Investigating Players' Affective States in an Interactive Environment

Uttam Kokil

Department of Technology, CoBPA

UND, Grand Forks, ND 58202. USA

Email: uttam.kokil@und.edu

Abstract—The objective of this paper is to examine player experience from a Human Computer Interaction Design perspective whereby usability, aesthetics, and hedonic components can be investigated in an interactive domain. Mihaly Csikszentmihalyi's concept of flow has been applied to the Component of User Experience (CUE) model to measure user experience (UX) of products, and other instruments such as the Presence Involvement Flow Framework *(ver. 2)* (PIFF); Gameflow and Game Experience Questionnaire to evaluate game enjoyment respectively. So far, the CUE Model has been applied in simulated user-testing situation. It becomes important to gauge the potential of the CUE Model in an interactive game scenario, given that it is composed of components such as perceived usability, perceived aesthetics and emotional responses. The aim of this study is to conduct a comparative analysis of two user experience models (Component of User Experience) and PIFF to examine players' emotional responses in four different conditions (low and high usability, low and high aesthetic value) when they play two different computer game category, namely "Hard Fun" and "Easy Fun" game respectively, for the touchscreen. This research will investigate how two independent variables, usability (low and high) and visual aesthetic (low and high), of a game user interface design will affect the dependent variables: player experience, task performance and emotional responses (enjoyment).

Keywords-user experience; visual aesthetics; computer games; game usability.

I. INTRODUCTION

Researchers argue that experiences are the new area of economic growth among consumers [1]. The game designer creates various experiences in a game in order to generate player enjoyment. *PIFF* [2] is a validated questionnaire that can be used to investigate user experience in games. The *Component of User Experience (CUE) Model* describes the three fundamental components of user experience that is comprised of instrumental quality, non-instrumental quality and emotional responses [3]. *CUE Model* has been applied to simulated product scenarios (e.g. simulations of audio players) however we are interested to examine its potential in an interactive environment to understand how it can be appropriated into the domain of computer game. It is important to investigate if *CUE Model* shares the same validity as another user experience tool such as *PIFF*, and whether it can be utilized to study "*users' experience of interaction with interactive products and systems*," in a gaming environment, as is the essence of this model.

Video and computer games are the fastest growing form of entertainment. The revenue generated by the computer game industry escalated to US$ 16.6 billion in 2011 from US$ 5.5 billion in 1999, in the U.S.A [4]. Technology is evolving at such an unprecedented pace that many end-users suddenly find themselves confronted with new mode of interaction especially when it comes to computer gaming with multi-touch screen or other controls. User experience varies in different environments [5], on different display sizes [6] or when using different input devices. Technology alone does not make a game successful. Player experience forms part and parcel of the gaming process. For instance, despite the rise of gaming technology, players have continued to express dissatisfaction with current computer games because most games do not provide the optimal level of challenge to accommodate players' skills, learning capabilities, and emotional qualities [7,8]. It is said that certain games are either too easy to win, or that they do not challenge the player to use his or her skills appropriately, and as a consequence, the player does not derive enough enjoyment during game play [7]. Lazarro explains that only 20% of the games that hit the market are successful [10]. It becomes imperative to investigate the phenomena that create optimum player experience in computer games by exploring the components of player experience as regards to the graphical user interface. Kankainen [11] defines user experience as a "*result of a motivated action in a certain context. User's previous experiences and expectations influence the present experience; this present experience leads to more experiences and modified expectations.*"

Until recently, more attention was given solely to the usability of a product, while other aspects that formed part of user experience were neglected. Gaming has received more attention in the HCI area, but "there have been only a few attempts to study user experience in games holistically." [5]. There are several components in a user interface design that give rise to different types of cognitive and emotional responses among users during interaction. Interaction design creates "user experiences that enhance and extend the way people work, communicate and interact" [12]. "User experience is highly subjective and dependent on a user's expectations, which in turn are shaped by user's age, education, cultural background, gender and several other factors" [13]. Researchers recognize the fact that games evoke an intensified level of emotions during game play so as to make the experience entertaining and enjoyable [14].

Aesthetics have been found to affect users' perceptions toward product use [15]. Lindgaard and Dudek [16] state that aesthetics is directly associated to emotions through the senses. Don Norman [17] also mentions that appearance of a product affects the very visceral part.

This research is designed to study the theory of the "four Fun Keys." Lazarro [18] describes game classification in terms of Fun Keys: "Hard Fun, Easy Fun, Altered state and People factor." This theory explains how each game category provides the necessary motivation to play, and the spirits of the gamer in each type of game. The player is determined to meet specific goals when playing a hard fun game that elicits emotions such as frustration and "fiero." For example, the scores achieved gauge the skill level. In an Easy Fun type game, the players explore and discover the game by "focusing on the enjoyment of experiencing the game activities." This is not about winning the game but rather it focuses and stimulates one's curiosity by figuring out the different game strategies and levels. In the Altered state, players feel an internal change, from one mental state to another. People factor is more about the experience a player derives while interacting with other players during gameplay such as in multiplayer games.

For this research, "visceral rhetoric" can be defined as the emotional responses that are automatically triggered by audio and visual components of the game surface layer. Game design comprises of game interface, game mechanics and Game Play [19]. This indicates that game interface has an influence on players' behavior and interaction. Cara Wrigley [20] defines visceral hedonic rhetoric in the context of interactive products as "the properties of a product that persuasively elicit the pursuit of pleasure at an instinctual level of cognition."

II. GAPS

Cara Wrigley [20] describes how the visceral hedonic rhetoric model or tool is relevant to product designers to devising interactive products that will create a continuing emotional impact with the consumers. The whole gamut of design elements of a product elicits some kinds of emotional responses from the users. The researcher mentions that this tool needs validation. It is important to investigate which specific attributes of the visceral rhetoric will give rise to hedonic responses. Furthermore, she recommends that the model could be tested out in other design domain for designers to better understand how consumers' visceral responses are affected by visceral hedonic rhetoric. Research has demonstrated mixed results when it comes to perception of usability and visual aesthetics. Many studies have been conducted to evaluate users' emotional responses in games or to developing tools to measure user experience, however, little is known how the visual rhetoric of a game interface affect user behavior, performance, emotional responses and player experience. There are several gaps identified when it comes to perception of beauty and usability as they relate to user interface design. *"Game interface is part of the surface layer for game control. The experience of the controls is directly tied to the emotional experience of play, thus user interface in a game is very important"* explains video game designer, Robin Hunicke. Another researcher defines aesthetics as the *"sensuous qualities, the emotions, moods, and experiences"* that occurs while interacting with a product [21]. Aesthetics have become an important topic among HCI researchers lately as it forms an integral part of user experience. In the study "what is beautiful is usable," [22] the researchers found out that the relationship between usability and aesthetics were strongly correlated, which was in line with a previous study in the field of marketing and consumer behavior that explained how physical appearance of a product were related to personality traits [23]. On the contrary, when Hassenzahl [24] conducted a study on MP3 skin players, he did not find any relation between beauty and perceived usability.

Usability may be considered more important when the product is used for an important and time critical task, and less so in *"a more relaxed mode of exploration and discovery"* [25]. Hence it becomes imperative to investigate the connection between usability and aesthetic, when computer games are played in the action or goal mode. According to Hassenzahl, classical aesthetic is different from beauty; he considers classical aesthetic to include visual usability that complements usability of interaction. *"Aesthetics is too broad as a term (modern art has an aesthetic value, but most of the time not beautiful) or we use it as a pretentious replacement of what we actually mean, just because aesthetic sounds more learned. In both cases, beauty is the better term,"* declares Hassenzahl in an email conversation. *"Beauty is synonymous to an affect driven evaluative response to the visual gestalt of a product."* [26]. Hassenzahl [24] further explains that beauty and usability is mediated by "goodness" and there is a low correlation between hedonic and pragmatic. The latter finding in turn reiterates Lavie and Tractinsky's study [27] that reveals the correlation between expressive aesthetics and usability is low.

Thuring and Mahlke [28] conducted two studies using portable audio players to find out whether perceptions of instrumental and non-instrumental qualities were related. He simulated two versions of the portable audio players by varying the level of usability and visual aesthetics such that there were four combinations in all. The results revealed that both the variations of usability and aesthetics had an effect independently on emotional responses (valence and arousal) respectively. Mahlke and Lindgaard [29] suggested that the effect of perceived visual aesthetics on emotional aspects of user experience should be investigated further. The researchers explain that there are challenges such as the "inter individual differences of aesthetics judgments" concerning visual aesthetics in human technology interaction that need to be addressed [29]. Everyone has a different level of perception of beauty. When evaluating

visual aesthetic aspect of an interface, it is important to take recourse to *Centrality of Visual Product Aesthetics* (CVPA) scale that measures the degree of visual aesthetics an individual accounts for a product [30] to obtain accurate results. Furthermore, Hartmann et al. [26] state that it is imperative to study the behavior of aesthetically sensitive and non-aesthetically sensitive participants in user populations, especially if the aim is to investigate different level of visual complexity in a user interface design. Hence, aesthetic perception also depends a lot on the background of the user.

When a user is exposed to a web interface, usually this gives rise to a halo effect [31, 26] that affects user behavior on subsequent webpages. For instance, if the visual aesthetic is of high quality, even though there is a slight usability issue, the halo effect will override the glitch, and provide a satisfying user experience. One aspect that needs further investigation is the intensity of the halo effect, and how it relates to the degree of usability and aesthetic value. This finding resonates to Hassenzahl and Ullrich's [25] study, which explains in a critical situation, usability is considered the most valuable in contrast to an exploratory/discovery situation, where usability issue is regarded as secondary. Lindgaard and Dudek [16] conducted a study on websites styles to find out that high aesthetic quality and very low perceived usability gave rise to high user satisfaction. It was concluded from this study, "what is beautiful may not be necessarily perceived to be usable." Yet, Tractinsky et al. [22] state "what is beautiful is usable." The above studies are all contradictory to each other. There is little evidence that "explain how and why users judge a particular design to be more or less aesthetic" [26].

Liu et al. [32] investigated the dynamic difficulty adjustment (DDA) in computer games so that the "mechanism in computer games can automatically be suited to gaming experience of the player's characteristics." Liu et al. (2009) further explained that much research is being carried out to evaluate player's performance that is based on game adaptation. It would be more useful to investigate the "affective state" of the players instead. Katsyri et al. [33] made use of electromyography (EMG) to measure emotional responses of 44 participants to aesthetic background images that has a varying level of valence (unpleasant to pleasant) and arousal (calming to exciting). When a pleasant image was presented alone and along with text (new message), positive emotions were evoked. It was found that high arousal images improved superimposed text recall. They suggest that future research should be conducted to investigate the effects of aesthetic background images in other domains.

III. AIMS

One of the major objectives of this research is to carry out a comparative study to investigate how player experience is affected by the visual rhetoric (graphic, text, animation, sound) of a computer game, when participants play two different kinds of game, *Hard Fun and Easy Fun* respectively [18]. It is relevant to examine how the visual aesthetic, including the attributes of interactivity such as "movement speed, movement range, response speed, concurrency" [34] of the dynamic game user interface will affect players' physiological arousal and valence by using physiological measures, in addition to self-report measurement. This research is important because game designers should understand what user interface elements can optimally enthrall game enthusiasts and that developers should devise specific types of games or platform, depending on the objectives (goal mode or action mode), to make it appealing and enjoyable to the right audience. This research will eventually contribute to understand the creation of appropriate user interface components that can lead to better game interaction for players to derive optimal enjoyment and challenges that will lead to enhanced user satisfaction. It is also important to find out how the players' emotional responses are affected by the visual rhetoric of the game interface when they are in different meta-motivational states. Players' emotional responses will be examined in two different conditions: *telic* (goal) and *paratelic* (action). In the goal mode, the participants will be required to play the computer game until they reach a certain score or level, whereas in the action-mode, all participants will be given equal amount of time to play the game. "Usability is considered to be a more important component when the product is utilized for an important and time critical task, and less so in a more relaxed mode of exploration and discovery." [25]. Does this hold true in a game scenario when one plays a *hard fun* and *easy fun* game category respectively? How does the visual rhetoric and gestalt affect the player when he is in a goal mode and in an action mode of gameplay respectively? Moreover, the users can be further segmented into two different groups called verbalizers and visualizers [35] to examine how each group would process and elicit emotional responses towards the visual rhetoric of the game user interface.

Admittedly, components like engagement, immersion, and flow have been used as attributes to measure UX in games. For this study, it is essential to evaluate user experience in games from a multi-dimensional perspective, by appropriating CUE [28] Model and compare the results using other game enjoyment and UX models in the field of Human Computer Interaction Design, like Gameflow [8], Game Experience Questionnaire (GameLab, Eindhoven University of Technology) and UX model such as PIFF [2], that integrates components like Adaptation (Presence and Involvement) and Flow (cognitive evaluation and emotional outcomes), Component of User Experience Model. In addition, it may be useful to compare the above experiments in different cultural settings to check if the results are generalizable.

IV. METHODOLOGY

It is clear that measuring emotional responses in HCI has

been a challenge for many researchers despite numerous techniques that have been devised. Physiological (skin conductance, heart rate, pupillary dilation, blood pressure, respiration, vocal tone, facial expressions, muscles action, electroencephalography (EEG), electromyography (EMG)) [36] and self-report tools (pre and post-test questionnaires, interviews, focus groups) have been commonly utilized to measure emotional responses. The advantage with physiological measures is that the researcher can capture emotions accurately. The disadvantage is that it is costly to administer and collect data. Researchers can still detect different kinds of affect using the self-report measurement that includes rating scales, questionnaires, graphical differentials, and verbal depiction of emotional states. The drawback of self-report methods is that the participant is conscious when his emotion is being measured; self-report methods are not suitable for measuring low intensity emotions, according to Frijda [39]. Researchers have commonly utilized self-report measurements because they are cheap to conduct. For the scope of this study, two UX models (CUE and PIFF) will be compared in a game context, and data will be collected when participants play a touch screen game on ipads. Instruments that will be used to collect data include both physiological (skin conductance) and self-report tools.

Data will be collected using the following instruments: (i) Verbalizer-Visualizer questionnaire [37] for screening participants. (ii) HEP Questionnaire [38] for gathering usability data. (iii) Classical and Expressive Aesthetics [27] (iv) Game Experience Questionnaire (GEQ) to measure enjoyment in games. The GEQ is a verbal emotional tool that can measure human experience of media enjoyment, in the context of gaming. The GEQ consists of three modules: actual game experiences, post-game experiences, and social roles of players. The items are based on concepts like immersion, flow, challenge and affect. The stimuli used to collect data are a *hard fun* and *easy fun* category game devised for the touch-screen that can be customized in terms of its usability and aesthetics features. A panel of game experts will first validate the game to ensure that it meets the norms as far as game play, game mechanics and game user interface design are concerned. The game will then be modified into four different conditions as shown in Table 1. The independent variables are usability and aesthetic quality. The dependent variables are emotional reactions and user experience.

TABLE I.

| | | Usability (A) | |
		Low (A1)	High (A2)
Aesthetics (B)	Low (B1)		
	High (B2)		

Both Qualitative and Quantitative methods will be used in this study. 200 participants will be recruited, and devised into two groups known as "verbalizers" (better at processing text) and "visualizers (better at processing images)." The verbalizer-visualizer [37] questionnaire is a five items questionnaire in which the participant needs to select between the two approaches of processing information, either words or pictures. Based on the visualizer-verbalizer questionnaire, participants will be screened into two groups: the verbalizer and the visualizer, each group will consist of 100 participants. Gender balance will be taken into consideration within each condition. A two-way ANOVA in-between subject test will be performed, with two independent variables: usability (low and high) and visual aesthetics (low and high). In addition, by making use of the CVPA (Centrality of Visual Product Aesthetics) instrument, individual differences among participants can be analyzed in order to understand to which degree users are aesthetically oriented. The data gathered from the CVPA questionnaire can be added as a covariate to the analysis, which will result in an ANCOVA.

The following research questions will be attempted:
(i) How is player experience affected in the following states: (telic) goal mode and (paratelic) action mode? (ii) What impact does the level of visual aesthetic in each game category has on the two group of players (visualizers and verbalizers)? (iii) How is the Flow Graph (Challenge v/s Skills) affected by varying levels of the two independent variables? How do components like enjoyment, player experience, player performance and emotional responses affected by the two levels of independent variables?

V.   CONCLUSION

This study is expected to answer multiple research questions that will be important for game designers to consider and apply during game development. It is necessary to understand the characteristics of players for instance, whether verbalizers derive more enjoyment than visualizers in gaming context, and how the visual rhetoric affects each category of players. Game designers will need to further explore specific elements of the user interface that give rise to particular emotional responses, in the case of each game category–hard fun and easy fun. It is also necessary to investigate whether the "flow" concepts still hold true when the game attributes (visual aesthetics) are varied in each game condition. Answering the above questions will help pave the way to devise optimal game experience for appropriate audience.

VI. REFERENCES

[1] J. Pine and J. Gilmore, *The experience economy: work is theatre and every business a stage*. Cambridge, MA: Harvard Business School Press, 1999.

[2] J. Takatalo, "Psychologically-Based and Content-Oriented Experience in Entertainment Virtual Environments," Ph.D. dissertation, University of Helsinki, Finland, 2011.

[3] S. Mahlke, "User Experience of Interaction with Technical Systems," Ph.D. dissertation, Technical University of Berlin, Germany, 2008.

[4] "Game Player Data, Entertainment Software Association." Accessed Oct 03, 2012. http://www.theesa.com/facts/salesandgenre.asp

[5] J.Takatalo, J. Hakkinen, J. Kaistinen, and G. Nyman, "User Experience in Digital Games: Differences Between Laboratory and Home." Simulation & Gaming (August 10, 2010). doi:10.1177/1046878110378353.

[6] D. Machaj, C. Andrews, and C. North, "Co-located Many-player Gaming on Large High-resolution Displays." In 2009 International Symposium on Social Computing Applications (SCA-09), 697–704, 2009.

[7] K. Gilleade, A. Dix, and J.Allanson. "Affective Videogames and Modes of Affective Gaming: Assist Me, Challenge Me, Emote Me." In Proceedings DIGRA 2005, 16–20. Vancouver, Canada, 2005.

[8] Penelope Sweetser and Peta Wyeth. "GameFlow: A Model for Evaluating Player Enjoyment in Games." ACM Computers in Entertainment 3, no. 3 (2005).

[10] K. Isbister and N. Schaffer, In Game Usability: Advice from the Experts for Advancing the Player Experience. Burlington, MA: Morgan Kaufman, 2008.

[11] A. Kankainen, "UCPCD: User-centered Product Concept Design." In Proceedings of the 2003 Conference on Designing for User Experiences, 1–13. New York: ACM, 2003.

[12] J.Preece, Y. Rogers, and H. Sharp. Interaction Design: Beyond Human-Computer-Interaction. New York: Wiley, 2002.

[13] A. Kukulska-Hulme, "Mobile Usability and User Experience." *In Mobile Learning: A Handbook for Educators and Trainers*, ed. Kukulska-Hulme & Traxler, (United Kingdom: Routledge, 2005).

[14] R.L. Hazlett, "Measuring Emotional Valence During Interactive Experiences." 1023. ACM Press, 2006. doi:10.1145/1124772.1124925.

[15] P. Zhang and G.M. Von Dran, "Satisfiers and Dissatisfiers: a Two-factor Model for Website Design and Evaluation," *Journal of the American Society for Information Science* 51 (2000): 1253–1268.

[16] G. Lindgaard and C. Dudek, "What Is This Evasive Beast We Call User Satisfaction?" *Interacting with Computers* no. 15 (2003): 429–452.

[17] D.A. Norman. "Emotion and Design: Attractive Things Work Better." Interactions 4, no. 9 (2002): 36–42.

[18] Nicole Lazarro, "Why we play games: Four Keys to more emotion without story," (2004), http://www.xeodesign.com/whyweplaygames.html

[19] A.M. Federoff, "Heuristics and Usability Guidelines for the Creation and Evaluation of Fun in Video Games" (Master's thesis, Indiana University, 2002). http://melissafederoff.com/heuristics_usability_games.html.

[20] C.J Wrigley, "Visceral hedonic rhetoric" (PhD diss., Queensland University of Technology, 2011). http://eprints.qut.edu.au/46040/

[21] I. Engholm, "The Good Enough Revolution – the Role of Aesthetics in User Experiences with Digital Artefacts." Digital Creativity 21, no. 3 (2010): 141–154.

[22] N. Tractinsky, A.S. Katz, D. Ikar, "What is beautiful is usable" Interacting with Computers no. 13 (2000), 127–145.

[23] K. Dion, E. Berscheid, and E. Walster, "What is beautiful is good," *Journal of Personality and Social Psychology* 24(3), 1972): 285-290.

[24] M. Hassenzahl, "The interplay of beauty, goodness and usability in interactive products," *Human-Computer of Interaction*, 19 (2004): 319-349.

[25] M. Hassenzahl and D. Ullrich, "To do or not to do: Differences in user experience and retrospective judgments depending on the presence or absence of instrumental goals," *Interacting with Computers* 19, Issue 2, (2005): 429-437.

[26] Hartmann, Jan, Alistair Sutcliffe, and Antonella De Angeli. "Towards a Theory of User Judgment of Aesthetics and User Interface Quality." ACM Transactions on Computer-Human Interaction 15, no. 4 (November 1, 2008): 1–30. doi:10.1145/1460355.1460357.

[27] T. Lavie and N. Tractinsky, "Assessing dimensions of perceived visual aesthetics of web sites," *International Journal of Human-Computer Studies* 60 (2004): 269–298.

[28] M. Thuring and S. Mahlke, "Usability, Aesthetics and Emotions in Human Technology Interaction," *International Journal of Psychology* 42(4) (2007): 253-264.

[29] S. Mahlke, and G. Lindgaard. "Emotional Experiences and Quality Perceptions of Interactive Products." *In Human Computer Interaction*, ed. J.Jacko, 164–173. 1st ed., (Berlin Heidelberg:Springer-Verlag, 2007.

[30] P.H. Bloch, F.F Brunel, and T.J. Arnold, "Individual differences in the centrality of visual product aesthetics: concept and measurement," *Journal of Consumer* Research 29, no. 4 (2003):551-565. doi: 10.1086/346250

 [31] L. Deng and M.S. Poole, "Affect in Web Interfaces: A Study of the Impacts of Web Page Visual Complexity and Order," *MIS Quarterly* 34 no.4 (2010): 711-730.

[32] Liu, Changchun, Pramila Agrawal, Nilanjan Sarkar, and Shuo Chen. "Dynamic Difficulty Adjustment in Computer Games Through Real-Time Anxiety-Based Affective Feedback." *International Journal of Human-Computer Interaction* 25, no. 6 (August 12, 2009): 506–529. doi:10.1080/10447310902963944.

[33] Kätsyri, Jari, Niklas Ravaja, and Mikko Salminen. "Aesthetic Images Modulate Emotional Responses to Reading News Messages on a Small Screen: A Psychophysiological Investigation." *International Journal of Human-Computer Studies* 70, no. 1 (January 2012): 72–87. doi:10.1016/j.ijhcs.2011.08.007.

[34] Y. Lim, S. Lee and K. Lee, "Interactivity Attributes: A New Way of Thinking and Describing Interactivity." 105–108. New York: ACM Press, 2009.

[35] Massa, Laura J., and Richard E. Mayer. "Testing the ATI Hypothesis: Should Multimedia Instruction Accommodate Verbalizer-visualizer Cognitive Style?" *Learning and Individual Differences* 16, no. 4 (January 2006): 321–335. doi:10.1016/j.lindif.2006.10.001.

 [36] Shami, N. Sadat, Jeffrey T. Hancock, Christian Peter, Michael Muller, and Regan Mandryk. "Measuring Affect in Hci." 3901. ACM Press, 2008. doi:10.1145/1358628.1358952.

[37] Mayer, Richard E., and Laura J. Massa. "Three Facets of Visual and Verbal Learners: Cognitive Ability, Cognitive Style, and Learning Preference." *Journal of Educational Psychology* 95, no. 4 (2003): 833–841. doi:10.1037/0022-0663.95.4.833.

[38] H. Desurvire, M.Caplan and J.A. Toth. "Using Heuristics to Evaluate the Playability of Games." In CHI '04 Extended Abstracts on Human Factors in Computing Systems. New York: ACM Press, 2004.

[39] Frijda, N.H (1986). The emotions. Cambridge: Cambridge University Press.