Situated emotional problem solving in interactive computer games [1]

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In N., H. Frijda (Ed.), *Proceedings of the VIXth Conference of the International Society for Research on Emotions, ISRE'96* (p. 276-280). Storrs, CT: ISRE Publications.

Introduction

Although there has been a recent increase of empirical studies on emotion, laboratory results remain difficult to transpose to spontaneous real emotional experiences. This difficulty is in part due to the artificial separation of intrinsically related psychological processes - such as emotion, cognition, and behavior - in different fields of research. An additional problem lies in the fact that current methods and experimental settings do not necessarily enable to cope with the complexity of human reasoning, feeling, and acting. To overcome some of these shortcomings, we propose a more ecological approach, i.e., to analyze these processes simultaneously, in terms of what we call *situated emotional problem solving,* within an interactive computer game setting (a micro world scenario).

The Geneva Appraisal Manipulation Environment (GAME)

In order to achieve this, we developed the Geneva Appraisal Manipulation Environment (GAME), a tool for generating experimental computer games. The first part of this paper presents the technical and methodological components of this research tool. The second part describes the theoretical embedding of the experimental approach and of micro world scenarios.

Methodological and technical aspects of GAME

Games generated with the GAME tool are Pacman-type games and consist of series of rectangular maze-like levels or game boards in which the player, i.e., his agent in the game, has to pass through while trying to gain as many points as possible. On his way through the mazes the player's agent has to flee from enemies or fight them if he has enough power. Traditionally, in each of the four corners of the maze there is a "powerpoint" that puts the agent into a time-limited powermode enabling him to fight his enemies. If he fails to reach these, the agent can be eliminated by his enemies. Since the player can loose an agent, he or she has several agents available throughout the game.

Compared to traditional computer games, GAME provides important enhanced and extended possibilities that turn a computer game into a psychological research instrument. These possibilities relate to:

a) Game extensions which require more cognitive processing, thus allowing strategic behavior under time pressure (emotional problem solving). This can be done by introducing different kinds of tools, that the player may collect and apply when adequate or necessary.
b) Automatic data recording (with an automatic subject database control), automatic questionnaires and dialogues (that can easily be modified or translated to a preferred language).
c) Automatic control of a VCR, and of an AEC-box (Adrienne Electronics) which provides vertical time code information on video tapes. This time code can also be used as the reference for game data storage. Tape recordings enable an automatic analysis of the subject's facial behavior. These facial data can be automatically matched to the corresponding game data (for further details on the method for automated face coding see Kaiser & Wehrle, 1992; Wehrle & Kaiser, submitted).

[1] This project is supported by grants from the Swiss National Science Foundation (FNRS 11-39551.93 "Dynamic man-computer interactions as a paradigm in emotion research") granted to S. Kaiser.

d) The possibility to design game scenarios, which allows the systematic experimental variations of variables. In our experiments the design is based on the theoretical postulates described hereafter.

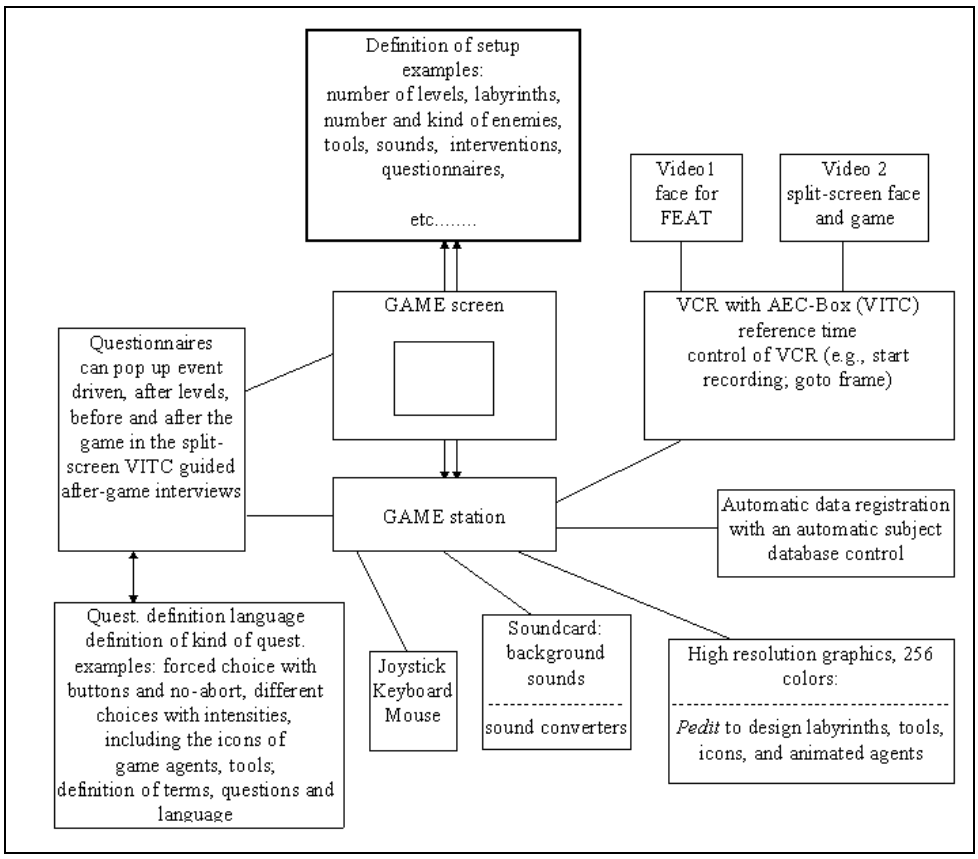

Figure 1: Components of the Geneva Appraisal Manipulation Environment (GAME)

Figure 1 illustrates the different hardware- and software-components of GAME. These components support the preparation and the conducting of an experiment. In the preparation phase, all levels of a game can be defined in terms of what kind of objects, characters, and events occur and when they occur. Moreover, the timing of the dialogues and pop-up questionnaires, as well as the general parameters of each level can be specified. The configuration of a specific game for a particular research question requires no programming skills. There is a powerful editor to design the characters in the game (agent, friends, enemies), the icons (tools, pictures) and the different game boards. The conduction of an actual experimental session is almost completely controlled by GAME.

We will briefly describe some of the game characteristics. Figure 2 shows an example of a game board. At the beginning of a level, the agent is in his home at the center of the maze. Here he cannot be attacked by his enemies. On the right side the amount of agents in reserve is indicated. In the maze different kind of enemies and tools are represented. The tools that are already collected are shown in a container below the maze. The game can be defined with respect to characteristics of the agent, of the other animated characters, of the objects, and general characteristics of the mazes. There are several kinds of animated characters. Other than a variety of enemies, two additional characters were introduced. The first character appears in the maze and is called Janus. Janus either displays a “gentle behavior” when meeting the agent, i.e., he gives him power to fight his enemies, or he “misbehaves”,

i.e., he takes the power away. The second character is not located within the maze but is presented as an animated face situated outside the maze in the upper right corner of the screen (see Figure 2). This character is named “Helper” and was introduced to add at least some aspects of a social component.

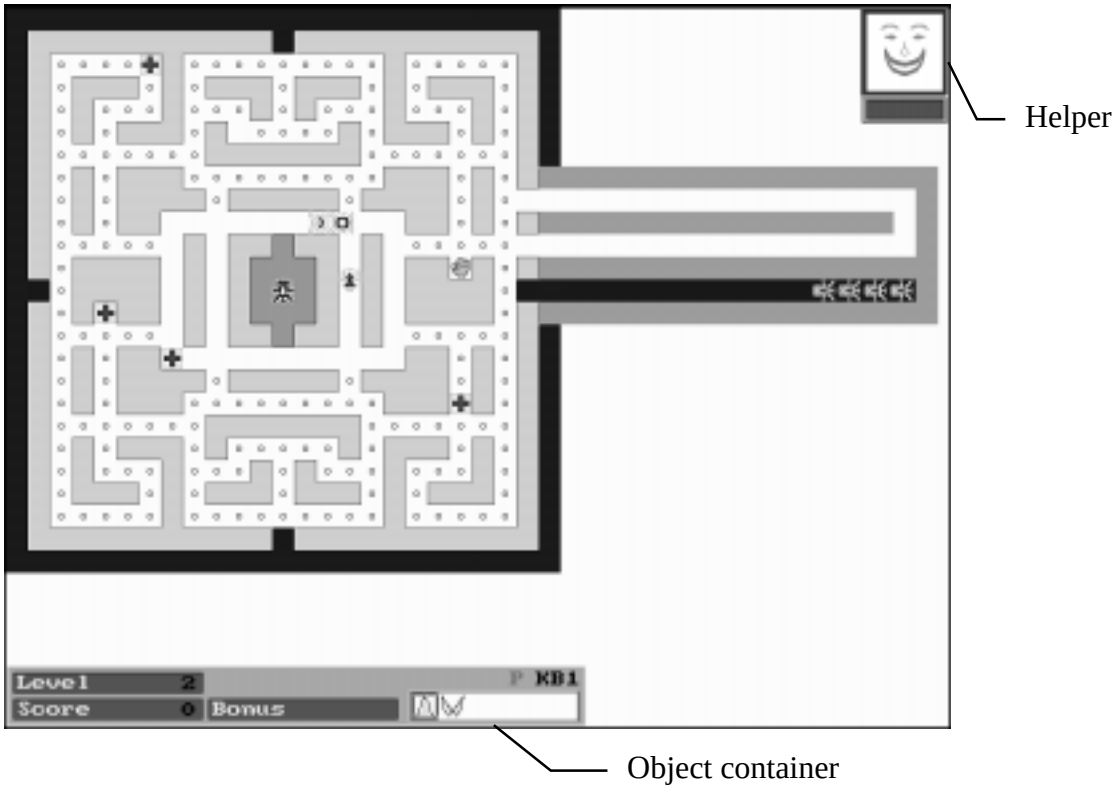

Figure 2: An example of a game board specified with GAME

This appeared as important since social interactions belong to the most powerful sources for the elicitation of emotions. The Helper escorts the player throughout the game, he provides him with information about tool usage, and occasionally helps if the agent is in trouble. However, the assisting capacity of the Helper is not unlimited (i.e., he can only help if he has enough “magic”). For this reason, on some levels he asks the player to collect magic potions which are distributed throughout the maze. These latter are not necessary to finish the level and require extra activity to be earned. If the player fails to collect enough of the potions the Helper disappears. This reciprocal relationship is intended to strengthen the player’s commitment to the Helper. In the next section we present some examples of the theoretical background of the game specifications.

Theoretical embedding of micro world scenarios

The creation of micro world scenarios is based on theoretical predictions concerning *emotion antecedent appraisal* and *emotion specific action tendencies* as postulated by different cognitive emotion theorists (Scherer, 1988; Frijda, 1986). Furthermore, game scenarios have been related to *prototypic emotion antecedent events*, as postulated by Ekman & Friesen (1975). In the scope of this paper we can only provide illustrations of the relation between game specifities and each of the models proposed by these authors.

Scherer's Appraisal dimensions

A central feature of Scherer's component process model is the notion that the elicitation of an emotion process and its differentiation into different types of emotional qualities such as fear, anger or joy is determined by a process of evaluation or appraisal of stimuli, events, or situations. Component process theory postulates relatively few basic criteria and assumes sequential processing of these in the appraisal process. The major "stimulus evaluation checks" (SECs), which are considered to be sufficient to account for the differentiation of all major emotions are novelty, intrinsic pleasantness, goal significance, coping potential, and compatibility with standards (some of these dimensions include subcategories, see Table 5 in Scherer, 1988). When relating appraisal dimensions to game specifications we differentiated between characteristics of the agent, of characters, of objects, and of general properties mentioned earlier. The differentiation between agent and general properties, for example, is important for the sub-dimensions of coping potential "control" (which relates the general controllability of a situation) and "power" (which relates to the actual coping potential of the agent). Controllability can be manipulated at the level of general properties, e.g., the speed of the game, the number of enemies, the size of the maze. However, the actual coping potential also depends on aspects of the agent, e.g., how many useful tools he has collected and can use, how many agents are left in reserve. The distinction between animated characters and objects is important for the differentiation between another sub-dimension of coping potential, i.e., the difference between intentionally (figures) and non-intentionally (objects) provoked events.

Frijda's Action tendencies or action readiness variables

Emotion specific action tendencies as postulated by Frijda (See Table 2.1 in Frijda, 1986) may be used as indicators as to what kind of behavioral options should be included in the game scenarios. For each action readiness variable, Frijda describes its end state, its function and the corresponding emotion. For example, for the "protection" function he postulates two action tendencies, which are "avoidance: withdrawal, turning away from" and "rejection: closing". The corresponding end states are "own inaccessibility" on the one hand, and "removal of object" on the other hand. Accordingly we included in the game scenarios different kinds of behavioral options, e.g., the option to hide oneself (the agent), the option to wait in protected environments such as the home, the option to flee, the option to build barriers, or the option to protect oneself with a shield. "Barriers" and "shields" are objects (tools) that the player can collect. In addition, the player can receive a shield from the Helper if he or she calls him with a "bell" (another tool). This kind of a time-limited protection, which is obtained through a rather "supplicative strategy" in the sense of Bischof (Bischof, 1985), offers the advantage that the enemies cannot eliminate the agent (the enemies bounce off) yet at the same time it has the disadvantage that the agent cannot do or collect anything. In order to use the tools that are already in the tool container, the player has to select them. In those moments when a tool has to be applied this has to be done very rapidly. Therefore, it is a good strategy to pre-select the tool that seems to be the most useful in a given context. This pre-selection can be interpreted as a direct indicator of the player's action readiness. For example, if the player reaches a new level with many different enemies, he can either pre-select a "fist", which gives him power (action readiness: antagonistic; end state: removal of obstruction) or he can pre-select a "shield" (action readiness: rejecting; end state: protection).

Ekman & Friesen's prototypic emotion antecedent events

Ekman and Friesen (1975) propose a description of prototypic emotion antecedent events for what they termed basic emotions. Concerning happiness they differentiate between pleasure happiness, relief

happiness, and happiness that involves the self concept (pride). Relief happiness occurs when a negative emotion has ended. In the game scenario, this kind of emotion antecedent event is operationalized in two steps. First, the general speed of the game is increased (low controllability, high risk to loose the agent). This phase is intended to induce negative emotions. After a given time, the Helper reduces the speed to a controllable level. For the emotion of pride, Ekman and Friesen propose the following "somebody tells you that you have done a good job". In order to evoke pride in the game we used the Helper character defined above. If the player collects all magic potions in a given level, the Helper thanks the player and tells him that he really has done a good job.

Results

In a first experiment with 30 subjects, we defined a game scenario including 10 different levels. One goal of this study was to test the reliability of our operationalizations for the emotion antecedent events, as postulated by Ekman and Friesen, for anger, fear, sadness and the different types of happiness.

Table 1: Percentage of subjects reporting the predicted emotion in one or more of the explicitly designed scenes.

Emotion categories	% of corresponding responses
Relief-Happiness	70%
Happiness	98%
Pride/other Happiness categories	33% / 40%
Anger/Disappointment	60% / 40%
Fear	90%
Sadness/Helplessness	43% / 24%

As reported in Table 1, it appeared that we were able to construct adequate scenes for the postulated emotion specific events and that most of the subjects reported the corresponding emotions. Given space constraints, we will only comment on the results that are related to the Helper. According to our predictions, 73% of the subjects reported happiness (33% of these reported pride) after the compliments of the Helper. However, 17% of subjects reported no emotion and 10% actually reported anger. One explanation for this unexpected results could be that not all subjects appreciated the Helper's interventions and perceived them instead as being restrictive and patronizing. This interpretation is supported by the fact that most subjects (67%) that reported happiness or pride in this situation also reported sadness or helplessness when the Helper disappeared (This situation was also explicitly manipulated in the experiment and occurred at the end of the 9th level). The other subjects reported no emotion or anger, one subject even reported relief happiness.

Conclusion

Overall, our experimental setting seems quite capable of inducing a variety of distinct emotions. This is confirmed by the spontaneous comments of many subjects. Even those who were skeptic in the beginning and confused by the camera reported having experienced rather strong emotions and that they had forgotten about the camera. Other than the results specific to emotions, we found important between subjects differences in terms of what can be called "game strategies". One group of subjects for example tried to eliminate all enemies on a level and collected and used most of the tools. Whereas another group tried to finish each level as fast as possible, tried to avoid the enemies, and used the tools only rarely.

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