward this subject and specially the book of R. Picard, *Affective Computing* [20].

IV. CONCLUSION

In this paper, after the state of art in which we see that the social phobia is a real problem of public health, we proposed a method to control the generation of the stimuli in order to induce the desired level of anxiety in a phobic human. The evaluation of this proposition is related to the implementation and clinical tests, which are our future research work.

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