Affective Videogames and Modes of Affective Gaming: Assist Me, Challenge Me, Emote Me

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ABSTRACT
In this paper we describe the fundamentals of affective gaming from a physiological point of view, covering some of the origins of the genre, how affective videogames operate and current conceptual and technological capabilities. We ground this overview of the ongoing research by taking an in-depth look at one of our own early biofeedback-based affective games. Based on our analysis of existing videogames and our own experience with affective videogames, we propose a new approach to game design based on several high-level design heuristics: *assist me*, *challenge me* and *emote me* (ACE), a series of gameplay "tweaks" made possible through affective videogames.

Keywords
affective videogames, affective feedback, biofeedback, physiology

INTRODUCTION
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[Jill] I don't know what happened.
[Chris] Barry. Where's Barry?
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So opens the mansion scene to Capcom's survival-horror *Resident Evil* (Capcom, 1996) - and with it one of the gaming world's first tentative steps toward realisation of the emotionally-immersive, narrative cinematic experience. These days, experiences such as that offered by *Resident Evil* on the PSone, are increasingly common-place.

We are emotionally-fickle creatures; if affect is not conveyed properly during game play (e.g. if *Resident Evil* could not inspire fear in the player), then the player's suspension of disbelief can be negatively affected and so spoil the gaming experience. Current advances in computation and

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memory capabilities mean that videogames are more than capable of conveying affect just as well as traditional media (e.g. film, books). As a result, emotionally-engaging games are becoming more reliant on the imagination of game designers than on the constraints of the currently available technology to promote emotive experiences.

However the interactive nature of the videogame allows us to go one step further than traditional media. Unlike the latter; videogames are dynamic entities, they change according to how the player interacts with them. At the moment, these interactions are based purely on the input the player consciously decides to use in the game world (i.e. actions executed through the game controller). However these actions are not the only thing going on with the player during play; there are unseen physiological responses (e.g. heartbeat rate variations) taking place within the player's body as well as various behavioral responses (e.g. gestures, facial expressions, body postures). Such responses are useful in identifying the current emotional state the player is in. If this information could be somehow collected and invested in the game dynamics; the affective bandwidth of future games could be increased (i.e. bi-directional, game affects player, player affects game and so on) allowing for the emotive "tweaking" of conventional gaming experiences or the creation of whole new ones. This form of gameplay is commonly referred to as *affective gaming;* where the player's current emotional state is used to manipulate gameplay.

TOWARDS AFFECTIVE VIDEOGAMES

In order to have an affective videogame, both player and videogame have to be responsive to the affective signals of the other. For players, this has always been so; as emotional beings we respond both to the general game-playing experience (e.g. enjoying play), and to the more provocative affective elements a videogame offers (e.g. emotionally-packed stories). Indeed players of the 1983 text-based game *Planetfall* (Infocom, 1983) responded emotionally even years later when they recalled Floyd, a robot in the game that sacrificed itself in order to save the player [8]. However in conventional videogames the system has no means of assessing the player's emotion beyond the conscious control instructions (e.g. go left, go right). In order to have truly affective videogames the system needs to be able to sense aspects of the player's emotions more directly.

Biofeedback

From a physiological point of view affective gaming can be instrumented through *biofeedback* - a technique that allows the user to view the otherwise invisible physiological processes that occur within the body. In applied biofeedback [12], such information can be used to treat medical conditions such as migraines and incontinence. During biofeedback therapy a display of the biological process pertaining to the condition being treated allows a patient to begin to exert a limited amount of conscious control over these processes and so begin treatment.

However furnishing a videogame with biological information during gameplay does not make a game affective. *Bionic Breakthrough* (Breakout clone), an Atari videogame presented back at the 1983 Consumer Electronics Show measured electrical activity in a player's forehead muscles (device was called the Atari MindLink), but this was merely in order to control the movements of the paddle and so replace conventional input (i.e. joystick). For a physiological receptive game to become affective, it needs to propagate *affective feedback* [3]. Just replacing

conventional input (i.e. conscious command decisions executed through physical interactions with a game pad), is what we regard as a straight-forward biofeedback game.

Affective Feedback

Coined by Bersak et al, affective feedback "in essence .. means that the computer is an active intelligent participant in the biofeedback loop" [3], where both player and game are affected by the actions of the other. What is distinctive about the notion of affective feedback in comparison to biofeedback is that the physiological changes in the loop are uncontrolled. In biofeedback games the player explicitly participates in controlling their physiological responses in order to control the game world. In contrast the player may not even be aware that their physiological state is being sensed during play of an affective videogame as the intention is to capture their normal affective reactions.

The problem with defining biofeedback and affective games is that there is a fine line between them which often becomes blurred. Take for example, the relax-to-win game by Bersak et al [3]. The game uses the player's galvanic skin responses (i.e. sweat), to measure their current state of relaxation. This in turn is used to control the speed of a dragon in a racing game. The relationship between physiology and gameplay is relatively straightforward and easy to grasp, the more relaxed the player is the faster their dragon will go. On the surface this is a typical biofeedback game in which physiological data replaces conventional control inputs. However the competitive nature of videogames runs counter to this; relaxing whilst trying to win is not exactly the norm. As Bersak et al discovered players had difficulty initially adjusting to the game format; they become more aroused during play, which in turn caused them to lose as their speed reduced, further promoting arousal at the loss. This feedback of uncontrolled affective information propagates an affective feedback loop, which makes the game an affective game. However if through practice, the player becomes proficient in controlling their natural physiological responses; the awareness of volitional control makes the game become a biofeedback game once again.

In essence a videogame is affective if it can maintain an affective feedback loop; if the player becomes consciously aware of how that feedback loop is controlled by their physiology and so able to consciously control their reactions, the affective nature of the feedback loop is lost and it becomes a form of biofeedback. The creation of affective games is therefore dependant on how the game designer uses the physiological responses of the player in influencing gameplay.

AN AFFECTIVE VIDEOGAME

Physiological interfaces have been used in games for many years (e.g *Tokimeki Memorial Oshiete Your Heart* (Konami, 1997), a Japanese arcade dating simulator that uses a players pulse and sweat level to influence the outcome of a date), but such interfaces have more often than not been used as mere gimmicks. It is only recently with the growing popularity of Affective Computing [9] within the interactive community has the interest in the development of affective games taken on a more serious note [1, 4, 6, 7, 11, 13]. In order to investigate some of the issues of affective gaming, we developed a toolkit called the *Intelligent Gaming System* (IGS) in order to facilitate the creation of affective games [6].

Using the toolkit a mouse-driven target-acquisition videogame was developed, that used the player's heartbeat rate to influence gameplay. The game itself was a spin on the *Missile Command* (Atari, 1980) style of play. Targets moved up from the bottom of the screen and the player tried to destroy them before they reached the top. Those that reached the top damaged the player's health. If the player's health reached zero as a result of letting too many targets through, the game would end in failure, but if the player survived until a preset timer reached zero they won. This basic game was augmented with an affective feedback loop. Physiological data was used to change the nature of the challenge the game presented. The aim was to keep engagement, as measured by changing heartbeat rate, within an optimum range.

The game would begin by taking a baseline of the player's heartbeat rate at rest. From this baseline a series of affective states were projected onto the player's potential heartbeat range and for each affective state the game would respond in a different manner. As a general rule of thumb, increases in the player's heartbeat rate were taken as a positive sign that the player was engaging with the game, whereas decreases in the player's heartbeat rate were taken as a negative sign, a lack of engagement. Should the player become over stimulated or under whelmed by the game, gameplay would alter to reverse the player's affective state. In the case of over stimulation the game would reduce the number of visual threats in order to calm play and in the case of under stimulation the number would be increased. To maintain the game's difficulty level, when the number of threats was decreased as a result of over stimulation, the damage of each target was increased. Similarly if the number of threats was increased their individual damage was decreased. In this manner affective feedback was used purely to influence the gaming experience, not the likelihood of winning.

A test group consisting of undergraduate students and researchers (8 people, 6 male, 2 female, aged 21-38) were asked to try out the game; the experiences of each player were documented. They were not informed how the physiological data was being used to influence gameplay. The test group reported a general feeling that the game provided an enjoyable play experience. In addition, those players who frequently played videogames reported that they had more fun if the game was attuned to small physiological changes, whereas those players who rarely played videogames reported that they had more fun when it was attuned to large physiological changes. Through real-time observations of the native heartbeat rate data, the reason for this became apparent – experienced players responded less physiologically compared with inexperienced players. This certainly fits research conducted on novelty and its habituation with repetition where physiological reactions diminish as novel situations are repeated over and over again [14].

This game suggested that even quite simple affective feedback could be used to create more desirable gaming experiences, but also highlighted how critical it was that the individual differences between the player's be compensated for.

MODES OF AFFECTIVE PLAY

Based on our analysis of existing videogames and our own experience of the design of affective games (as seen above), we propose several high level design heuristics for affective gaming; *assist me*, *challenge me*, and *emote me* (ACE). These of which can be used to create an assortment of different gaming experiences.

Assist Me

Progressing through videogames can be a trying experience for players; from missing clues that indicate where to go next, to just not being able to kill that end-of-level boss. These events can impede game progress and give rise to player frustration.

We propose that a videogame can measure frustration using a player's physiology [5]. Combining this with knowledge of the game context allows problematic situations to be identified and aspects of the game adjusted accordingly (i.e. relieve stress) - *assist me* gameplay. For example if during play of an RPG the player's frustration was to rise, we would: - identify possible causes of frustration intrinsic to the game design, evaluate the player's current status within the game, then select the most likely cause of frustration and adjust the gameplay to remedy it (e.g. if frustration begins to rise and the game finds that the user is still looking for a key a suitable remedy would be to prompt the player with a hint as to its location).

The evaluation of our own affective game indicated that casual gamers were most sensitive to the changes in gameplay afforded by the use of affective feedback. This suggests that the affective capability that would allow a game to respond sympathetically to player frustration would be of most benefit to those whose natural response to frustration would be a disinclination to continue play. It may be the case that the "assist me" functionality is of less benefit to those experienced gamers who accept frustration as an integral component of the gaming experience [7].

Challenge Me

Developing games that prove sufficiently taxing for players to remain engaged is somewhat confounded by the fact that individual player's skills are different. The challenges that each player derives satisfaction from will vary from player to player. In order to improve the level of challenge and thus increase the useful lifespan of a game, new methods for challenging players must be identified.

In current game designs, developers typically provide three or more levels of difficulty (e.g. easy, medium, hard), in order to satisfy the demand for challenge from various gaming groups. The success of this approach depends entirely on how the player assesses their level of perceived expertise. And even this does not preclude a mismatch between the games designers' categorisations of what an ideal challenge is and the player's capabilities [7].

When assessing our own affective game players were initially asked to indicate their level of expertise. Player profiles correlated nicely with their physiological responses to the challenges the game offered. The more experienced the gamer had indicated themselves to be, the better their ability to manage arousal in the face of increasing challenge.

These preliminary findings are in line with previous psychophysiological research assessing the correlation between task engagement and negative emotional states such as boredom [10]. The biocybernetic system developed as part of Pope's research used affective feedback as a response to detected negative emotional states in order to reconfigure a task interface to counteract negative states and thus increase engagement - an important indicator for future affective game technologies.

We therefore propose that the player's engagement as measured through their arousal level can be used to dynamically alter the challenge the game provides, thus suiting the individual player better - *challenge me* gameplay.

Emote Me

Recent advances in design aesthetics have allowed videogames to provide sincere emotional experiences. However not all videogames succeed in providing an effective emotional experience. Even if the game content is well designed, the player may just get used to the incidents and hence not experience the emotions the designer intends. By measuring the user's actual emotional state the game can modify its content to once again provoke the intended emotions - *emote me* gameplay.

SUMMARY

In this paper we have provided an introduction to the field of affective gaming from a physiological point of view. Much of the existing research in this area is concerned with biofeedback-based interfaces in the form of interactive games to train a subject to gain control over their own, otherwise invisible, physiological responses. Although a crossover exists in technological terms, affective gaming is *not* the same as biofeedback gaming. Further discussion of these categorisations and an in-depth analysis of the utility of physiological signals in interactive computer systems can be found at [2].

We also presented an example of a game that uses affective feedback to influence game play, but is clearly not a biofeedback game, demonstrating that it is possible to produce truly affective games. Based on our own experience of affective game design and our analysis of existing mainstream gaming technology we have introduced a set of heuristics: assist me, challenge me, emote me, which we believe can assist the designers of future affective computer games.

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