The Impact of Visual Aesthetic Quality on User Engagement during Gameplay

Uttam Kokil
Kennesaw State University
Marietta Campus, GA 30060. U.S.A
E-mail: ukokil@kennesaw.edu

***Abstract*—The aim of this study was to examine player behavior in two different levels of visual aesthetic quality of a tablet game user interface. First, the tablet game was created by applying user centered design principles, such as prototyping and usability testing in an iterative manner. The game was then modified into two different visual aesthetic conditions – monochromatic (low quality) and in full color (high quality) to serve as response stimuli. The first objective examined the effect of visual aesthetic quality on user engagement using the user engagement scale (UES). The four components of user engagement are *reward, aesthetics, focused attention*, and perceived *usability*. It was observed that three of the user engagement components, *reward, aesthetics* and *usability* significantly predicted *perceived high visual aesthetic quality* interface. In addition, three user engagement components, reward, aesthetics and focused attention, supported *perceived visual aesthetic quality* for the low-quality interface. This result was further substantiated by investigating the effect of perceived usability in the same experimental condition using the *AttrakDiff* questionnaire. The main finding of this study reveals that high visual aesthetic quality user interfaces are perceived to be usable whereas low visual aesthetic interfaces are not. There was also a significant difference in the level of *overall user engagement* between the two game interfaces, as participants found the high visual aesthetic quality to be more engaging.**

Keywords-tablet gaming; user experience; user interface design; user engagement; perceived usability; visual aesthetics.

I. INTRODUCTION

The ubiquitous property of tablet gaming has contributed to a wider demographic of users [1] [2]. Clearly the rate of tablet adoption is due to an innovation that has been perceived to have a greater relative advantage by the end-users, as per the Diffusion of Innovations Theory [3]. Digital games arise from a wide spectrum of genres, classifications, and categories; technology acts as a catalyst for the changing medium of game interaction, from consoles to touch screen devices. In fact, traditional keyboard and console-based games are dramatically shifting to the more affordable touch-screen games for tablets and mobile devices [4]. The advent of touchscreen computing has revolutionized the field of Human Computer Interaction (HCI) as it has become part of our everyday life and experience [5]. The mobile platform has tremendous scope for developing newer types of games, targeted to a broader demographic of users [1]. Designing digital games for a broader audience is complex in the sense that all users have their own preference and motive in terms of game genres, such as action, adventure, or serious games. There is unanimous acceptance among researchers and practitioners in the HCI field that applications must be designed with the inclusion of non-task-related concepts [6], which Mahlke [7] positions as non-instrumental quality and other researchers describe as hedonic components [8]–[11]. Instrumental quality is also referred to as the pragmatic aspect of product quality which incorporates functionality, usability, practicality, and utility; non-instrumental quality on the other hand encompasses visual aesthetics, and hedonic qualities such as pleasure, enjoyment, and fun. Therefore, it becomes pertinent to design "engaging experiences" in products, to captivate and enrich user experience (UX) by adding playful and fun features in games [12]. A method to engage end-users is to create user-centric applications based on user needs and satisfaction.

HCI practitioners have linked UX to components beyond instrumental quality to include hedonic, visual aesthetics, affective, emotions, and "experiential" technology-interaction [13]–[15]. The roles of instrumental and non-instrumental qualities in products have been closely studied over and again by several scholars [7] [16]–[18]. There has been no consensus on the relationship between usability and visual aesthetics in the domain of product design, or interactive design. Some researchers have lengthily discussed the concept of what is "*beautiful is usable,*" signifying that a "beautiful" object influences usability [19], while other scholars have shown that there is no relationship between usability and visual aesthetics [20] or the factors are independent from each other [7]. User engagement is part of a positive UX [21]. Carr [22] explains that game players are able to make choices and important decisions during gameplay by virtue of the visceral characteristics of visual elements. This implies that users make judgment based on both cognitive and emotional capabilities [23], induced by visual elements [24]. It becomes essential to examine user perceptions and behavior during gameplay interaction. This will provide a deeper insight why users are attracted and engaged to play games [7]. The main objective of this study is to examine the effect of visual aesthetic quality on four components of user engagement [25] in tablet game interfaces. According to extant literature, no distinction has been made concerning the level of visual aesthetics in products that have an impact on usability. The second objective attempts to bridge the knowledge gap by providing insights to identify the level of visual aesthetics in

 ISBN: 978-1-61208-616-3

user interfaces that influence usability. Section II provides an overview of the literature review. Section III justifies the methods, including data gathering procedure. Section IV elucidates the analysis and results portion. Section V concludes the paper.

II. LITERATURE REVIEW

It has been argued that the components associated with usability, such as effectiveness, efficiency and satisfaction alone cannot be a sole predictor of UX. The inclusion and assessment of hedonic and experiential attributes concerning human technology interaction such as pleasure, fun, enjoyment, and engagement are necessary to close the loop [26]. A game interface connects a player's experience to the gaming system; hence it becomes imperative to understand user engagement, UX, and emotional outcome, along with the characteristics of the tablet user interface. It is clear that mobile devices have a set of new features (touch screen, camera, GPS, etc.) over game consoles that offers different mode of interactions. According to Cyr et al. [27, pp. 951], aesthetics has demonstrated to have a "positive effect on user perception on mobile system's ease of use, usefulness and enjoyment." However, the impact of the degree of visual aesthetic quality (low or high) on perceived usability is not clear.

O'Brien and Toms [25] conducted a study in the e-commerce domain to explore the hedonic and utilitarian motivation with regards to user engagement in the online shopping domain. The hedonic and utilitarian motivation and engagement include both functional and pleasurable aspects of UX and the hedonic qualities of product attributes, such as entertainment and utilitarian concepts including efficiency, cost, and functional attributes influence user engagement. Consequently, several studies have been conducted to assess user engagement in the domains of video games [28], online news [29] [30], and web searching [31]. UX examines the quality of information interactions from users' perspective [21]. User engagement forms part of UX, as the positive side of user interaction is accentuated, whereby technology can entice and motivate the user towards product use [32]. User Engagement is defined as a user-product relationship encompassing an emotional, cognitive and behavioral bond that prevails over time [6]. User Engagement encompasses the initial reaction of users towards technology [33] as well as the continuous use and re-engagement with the information system over time [34] [35]. Engagement is determined by factors like visual aesthetics, system usability, user involvement and evaluation of the experience [34]. It was recommended that the term "engagement" should replace "satisfaction" as the latter does not signify the experience a user is drawn into a user interface [36]. User attitude towards the system is part of engagement and focused on the thoughts of individual users [37], "feelings" [38], "their degree of activity" [37], and "during system use [39]". O'Brien and Toms [40] devised the UES scale to measure user engagement by assessing user perspective of *perceived usability, aesthetics, novelty, felt Involvement, endurability*, and *focused attention*. In this study, it was recommended to combine *novelty, felt involvement and endurability* into one factor called *reward,* because they all formed part of the hedonic aspects. By contrast, perceived usability, aesthetics and focused attention emerged to be typically different from each other in the UES scale study. Wiebe et al. [28] recommended to use fewer constructs in the UES scale. Hence, the UES scale was reduced to four factors: *perceived usability*, *aesthetics*, *focused attention and reward* [29].

A description of the user engagement scale components is provided as follows. Researchers have associated, *endurability* to an experience in which users will remember the most gratifying moments during an activity, and will most likely repeat those activities again [41]. It is also associated to user loyalty. *Novelty* covers a new idea or concept pertaining to game narrative or storytelling, or a creative method for a player to interact with the game user interface, which may give rise to elements of surprise or excitement during gameplay. It arouses a user sense of curiosity [42]. *Felt involvement* is described as a fun experience which sustains user interest in an interactive environment which may arise from an emotional connection between the interface and the user [28]. *Focused attention* is defined as a high-level concentration and absorption of one's mental state into an activity, which resonates with the flow theory, whereby the notion of time is lost when a user is fully immersed into the activity at hand [26]. Aesthetics appeals to the senses. Engholm [43] defines aesthetics as the "sensuous qualities, the emotions, moods, and experiences" that occur while interacting with a product. Visual aesthetics refers to the appearance the user interface, depicted as the top-most visible surface layer of the UX model [44]. Perceived usability is defined as the ease of use, the practical side of a product use, with goals such as efficiency, effectiveness, and user satisfaction in specific contextual use (ISO 9241-11).

III. METHODOLOGY

The objectives of this study were: (i) to examine the relationship between visual aesthetic quality and perceived game usability (ii) to examine the impact of visual aesthetic quality on game engagement. A convenience sample frame of fifty-six participants were recruited for the first objective on a university campus in the US. Thirty-five participants took part in the second objective. The within-subject tests minimized error variance individual differences between treatments. Participants were randomly assigned to each treatment to create equivalent conditions and to control extraneous variables across conditions. Participants selected for this study were between 18–35 years old. Perceived game usability data were collected using the dimensions related to pragmatic quality (PQ) of the *AttrakDiff* instrument. The dimensions related to visual aesthetics quality (AT) of the *AttrakDiff* instrument were used to

 ISBN: 978-1-61208-616-3

gather data related to the perceptions of visual aesthetics [25]. PQ is comprised of seven bi-polar items, and is related to the perceived usability assessing ease of use. Similarly, AT consists of 7 bi-polar items, aimed to measure the perceived visual aesthetics of the game user interfaces. The procedure involved a within-subjects test whereby the same participant interacted with both game versions. Each participant was randomly assigned to play either the low or high visual aesthetic game version in order to ensure high internal validity; according to *Law of Probability*, this ensures that two equivalent groups are created [27]. A high visual aesthetic quality of an iOS adventure game was primarily created; the same interface was modified into a low-quality visual aesthetic condition by violating the Principles of Design, such as rendering low-bits graphics and reducing the contrast between foreground elements and the background. Each game session lasted for 10 minutes. At the end of each game session, participants were instructed to complete the 7-items of the PQ and the 7-items of the VA section of the *AttrakDiff* instrument, and the 31-items of the *User Engagement Scale (UES)* questionnaire. The original UES is a self-report instrument which consists of the following constructs: *usability, aesthetics, focused attention, novelty, endurability, felt involvement* to capture user engagement. In this study, data from the three constructs *novelty, endurability* and *felt involvement* were combined as a single construct called *reward*.

IV. RESULTS AND ANALYSIS

The first objective of this study was to examine if a variation of the visual aesthetic quality (low or high) a game user interface influences perceived game usability. The *perception of usability* data was first inspected for normality of distribution and verified for ANOVA assumptions. The boxplots did not reveal any extreme outliers or skewness. The bell-shaped curve, though slightly skewed to the right, confirmed that the data were normally distributed. During the preliminary analysis, it was noted that the variability of the *perceived usability* for the high-quality visual aesthetic quality was higher than the low visual aesthetic quality version. The perceived usability result was reported using *AttrakDiff-(PQ)* while the perceived visual aesthetic quality result was reported using *AttrakDiff-(AT) (Hassenzahl, 2003)*.

It was important to verify if the ***perceived visual aesthetic quality*** of the two game conditions were different. The result demonstrated that the *perception of visual aesthetic quality* was statistically significant, $F(1,51)=76.997$, $p<0.05$, n=52. The null hypothesis is rejected, inferring that there is a significant difference of perceived visual aesthetics between the quality for the two game user interfaces. The descriptive statistics reveal that the high visual aesthetic quality interface had a mean value of 4.89 whereas the low visual aesthetic quality was rated at 3.91; the boxplot shows that high visual aesthetic quality interface had a higher variability, slightly skewed to the right. The partial eta-squared, $n_p^2 = 0.602$, and according to Cohen's [45] guidelines, is considered a large effect. It is deduced that 60.2% of the variance in the dependent variable, perception of visual aesthetics, is accounted by the independent variable, visual aesthetic quality.

A one-way repeated measures ANOVA was conducted to compare the mean values of **perceived game usability** in the two levels of user interfaces, low and high visual aesthetic quality. IBM SPSS result for the PQ dependent variable shows $F(1, 55)=0.196$, $p=0.660$, n=56. For the low visual aesthetic interface, the mean value of the *perceived game usability* was rated at (μ=4.84, SD 0.74) whereas for the high visual aesthetic interface, the mean value for the *perceived usability* was (μ=4.88, SD 0.79). Given that *p*-value>0.05, this implies that the perception of usability of both conditions of the game interfaces was not statistically significant, as both the low and high visual aesthetic quality were deemed to be equally usable. It was deduced that there was no effect-size, as per Cohen's guidelines [45], given that partial eta-squared, $n_p^2 =0.004$, which indicates that the independent variables, low and high visual aesthetic qualities, did not influence the dependent variable, perceived usability.

Pearson Regression Analyses were conducted to have a deeper understanding of the relationship between (i) the independent variable – *perceived high visual aesthetic quality* of game interface, and the dependent variable - *perceived game usability* (ii) the independent variable – *perceived low visual aesthetic quality* of game interface, and the dependent variable, *perceived game usability*.

The relationship between ***perceived game usability***, as measured by *AttrakDiff-(PQ)*, and ***perceived high visual game aesthetics***, as measured by *AttrakDiff-(AT)*, was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity occurred. There was a weak, significant positive correlation between the two variables, r=0.298, n=55, $p=0.035$. The high visual aesthetic quality significantly supports perceived usability, as $p<0.05$. Given the value of $R^2=0.089$, 8.9% of the variation in the response variable could be explained by the high visual aesthetic game version. It is reasonable to deduce that high visual game aesthetic quality has an effect on perceived game usability.

In addition, the relationship between ***perceived game usability***, as measured by *AttrakDiff-(PQ)*, and ***perceived low visual game aesthetics***, as measured by *AttrakDiff-(AT)*, was investigated using the Pearson product-moment correlation coefficient. There was a weak, positive correlation between the independent variable, *perceived low visual aesthetic quality*, and the response variable, *perceived usability*, r=0.193, n=49, $p>0.05$ 9 ($p=0.185$). Low visual game aesthetics did not significantly support the predicted perceived game usability. Given the value of $R^2=0.037$, it is deduced that 3.7% of the variation in the response variable

was accounted for by the independent variable. Therefore, it may not reasonable to rely on this equation to predict perceived game usability using the low aesthetic quality version of the game user interface. It is deduced that low visual game aesthetic quality does not have an influence on perceived game usability.

The **second objective** was to evaluate the impact of visual aesthetic quality on user engagement in the same experimental setting. A repeated one-way ANOVA data analysis of the UES questionnaire revealed that there was a statistically significant difference of user engagement level between the two game versions, $F(1,34)=18.05$, $p<0.05$, multivariate partial-eta squared 0.348. Following the commonly used guidelines proposed by Cohen [45, pp.284–7], (0.01=small, .06=moderate, 0.14=large effect), this result suggests a very large effect size. This result comprises all the four components of the UES instrument. Users were more engaged in the high visual aesthetic version of the game user interface, which scored a mean value of μ=2.92 (SD 0.49) as compared to μ=2.67 (SD 0.45) for the low visual aesthetic version.

TABLE I. DESCRIPTIVE STATISTICS UES COMPONENTS

UES Dimension	Mean		Significant value 0.05	F-statistics
	Low Visual Aesthetics	*High Visual Aesthetics*		
Overall UES	μ=2.67 (SD 0.45)	μ=2.92 (SD 0.49)	$p<0.05$	F (1,34) =18.05
Reward	μ=2.99 (SD 0.69)	μ=3.24 (SD 0.75)	$p=0.003$	F (1,34) = 10.09
Focused Attention	μ=2.39 (SD 0.91)	μ=2.45 (SD 0.92)	$p=0.467$	F (1,34) = 0.540
Aesthetics	μ=2.77 (SD 0.53)	μ=3.78 (SD 0.40)	$p<0.05$	F (1,34) = 53.78
Usability	μ=3.53 (SD 0.52)	μ=3.65 (SD 0.49)	$p=0.111$	F (1,34) = 2.68

Four individual dimensions of UES were individually compared as shown in Table I. All the user-engagement constructs (*reward, focused attention, aesthetics, usability*) were rated higher for the high-quality visual aesthetic game user interface version, implying that participants were more engaged in that version. Participants found a significant difference between the low and the high visual interface in the case of *aesthetics* and *reward*, $p<0.05$. There was no significant difference in the case of perceived *usability* and *focused attention* between the two game conditions.

In order to examine if the components of user engagement were influenced by each condition of visual aesthetic quality of game user interfaces, a multiple regression analysis was conducted to predict the continuous dependent variable, *perceived visual aesthetic quality,* based on the following four multiple independent variables: *reward, focused attention, aesthetics, and usability*

In the case of the **high visual aesthetic quality**, there was linearity as assessed by partial regression plots and a plot of *studentized* residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.455. Homoscedasticity was present, as assessed by visual inspection of a plot of *studentized* residuals versus unstandardized predicted values. No evidence of multicollinearity was found, as assessed by tolerance values greater than 0.1; the Collinearity Tolerance ranges from 0.325 to 0.681. The assumption of normality was met as assessed by the Q-Q plot. As shown in Table II, three components of user engagement, namely *reward ($p=0.001$), aesthetics ($p<0.005$)* and *usability ($p=0.008$),* (except *focused attention, $p=0.096$*) significantly predicted *perceived high visual aesthetic quality* of the game user interface, $F(4, 34)= 7.739$, $p<0.005$. R^2 for the overall model was 50.8% with an adjusted R^2 of 44.2%, a large effect size according to Cohen (1988).

TABLE II. PEARSON CORRELATIONS COEFFICIENTS BETWEEN HIGH VISUAL AESTHETIC QUALITY INTERFACE (HQ) AND UES COMPONENTS

	Perceived Visual Aesthetics (HQ)	Aesthetics	Focused Attention	Usability
Aesthetics	0.671**			
Focused Attention	0.226	0.374*		
Usability	0.401*	0.378*	-0.018	
Reward	0.525**	0.590**	0.691**	0.377*

** $p<0.005$; * $p<0.05$

TABLE III. PEARSON CORRELATIONS COEFFICIENTS BETWEEN LOW VISUAL AESTHETIC QUALITY INTERFACE (LQ) AND UES COMPONENTS

	Perceived Visual Aesthetics (LQ)	Aesthetics	Focused Attention	Usability
Aesthetics	0.404*			
Focused Attention	0.440**	0.548**		
Usability	0.222	0.079	0.123	
Reward	0.631**	0.535**	0.606**	0.463**

** $p<0.005$; * $p<0.05$

In the case of the **low visual aesthetic quality**, there was linearity as assessed by partial regression plots and a plot of *studentized* residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.916. Homoscedasticity was present, as assessed

by visual inspection of a plot of *studentized* residuals versus unstandardized predicted values. No evidence of multicollinearity was found, as assessed by tolerance values greater than 0.1. This implies that there was no evidence that two or more independent variables were correlated to each other, as the Collinearity Tolerance ranges from 0.424 to 0.726. The assumption of normality was met as assessed by the Q-Q plot. As shown in Table III, three components of user engagement, namely *reward ($p<0.005$), aesthetics ($p=0.008$)* and *focused attention ($p=0.04$),* (except *usability, $p>0.05$*) significantly predicted *perceived low visual aesthetic quality* of the game user interface, $F(4, 34)= 5.214$, $p=0.003$. R^2 for the overall model was 41.0% with an adjusted R^2 of 33.1%, a medium effect size according to Cohen (1988).

V. CONCLUSION

The above results add an important contribution to the field of HCI. High visual aesthetic quality of game interfaces has an impact on perceived usability, whereas interfaces with low visual aesthetic quality are not perceived to be usable. The results from Table 1 show that visual aesthetic quality had an impact on the *overall user-engagement* which was significantly different in each condition. The high visual quality game interface was more appealing as the colorful and crisp graphics sustained users' interests; the look and feel of the game elements were perceived to be more user usable. Emotional visceral responses, which emanate from our subconscious minds, are elicited by virtue of the game aesthetic quality. Colors, attractiveness and layout are essential design aesthetic elements that can immerse a player during mobile gameplay [46]. The level of overall user-engagement was greater in the high visual aesthetic quality.

Moreover, two components namely *reward* and *aesthetics* were perceived to be significantly different, as part of the engagement level in the two experimental conditions. This implies that a high visual aesthetic game user interface influences users' perception of *endurability*, *novelty* and *felt involvement,* holistically referred as *reward*, signifying that there were aspects of the high visual aesthetic interface that were self-motivating, gratifying, exciting, fun and surprising. This kind of engagement level prompted the users to play the game again in order to derive those unique experiences.

By contrast, the mean value of the two other components of user-engagement, *focused attention* and *perceived usability,* were not significantly different, and were perceived to be equivalent in either game interface. This leads to the conclusion that there are other factors besides visual aesthetics such as game mechanics and game narrative in tablet games that might have influenced *focused-attention* and *perceived usability*.

A limitation of the current study is that it may not be generalizable to other game types due to the relative small sample size. Further research is required to examine how game characteristics and components such as game mechanics and narrative may affect *focused attention* and *usability* in game interfaces. For future work, a larger sample size should be considered, including random selection of participants to increase externa validity of the experiment. This study can also be repeated with different cultural and/or demographic populations. This current study builds upon a previous work in progress research study that was presented at ACHI 2016.

REFERENCES

[1] C. Feijoo, J. Gomez-Barroso and S. Ramos, "An analysis of mobile gaming development: The role of the software platforms," *ICIN*, 11–14 Oct 2010, pp. 1-7.

[2] M. Ziefle, "Information presentation in small screen devices: The trade-off between visual density and menu foresight," *Applied Ergonomics*, vol. 41, no. 6, pp. 719-730.

[3] E. M. Rogers, "'Diffusion of innovations,", 5th ed., Free Press trade paperback ed., 2003.

[4] M. Oshita and H. Ishikawa, "Gamepad vs. touchscreen: A comparison of action selection interfaces in computer games," Proceedings of WASA, Workshop at SIGGRAPH Asia 2012, pp. 27-31.

[5] T. Schiphorst, "soft(n): Toward a somaesthetics of touch," *In ACM CHI EA '09 Extended Abstracts on human factors in computing systems*, Boston, MA, USA, April 04–09, 2009, pp. 2427-2438.

[6] S. Attfield, G. Kazai, M. Lalmas, and B. Piwowarski, "Towards a science of user engagement," In *ACM WSDM'11, Workshop on User Modelling for Web Applications*, Hong Kong, China. February 9–12, 2011, pp. (n.d).

[7] S. Mahlke, "*User Experience of Interaction with Technical Systems*," Ph.D. dissertation, The Technische Universität, Berlin, Germany, 2008.

[8] M. Hassenzahl, "The Effect of Perceived Hedonic Quality on Product Appealingness," *International Journal of Human-Computer Interaction*, vol. 13, no. 4, 2001, pp. 481-499.

[9] M. Hassenzahl, "The Interplay of Beauty, Goodness, and Usability in Interactive Products," *Human-Computer Interaction*, vol. 19, no. 4, 2004, pp. 319-349.

[10] P. van Schaik and J. Ling, "Modelling user experience with web sites: Usability, hedonic value, beauty and goodness," *Interacting with Computers*, vol. 20, no. 3, 2008, pp. 419-432.

[11] M. Hassenzahl and A. Monk, "The Inference of Perceived Usability From Beauty," *Human-Computer Interaction*, vol. 25, no. 3, 2010, pp. 235-260.

[12] K. Overbeeke, T. Djajadiningrat, C. Hummels, S. Wensveen and J. Frens, "Lets make things engaging," in *Funology*: *from Usability to Enjoyment*, Blythe, M.A., Overbeeke, K., Monk, A.F., Wright, P.C, (Eds.) Kluwer Academic, Dordrecht, 2005, pp. 7–17.

[13] J. Forlizzi and S. Ford, "The building blocks of experience: An Early Framework for Interaction Designers," *Proceedings of the 3rd conference on designing interactive systems*: *Processes, Practices, Methods, and Techniques, AC, New York, NY. USA,* 2000, pp. 419-423.

[14] M. Hassenzahl and N. Tractinsky, "User experience - a research agenda," *Behaviour and Information Technology*, vol. 25, no. 2, 2006, pp. 91-97.

[15] P. Desmet and P. Hekkert, "Framework of product experience," *International journal of design,* vol. 1, no. 1, pp. 57-66, 2007.
[16] A. Sonderegger and J. Sauer, "The influence of design aesthetics in usability testing: Effects on user performance and perceived usability," *Applied Ergonomics*, vol. 41, no. 3, pp. 403-410, 2010.
[17] J. Silvennoinen, M. Vogel, and S. Kujala, "Experiencing visual usability and aesthetics in two mobile application contexts," *Journal of Usability Studies, 10*, *(1),* pp.46-62, 2014.
[18] M. Hassenzahl, "The thing and I: understanding the relationship between user and product," In *Funology: from usability to enjoyment,* M. Blythe, C. Overbeeke, A. F. Monk, and P. C. Wright (Eds.) Dordrecht: Kluwer Academic Publishers, 2003, pp. 31–42.
[19] T. Lavie and N. Tractinsky, "Assessing dimensions of perceived visual aesthetics of web sites," *International Journal of Human - Computer Studies*, vol. 60, no. 3, pp. 269-298, 2004.
[20] M. Hassenzahl and A. Monk, "The Inference of Perceived Usability from Beauty," *The Human Computer Interaction,* vol. 25, no. 3, pp. 235–260, 2010.
[21] H. O'Brien and E. Toms, "Examining the generalizability of the User Engagement Scale (UES) in exploratory search,"*Information Processing and Management,* vol. 49, no. 5, pp. 1092-1107, 2012.
[22] B. Carr, "Applying cultural and critical theory to video game aesthetics," *Southern Mass Communication Journal*, vol. 27, no. 3, pp. 1–25, 2012.
[23] D. Norman, D, Emotional Design: *Why we love (or hate) everyday things.* New York: Basic Books, 2004.
[24] E. Amit, S. Gottlieb, and J. D. Greene, "Visual versus Verbal Thinking and Dual-Process Moral Cognition, " in *Dual-Process Theories of the Social Mind*, Chapter 23, J.W. Sherman, B. Gawronski, and Y. Trope, Eds. New York: Guilford Press, 2014, pp. 340-354.
[25] H. O'Brien and E. Toms, "The development and evaluation of a survey to measure user engagement", *J. Am. Soc. Inf. Sci.,* vol. 61, no. 1, pp. 50-69, 2010.
[26] E. Yom-Tov, M. Lalmas and H. O'Brien, *Synthesis Lectures on Information Concepts, Retrieval, and Services*. San Rafael, CA: Morgan and Claypool Publishers, 2014.
[27] D. Cyr, M. Head and H. Larios, "Colour appeal in website design within and across cultures: A multi-method evaluation," *International Journal of Human Computer Studies*, vol. 68, no. 1, pp. 1-21, 2010.
[28] E.N. Wiebe, A. Lamb, M. Hardy and D. Sharek, "Measuring engagement in video game-based environments: Investigation of the User Engagement Scale," *Computers in Human Behavior*, vol. 32, Mar, pp. 123-132, 2014.
[29] H. O'Brien and P. Cairns, "An empirical evaluation of the User Engagement Scale (UES) in online news environments," *Information Processing and Management*, vol. 51, no. 4, Jul, pp. 413-427, 2015.
[30] H. L. O'Brien and M. Lebow, "Mixed-methods approach to measuring user experience in online news interactions," *Journal of the American Society for Information Science and Technology*, vol. 64, no. 8, Aug, pp. 1543-1556, 2013.
[31] H. L. O'Brien and E.G. Toms, "Examining the generalizability of the User Engagement Scale (UES) in exploratory search," *Information Processing and Management*, vol. 49, no. 5, Sep 1, pp. 1092-1107, 2013.
[32] J. Webster and H. Ho, "Audience engagement in multimedia presentations," *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, vol. 28, no. 2, Apr 1, pp. 63-77.
[33] A. Sutcliffe, "Designing for User Engagement: Aesthetic and Attractive User Interfaces," *Synthesis Lectures on Human-Centered Informatics*, vol. 2, no. 1, Jan, pp. 1-55, 2009.
[34] H. L. O'Brien and E.G. Toms, "What is user engagement? A conceptual framework for defining user engagement with technology," *Journal of the American Society for Information Science and Technology*, vol. 59, no. 6, Apr, pp. 938-955, 2008.
[35] R. D. Jacques, "The nature of engagement and its role in hypermedia evaluation and design," Doctoral Thesis. South Bank University, London, 1996.
[36] W. Quesenbery, "Dimensions of Usability: Defining the Conversation, Driving the Process," *Proceedings of the UPA 2003 Conference*, Scottsdale, AZ, June 23-27, 2003
[37] B. Laurel, *Computers as Theatre.* Reading, MA, USA: Addison-Wesley, 1993.
[38] R. Jacques, J. Preece and T. Carey, "Engagement as a Design Concept for Multimedia," *Canadian Journal of Learning and Technology / La revue canadienne de l'apprentissage et de la technologie*, vol. 24, no. 1, Jan 15, pp. 49, 1995.
[39] A. Norman and S.W. Draper, *User Centered System Design*, Hillsdale, NJ: Lawrence Erlbaum, 1986.
[40] H. L. O'Brien and E.G. Toms, "The development and evaluation of a survey to measure user engagement," *Journal of the American Society for Information Science and Technology*, vol. 61, no. 1, Jan, pp. 50-69, 2010.
[41] J. C. Read, S. J. MacFarlane, and C. Casey, "Endurability, engagement and expectations: Measuring children's fun," *Interaction design and children*, vol. 2, pp. 1-23, 2002.
[42] H. L. O'Brien, E.G. Toms, E. K. Kelloway and E. Kelley, *Developing and evaluating a reliable measure of user engagement*, *Proceedings of the American Society for Information Science and Technology*, Columbus, OH, USA, vol. 45, no. 1, 2008, pp. 1-10.
[43] I. Engholm, "Digital style history: the development of graphic design on the Internet," *Digital Creativity*, vol. 13, no. 4, pp. 193-211, 2002.
[44] J. J. Garrett, *The elements of user experience*, 2nd ed., Berkeley, CA: New Riders, 2011.
[45] J. Cohen, *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., New Jersey: Erlbaum: Hillsdale, 1988.
[46] J. Merikivi, V. Tuunainen, and D. Nguyen, "What makes continued mobile gaming enjoyable?" *Computers in Human Behavior*, vol. 68, pp. 411–421, 2017.

 ISBN: 978-1-61208-616-3