Influencing Player Emotions Using Colors

Evi Joosten, Giel van Lankveld, Pieter Spronck
Tilburg University / TiCC
P.O. Box 90153
NL-5000 LE Tilburg
The Netherlands
evijoosten@gmail.com, {g.lankveld, p.spronck}@uvt.nl

ABSTRACT: *People experience emotions when playing videogames. It can be argued that these emotions are their main reason for playing. In this paper, we investigate whether colors can be used in videogames to elicit specific emotions. We ran an experiment with a videogame in which four different colors, associated with four specific emotions, were used in four different conditions (in this case, four different rooms in the game). After each condition we measured the players' emotional responses by means of a Self-Assessment Manikin (SAM) questionnaire. Our analysis revealed that the color red evoked a highly-aroused, negative emotional response, while the color yellow evoked a positive emotional response. These results were significantly different from the emotional responses measured for other colors. Furthermore, we found that inexperienced players showed much more explicit reactions to colors than experienced players. We conclude that the use of colors is a suitable method for game designers to elicit specific emotional responses from the players, in particular from novice players.*

Keywords: Emotions, Colors, Video Games, Self-Assessment Manikin

Received: 28 January 2012, Revised 19 March 2012, Accepted 27 March 2012

1. Introduction

"*Emotions*" are feelings, caused by persons or events, that are experienced over a short period of time, and that can change rapidly [19]. Experiencing emotions tends to be the main reason for people to play videogames [18]. Playing a game becomes an enjoyable experience if players experience emotions that they find satisfying. Therefore, manipulating emotions is a game designer's prime concern.

Psychological research has shown that music and color affect people's emotions. There is evidence that this holds in particular for videogames [12]. [21] found that colors influence emotions experienced during play of a gambling game. [24] found a link between the colors red and blue, and emotions experienced while playing a *Breakout*-like game. Previous research on the effect of colors on emotions in videogames was, however, generally limited in three ways: (1) only few colors were examined, (2) rather simple games were used, and (3) the adaptation of colors in order to influence emotions was considered to be outside the scope of the research.

In the present research we examine empirically to what extent colors can influence a player's emotions in a relatively complex role-playing game. We do not measure emotions directly, but instead focus on emotional responses, i.e., a player's arousal and valence (enjoyment) experienced during game playing.

2. Background

This section discusses how emotions can be measured (2.1), what the most salient emotions in video games are (2.2), and to what extent emotions can be evoked by the use of colors (2.3).

2.1 Measuring emotions

Theories of emotions state that humans are evolutionary endowed with a limited set of basic emotions. [22] researched selfreporting of emotions and discovered 87 different terms to describe particular emotions. These emotional terms were found to have a degree of overlap. Factorial analysis lead to six basic emotional clusters that accurately collate the underlying terms, each being identified by one basic emotion. [3] listed these basic emotions as anger, fear, disgust, happiness, sadness, and surprise. Each basic emotion is independent of the others in its behavioral, psychological, and physiological manifestations, and each arises from activation within unique neural pathways of the central nervous system [17]. One should therefore be able to measure basic emotions by examining facial expressions and physiological responses. However, there is insufficient empirical foundation for defining which emotions are basic and how they correlate to what can be observed [14].

Emotions can be measured indirectly in terms of emotional responses. Two-dimensional models of emotional responses have repeatedly been the focus of studies [11]. In these models all affective states (emotions) are understood to arise from common, overlapping, neuropsychological systems [17]. One often-used model is the 'circumplex model of affect' [20]. It characterizes emotions in terms of two dimensions of emotional responses, namely (1) arousal and (2) valence. *Arousal* is the physiological and psychological state of being proactive (active) or reactive (passive) to stimuli. *Valence* is an intrinsic positive (happy) or negative (sad) feeling that is evoked by an event, object, or situation. Russell posits that each affective state is the consequence of a linear combination of these two independent dimensions.

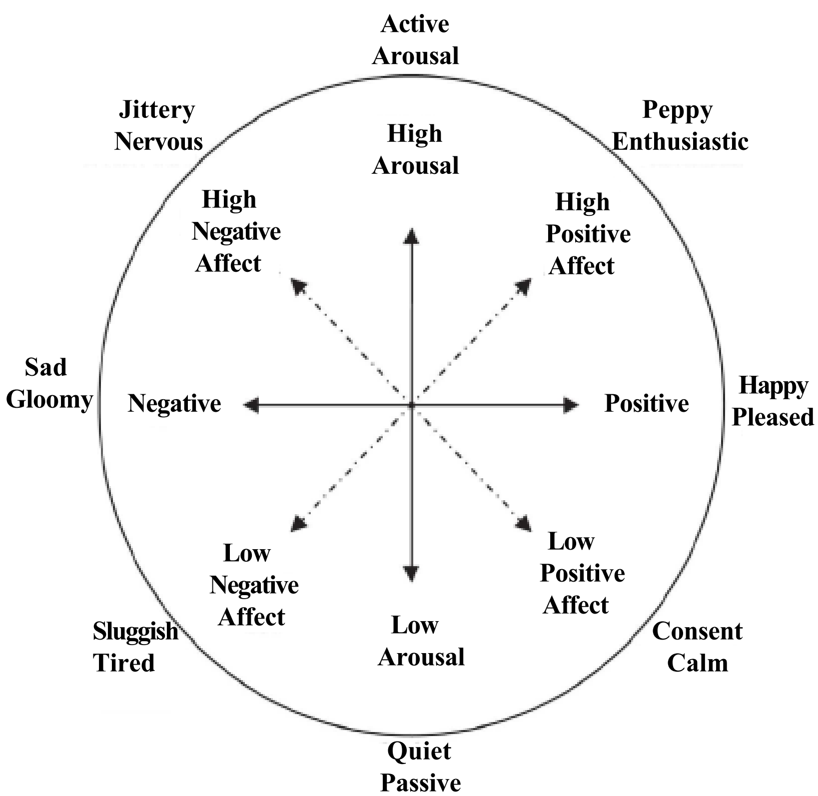

Figure 1. The circumplex model of affect [20] with valence on the horizontal and arousal on the vertical axis

Figure 1 displays Russell's circumplex model of affect. The horizontal axis represents valence and the vertical axis represents arousal. The area outside the circle provides examples of where common emotional terms are located in the circumplex model. The present research measures emotions based on emotional responses (arousal and valence), derived from the circumplex model of affect.

2.2 Salient emotions in videogames

[18] examined whether there are reliable differences in the emotional response patterns elicited by videogames with different characteristics (e.g., the view from which the game is played, naturalness of the videogame, amount of violence). They used the games *Tetris*, *Super Monkey Ball* 2, *Monkey Bowling* 2, and *James Bond* 007*: NightFire*. Emotions elicited by the games were defined by arousal and valence in terms of six affective states, namely: fear, anger, relaxation, pleasure, joy, and depression. They showed that arousal and valence are two important factors in enhancing emotions, especially in *James Bond* 007*: NightFire*. They demonstrated that arousal and valence are suitable measurements to identify emotions in a videogame.

[15] attempted to characterize some prototypical videogame emotions. Based on film theory he identified the following seven emotions: interest, enjoyment, worry, fear, surprise, anger, and frustration. All these emotions score high on the arousal level. Therefore, there is evidence that videogames generate highly-aroused emotions (i.e., are located above the horizontal axis in Russell's circumplex model of affect).

2.3 Effect of color on emotions

Color is a high predictor for emotions [2]. [4] measured the impact of changing color (in terms of saturation, brightness, and warmth) and contrast on tension felt in videogames. They reported a significant effect. Their results suggest that the use of lighting patterns attaches players emotionally to a game.

[24] examined the effects of the colors red and blue on players' emotions. They used five simple videogames where the color of the screen was manipulated. The results suggested that participants in the red group were more aroused than participants in the blue group. Therefore they found effects on arousal by manipulating color in videogames, though limited to the colors red and blue. Furthermore, the simple games they used can be considered less arousing compared to the more complex videogames that are common today.

[16], [13], and [23] stated that every basic emotion can be linked to a color. [16] linked colors to basic emotions as shown in Table 1. [13] confirmed Plutchik's findings. Of the emotions used in Plutchik's research, the highly-aroused ones are surprise, fear, joy, and anger. These should be prevalent in videogames. Therefore our research focuses on their associated colors: light blue, dark green, yellow, and red.

Emotion	Color
Surprise	*Light blue*
Fear	*Dark green*
Acceptance	Light green
Joy	*Yellow*
Anticipation	Orange
Anger	*Red*
Disgust	Purple
Sadness	Dark blue

Table 1. Emotions and corresponding colors as identified by [16]. The colors and emotions in italics are those used in the present research

3. Experimental setup

For the purpose of this research, we designed and built a videogame. The background colors in this game were manipulated. The emotional responses of players were measured through a questionnaire, and analyzed. This section describes the participants (3.1), the questionnaire (3.2), the game (3.3), and the method of analysis (3.4), respectively.

3.1 Participants

Students of the School of Humanities of Tilburg University were approached to participate in our experiment. A total of 68 students signed up, 51 of which were used during the analysis (6 students did not show up, 2 failed to complete the game, and 9 failed to fill out all the questionnaires). about 40% of the participants were male, and 60% female. Their age ranged from 18 to 31 years, with a mean age of 21.5 years, and a median age of 21 years.

3.2 Questionnaire

To measure players' emotional responses a picture-oriented instrument called Self-Assessment Manikin (SAM) was used [10]. The SAM, displayed in Figure 2, has been used in previous research to effectively measure emotional responses in a variety of situations, including reactions to videos (which can be compared to videogames). It is an easy, nonverbal (and therefore language-independent) method for quickly assessing people's reports of emotional responses [1]. By asking participants to indicate which image from a row of pictures best approaches their current emotional state, the SAM directly assesses the valence, arousal, and dominance associated with a response to an object or event. The arousal and valence dimensions are as discussed in the Background section. The dominance dimension is not related to an emotional response, but is used for indexing the relationship of control that exists between the perceiver and the perceived situation. Scores ranged from 1 to 9 (participants could also indicate a value between two neighboring pictures). For the first row (arousal), 9 indicated "*most aroused* " (left-most picture). For the second row (valence), 9 indicated "*most pleasant* " (left-most picture). For the third row (dominance), 9 indicated "*most in control* " (right-most picture).

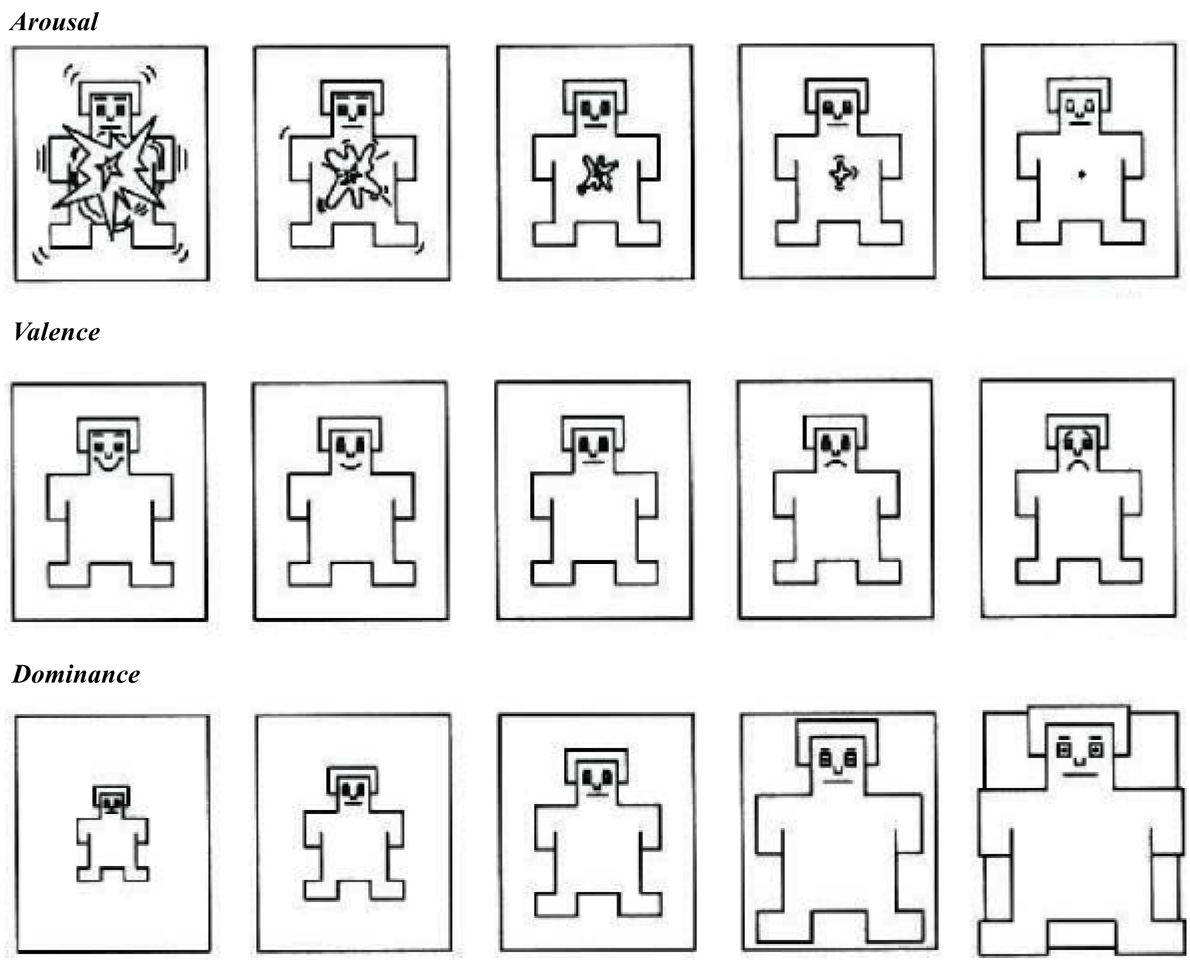

Figure 2. Self-Assessment Manikin (Lang, 1980)

3.3 Game

For the experiment we built a game as a *Neverwinter Nights* module using BioWare's Aurora toolset. The game starts with a short introduction that explains the game controls. After that the player encounters five conditions (situations). In each condition the player enters a different room, in which he has an interaction with a non-player character (NPC), and must collect an item, which he needs to open the next room (see Figure 3 for a screenshot). When all five items are collected, the participant can open a treasure chest and "*win*" the game. After leaving each of the rooms, the game asks him to fill out the SAM questionnaire. After the game is won, he is asked to fill out a short questionnaire, which includes a question on his experience with videogames.

The visual characteristics of the five conditions do not change in the game, apart from the ambient light color. The first condition is the control condition in which no manipulation takes place. In the other four conditions the color is manipulated. Color is therefore our independent variable. In order to prevent carry-over effects of the response set, the order of the colors of the four manipulated conditions are counterbalanced completely. As there are 24 different orderings for the four colors used in the experiment, our 60 participants were sufficient to test each ordering two or three times.

By manipulating the conditions' colors our aim was to stimulate feelings of surprise, fear, joy, and anger, which, according to [16], are associated with the colors light blue, dark green, yellow, and red (see Table 1). These feelings all should score high on the arousal dimension. However, whereas surprise and joy (light blue and yellow) should score high on the valence dimension, fear and anger (dark green and red) should score low on the valence dimension.

Figure 3. Screenshot of the game

3.4 Analysis

To analyze the results of the measured emotional responses, a one-way ANOVA, an independent-samples T-test, and descriptive statistics were performed using SPSS 16.0. The scores on the SAM were the three dependent variables: arousal, valence, and dominance. Descriptive statistics of these variables were performed over the control condition, the rooms, and the four colors.

Descriptive statistics were also used to measure the number of participants, the mean score of the SAM dimensions, and the standard deviation for the four rooms, the control condition, and the four colors. A manipulation check was performed to analyze the differences between the rooms (conditions) by a one-way ANOVA. To test whether there is a main effect for color (including the control condition) on the arousal, valence, and dominance scores a one-way ANOVA was performed. We also examined whether experience or inexperience with videogames had an effect on emotional responses using one-way ANOVA tests.

4. Results

In this section we discuss the SAM scores for the conditions (rooms), for the colors (and thus the emotions), and for the differences between experienced and inexperienced participants, respectively.

4.1 SAM-scores for the rooms

The mean scores on the SAM for the four manipulated rooms are presented in Table 2 and Figure 4. A one-way repeated measures ANOVA was conducted to compare scores on the *arousal*, *valence*, and *dominance* dimension in a Coping with Statistics test at the four manipulated rooms. There was no significant effect for the four rooms on the *arousal* scores, Wilks' lambda = .91, $F(3,48) = 1.67$ $p = .19$, multivariate partial $\eta^2 = .10$. There was a significant effect for the four rooms on the *valence* scores, Wilks' lambda = .76, $F(3,48) = 5.06$, $p = .004$, multivariate partial $\eta^2 = .24$. Post-hoc tests found a significant difference between room 1 and room 4, $F(3,48) = 5.06$, $p = .002$. There was a significant effect for the four rooms on the *dominance* scores, Wilks' lambda = .75, $F(3,48) = 5.30$, $p = .003$, multivariate partial $\eta^2 = .25$. Post-hoc tests found a significant difference between rooms 1 and 3, $F(3,48) = 5.30$, $p = .04$, between rooms 1 and 4, $F(3,48) = 5.30$, $p = .002$, and between rooms 2 and 4, $F(3,48) = 5.30$, $p = .03$.

From the results we conclude that a significant effect for the rooms was found on the valence and dominance scores. Scores for valence increased with the room numbers, with significant differences between rooms 1 and 4. Scores for dominance increased with the room numbers, with significant differences between rooms 1 and 3, rooms 1 and 4, and rooms 2 and 4. This means that, on average, a player's experience of pleasure and feeling of control increased while the game progressed.

Room	Arousal		Valence		Dominance	
	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
1	4.22	1.96	5.76	1.82	5.43	2.05
2	4.47	2.10	6.12	1.81	5.82	2.06
3	4.76	2.12	6.20	1.76	6.06	2.13
4	4.88	2.15	6.73	1.67	6.55	2.16

Table 2. Mean scores on arousal, valence, and dominance for the four manipulated rooms

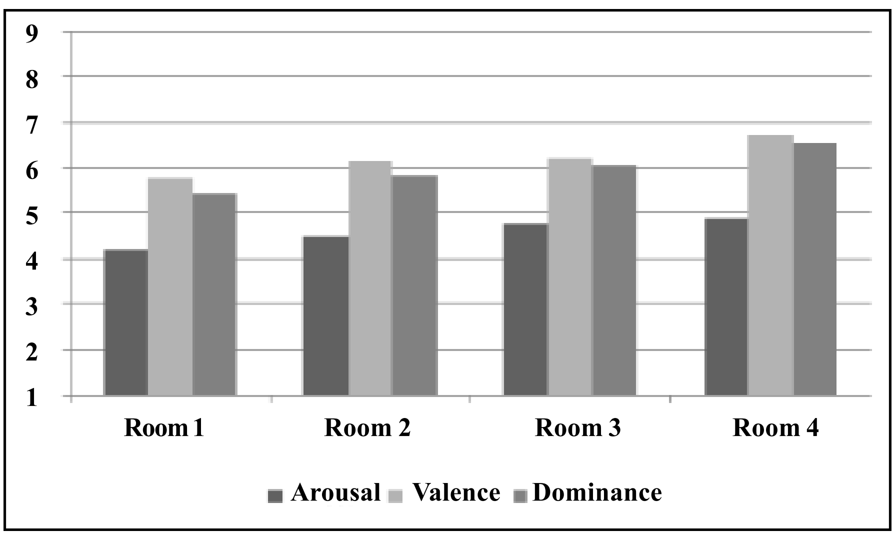

Figure 4. Mean scores on arousal, valence, and dominance for the four manipulated rooms

4.2 SAM-scores for the color conditions

The mean scores on the SAM for the four color conditions are presented in Table 3 and Figure 5. A one-way repeated measures

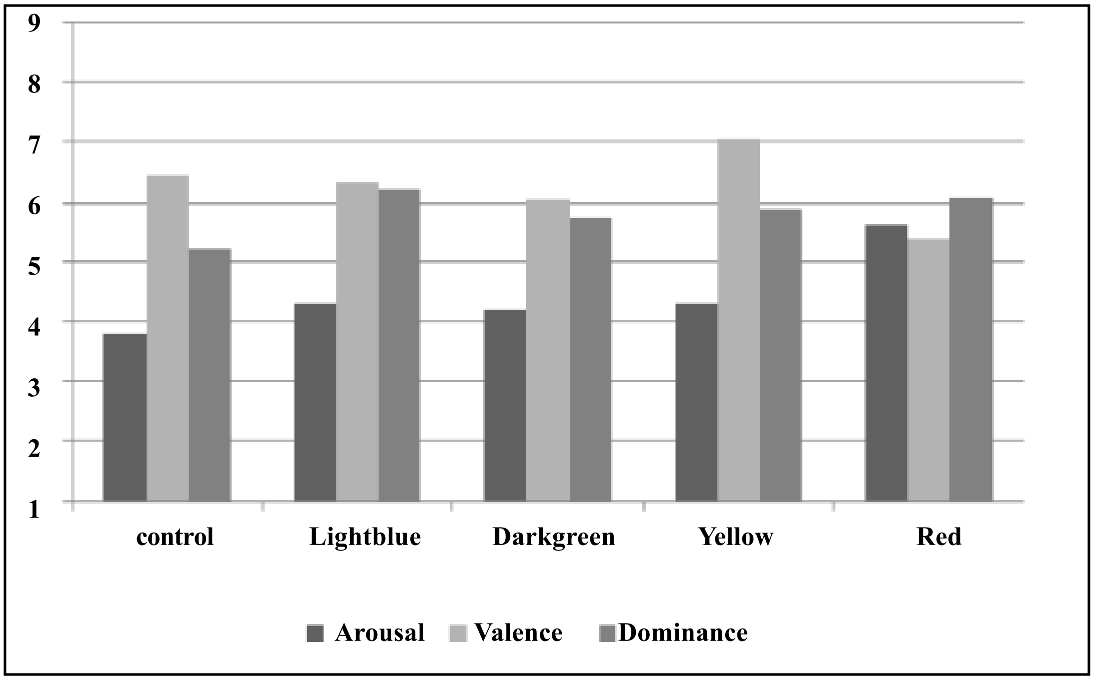

Figure 5. Mean scores on arousal, valence, and dominance for the control condition and the colors

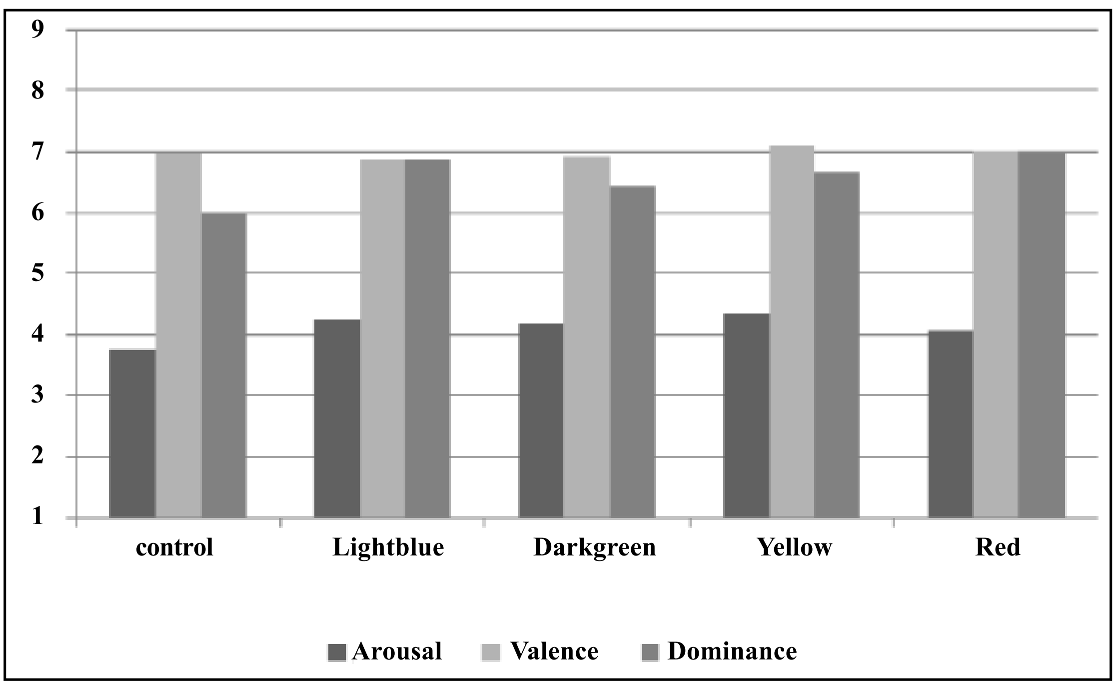

Figure 6. Mean scores on arousal, valence, and dominance of experienced videogame players for the control condition and the colors

ANOVA was conducted to compare scores on the *arousal*, *valence*, and *dominance* dimension in a Coping with Statistics test at the control condition (natural light) and at the color conditions: yellow, red, dark green, and light blue. We found a significant effect for color on the *arousal* scores, Wilks' lambda = .55, $F(4,47) = 9.61$, $p < .001$, multivariate partial $\eta^2 = .45$. Post-hoc tests found a significant difference between the control condition and red, $F(4,47) = 9.61$, $p < .001$, between yellow and red,

$F(4,47) = 9.61$, $p = .001$, between dark green and red, $F(4,47) = 9.61$, $p < .001$, and between light blue and red, $F(4,47) = 9.61$, $p < .001$. We found a significant effect for color on the *valence* scores, Wilks' lambda = .55, $F(4,47) = 9.54$, $p < .001$, multivariate partial $\eta^2 = .45$. Post-hoc tests found a significant difference between the control condition and yellow, $F(4,47) = 9.54$, $p = .002$, between the control condition and red, $F(4,47) = 9.54$, $p < .001$, between yellow and red, $F(4,47) = 9.54$, $p < .001$, between yellow and dark green, $F(4,47) = 9.54$, $p = .003$, and between red and light blue, $F(4,47) = 9.54$, $p = .007$. We found a significant effect for color on the *dominance* scores, Wilks' lambda = .77, $F(4,47) = 3.44$, $p = .02$, multivariate partial $\eta^2 = .23$. Post-hoc tests found a significant difference between the control condition and red, $F(4,47) = 3.44$, $p = .05$, and between the control condition and light blue, $F(4,47) = 3.44$, $p = .009$.

From the results we conclude that, on average, arousal scores for the color red were significantly higher than for any of the other colors or the control condition. There were no significant differences on arousal for the other colors. On average, valence scores for the color yellow were significantly higher than for the colors dark green and red, and for the control condition. There was no significant difference between the valence scores for yellow and light blue. Neither was there a significant difference for light blue and either dark green or red, or the control condition. The valence score for red, however, was significantly lower than those for yellow, light blue, or the control condition. For dominance no significant effects were found for any of the colors. This means that, on average, more so than any other color used in the experiment, the color red arouses a player, but is experienced as negative. The color yellow, more than any other color used in the experiment, is experienced as positive. These results are statistically significant.

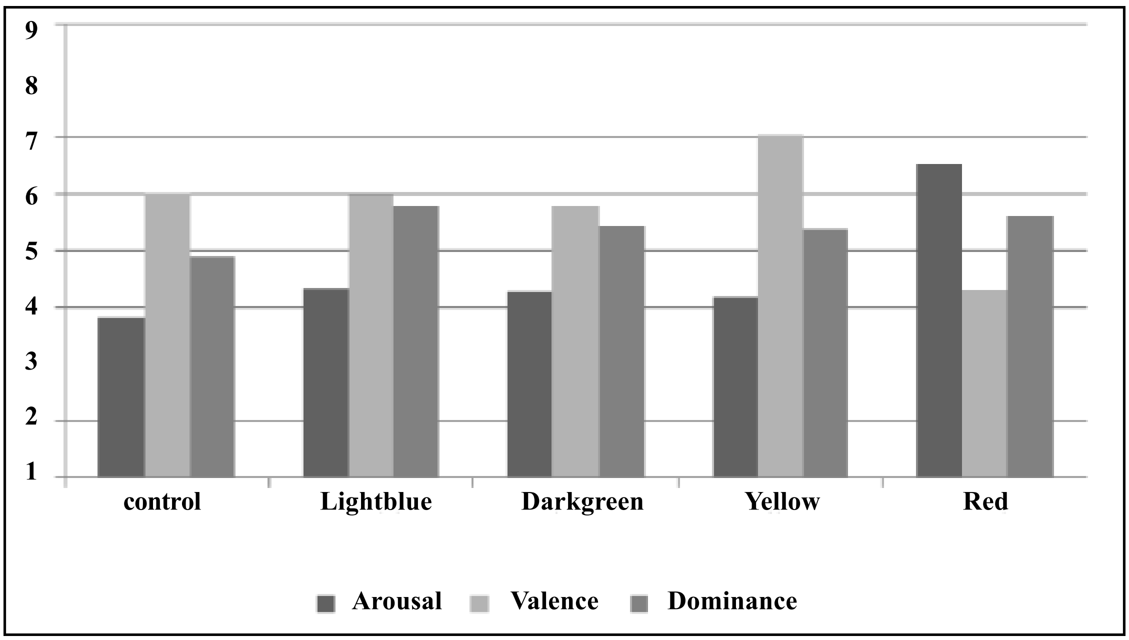

Figure 7. Mean scores on arousal, valence, and dominance of inexperienced videogame players for the control condition and the colors

4.3 SAM-scores and experience

When examining our data, we hypothesized that there were differences in scores between participants who considered themselves experienced videogame players, and participants who considered themselves inexperienced in this area. We therefore calculated the mean scores on the SAM for the four color conditions for these two groups separately. The results for experienced players are presented in Figure 6. A one-way repeated measures ANOVA found no significant effect for color on the *arousal* scores, Wilks' lambda = .81, $F(4,15) = .89$, $p = .49$, multivariate partial $\eta^2 = .19$. There was no significant effect for color on the *valence* scores, Wilks' lambda = .89, $F(4,15) = .47$, $p = .75$, multivariate partial $\eta^2 = .11$. There was no significant effect for color on the *dominance* scores, Wilks' lambda = .55, $F(4,15) = 3.10$, $p = .05$, multivariate partial $\eta^2 = .45$.

The results for inexperienced players are presented in Figure 7. A one-way repeated ANOVA found a significant effect for color on the *arousal* scores, Wilks' lambda = .26, $F(4,27) = 18.93$, $p < .001$, multivariate partial $\eta^2 = .74$. Post-hoc tests found a significant difference between the control condition and red, $F(4,27) = 18.93$, $p < .001$, between yellow and red, $F(4,27) = 18.93$, $p < .001$, between dark green and red, $F(4,27) = 18.93$, $p < .001$, and between light blue and red, $F(4,27) = 18.93$, $p < .001$. There was a significant effect for color on the *valence* scores, Wilks' lambda = .24, $F(4,27) = 21.09$, $p < .001$, multivariate partial $\eta^2 = .76$. Post-hoc tests found a significant difference between the control condition and yellow, $F(4,27) = 21.09$, $p = .005$, between the control condition and red, $F(4,27) = 21.09$, $p < .001$, between yellow and red, $F(4,27) = 21.09$, $p < .001$, between yellow and dark green, $F(4,27) = 21.09$, $p = .007$, between red and dark green, $F(4,27) = 21.09$, $p = .01$, and between red and light blue, $F(4,27) = 21.09$, $p < .001$. There was no significant effect for color on the *dominance* scores, Wilks' lambda = .82, $F(3,28) = 1.45$, $p = .25$, multivariate partial $\eta^2 = .18$.

From the results we conclude the following: For the colors dark green, red, and the control condition the 31 inexperienced participants scored significantly lower on valence than the 19 experienced players (one participant did not answer the question on experience), i.e., they derived less pleasure from these conditions. For the colors yellow, red, and the control condition the dominance scores of inexperienced participants were also significantly lower than for experienced participants, i.e., they felt less in control in these conditions.

For experienced participants we found no significant differences between the scores on any of the colors for any of the dimensions. In contrast, for inexperienced participants we found three significant effects. First, the arousal score for the color red was significantly higher than the scores for any of the other colors, or the control conditions. One might even call the score '*surprisingly high.*' Second, the valence score for the color yellow was significantly higher than the scores for the colors dark green, red, or the control condition. There was no significant difference with the color light blue, although the score for yellow was still quite a bit higher than the score for light blue. Third, the valence score for red was significantly lower than all the other colors or the control condition. For dominance, no significant effects were found. The somewhat surprising conclusion that we must draw is that the effects we found were mainly the result of the answers given by the inexperienced participants.

5. Discussion

In this section we discuss our findings on the effects of the rooms (5.1), the colors (5.2), and player experience (5.3) on emotional responses.

5.1 Effects of the rooms on emotional responses

Results on the differences between the rooms showed an effect on the valence and dominance dimensions. Differences on the valence scores between the rooms may be due to the enjoyment participants felt on winning the game. Participants felt more enjoyment in the last condition than in the first condition. [6] state that performance is an important factor for enjoyment in videogames.

The reason for the differences on the dominance scores between the rooms may be due to the fact that the participants got more experienced during the game, therefore navigation became easier [5] and participants felt more in control. This explanation is supported by the fact that experienced participants showed significantly higher dominance scores than inexperienced participants.

5.2 Effects of the colors on emotional responses

While we found effects on emotional responses for the colors yellow and red, we failed to find effects for the colors dark green and light blue. We provide three possible reasons for this lack of effect.

First, the lack of effect may be due to the environment used to measure emotional responses. The natural environments used by [16], who identified the relationship between colors and emotional responses, differ from ours. It is very well possible that color manipulation in a videogame leads to different emotional response effects than in a natural environment.

Second, the lack of effect may be due to the limited options for color selection in the Aurora toolset, which we used to build the game. The colors in the light blue and dark green condition were less intense than the colors in the red and yellow condition. [23] stated that colors of high intensity elicit stronger emotional effects in humans than those of low intensity. Furthermore, the color of the light blue condition was almost identical to the color of the control condition, and the color dark green made the condition very hazy, which might have a stronger effect on how a player experiences the game than just the color effect.

Third, the lack of effect may be due to the fact that in this experiment only the background light of a condition was manipulated. The objects in the condition and the condition itself were in standard colors.

5.3 Effects of experience on emotional responses

Emotional response effects for videogame experience were found on the valence and the dominance scores. Figures 6 and 7 show that, in general, experienced participants scored higher on these dimensions than inexperienced players. The higher scores for the experienced participants may be due to the perceived complexity of the videogame. Players who perceive less complexity during a videogame feel more enjoyment and have higher feelings of dominance [6].

Emotional response effects for color were only found for the inexperienced participants. The reason for the lack of emotional response effects of color for the experienced participants may be due to the fact that they are familiar with videogame situations. They know what to expect and how to navigate through the game; their experience guides them more than the colors they see. [8] stated that videogame players who are unfamiliar with a videogame situation use visual aspects (including color) of the videogame to make sense of the situation. Therefore, they take more note of visual cues, even subconsciously.

A further explanation for the lack of emotional response effects for experienced participants may be the time they spent in the conditions. We noted that, in general, they were very fast in playing the game. [9] found that the duration of a videogame is animportant factor in eliciting emotional responses.

6. Conclusion

We investigated to what extent the use of colors in a relatively complex videogame may influence a player's emotional responses. We found significant effects on emotional responses for the colors red and yellow. According to [16], the color red is associated with a feeling of anger, which evokes a highly-aroused, negative emotional response, and the color yellow is associated with a feeling of joy, which evokes a highly-aroused, positive emotional response. Indeed, in our experiment we found that red elicited a highly-aroused, negative emotional response, and yellow elicited a positive emotional response. We found that these color effects were prevalent mainly with inexperienced videogame players. We conclude that game designers can employ certain colors to manipulate player's emotions, specifically those of novice players.

7. Acknowledgments

This paper is an extended version of the paper "*Colors and emotions in video games*" by [7]. We thank the editor and publisher of the GAME-ON 2010 proceedings for the permission to extend and republish the paper. We also thank the anonymous reviewers for their comments. The *Neverwinter Nights* module used in this paper is freely available from the third author's webpage.

References

[1] Bradley, M. M., Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin (SAM) and the semantic differential. *Journal of Experimental Psychiatry & Behavior Therapy*, 25, 49-59.

[2] D'Andrade, R., Egan, M. (1974). The Color of Emotions. *American Ethnologist*, 1 (1) 49-63.

[3] Ekman, P. (1993). Facial Expression and Emotion. *American Psychologist*, 48, 384-392.

[4] El-Nasr, M., Niedenthal, S., Knez, I., Almeida, P., Zupko, J. (2006). Dynamic lighting for tension in games. *Game Studies*, 7(1).

[5] Griffith, J. L., Voloschin, P., Gibb, G. D., Bailey, J. R. (1983). Differences in eye-hand motor coordination of video-game users and non-users. *Perceptual and Motor Skills*, 57(1) 155-158.

[6] Holbrook, M. B., Chestnut, R.W., Oliva, T. A., Greenleaf, E. A. (1984). Play as a Consumption Experience: The Roles of Emotions, Performance, and Personality in the Enjoyment of Games. *Journal of Consumer Research*, 11 (2) 728-739.

[7] Joosten, E., Van Lankveld, G., Spronck, P. (2010). Colors and emotions in video games. 11th *International Conference on Intelligent Games and Simulation GAME-ON 2010* (ed. Aladdin Ayesh), EUROSIS, 61-65.

[8] Jørgensen, K. (2008). Audio and gameplay: an analysis of PvP battlegrounds in World of Warcraft. *Game Studies*, 8 (2).

[9] Landers, D. M., Boutcher, S. H. (1993). Arousal-performance relationships. *Applied sport psychology, Personal growth to peak performance* (J.M. Williams, ed.), 2nd edition, Mayfield Publishing Company, Palo Alto, CA.

[10] Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. *Technology in mental health care delivery systems*, 119-167, Ablex, Norwood, NY.

[11] Larsen, R. J., Diener, E. (1992). Promises and problems with the circumplex model of emotion. *Review of personality and social psychology*, 13, 25-59.

[12] Livingstone, S. R., Brown, A. R. (2005). Dynamic response: real-time adaptation for music emotion. *In*: *Proceedings of the Second Australasian Conference on Interactive Entertainment*, 105-111.

[13] Oberascher, L., Gallmetzer, M. (2003). Colour and emotion. *In*: Proceedings of AIC 2003 Bangkok: Color Communication Management, 370-374.

[14] Ortony, A., Turner, T. J. (1990). What's basic about basic emotions? *Psychology Review*, 97, 315-331.

[15] Perron, B. (2005). A cognitive psychological approach to gameplay emotions. *In*: *Conference Proceedings of DiGRA'*05*, Changing Views: Worlds in Play*, Digital Games Research Association.

[16] Plutchik, R. (2001). The nature of emotions. *American Scientist*, 89, 344-350.

[17] Posner, J., Russell, J. A., Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, 17, 715-734.

[18] Ravaja, N., Salminen, M., Holopainen, J., Saari, T., Laarni, J. J. A. (2004). Emotional response patterns and sense of presence during videogames: potential criterion variables for game design. *In*: Proceedings of the Third Nordic Conference on Human-Computer Interaction, 339-347.

[19] Robbins, S. P., Judge, T. A. (2008). *Organizational Behavior*. Prentice Hall International, Upper Saddle River, NJ.

[20] Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39, 1161-1178.

[21] Stark, G. M., Saunders, D. M., Wookey, P. E. (1982). Differential effects of red and blue coloured lighting on gambling behavior. *Current Psychological Research*, 2, 95-100.

[22] Ryman, D. H., Biersner, R. J., La Rocco, J. M. (1974). Reliabilities and validities of the mood questionnaire. *Psychological Reports*, 35, 479-484.

[23] Valdez, P., Mehrabian, A. (1994). Effects of colour on emotions. *Journal of Experimental Psychology*, 123, 394-409.

[24] Wolfson, S., Case, G. (2000). The effects of sound and colour on responses to a computer game. *Interacting with computers*, 13 (2) 183-192.