

Effective Affective User Interface Design in Games

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Abstract

It is proposed that games, which are designed to generate positive affect, are most successful when they facilitate flow (Csikszentmihalyi, 1992). Flow is a state of concentration, deep enjoyment, and total absorption in an activity. The study of games, and a resulting understanding of flow can inform the design of non-leisure software for positive affect. The paper considers the ways in which computer games contravene the accepted user interface guidelines and how this impacts on flow. The paper also explores the implications for research that stem from the differences between games played on a personal computer and games played on a dedicated console. The paper takes important initial steps towards defining how flow in computer games can inform affective design.

Keywords: games, flow, affect, user-interface design

1. Introduction

The value of affectively designed software increases as computers are continually integrated further into our lives. Designing for function and performance remains important, but increasingly the significance of designing for pleasure is recognised. Designing for positive affect is emerging as an important field of study and researchers interested in affective design face a variety of novel challenges. One important question to explore, at this early stage, is “what factors lead to positive affect in software users?”

The majority of research on non-leisure software design has been directed towards functionality and performance. Evaluation techniques have focused on measures of performance as a means of assessing usability, for example, keystroke analyses and target acquisition tasks (for reviews see Helander, Landauer, & Prabhu, 1997; Newman & Lamming, 1995; and Shneiderman, 1992). Where the relationship between usability and user affect has been considered, the focus has largely been on negative emotions; a need to prevent the user from experiencing negative affect as opposed to a desire to promote pleasurable interactions.

Video games constitute a genre of software in which the user’s affective experience is paramount. If a game does not generate positive emotions in the user, it will not succeed – there is no other reason to play a game. This requirement is one of the major differences between a game and a non-leisure software application. The user’s primary motivation when choosing to play a game is to experience positive affect. As a means of helping the user achieve this sense of positive affect, the game provides the user with a secondary task or goal (e.g., save the princess, annihilate the enemy, win the football game). In contrast to this, most non-leisure software is designed to facilitate the user’s achievement of a pre-existing task or goal (e.g., write a document, produce a web page, create a spreadsheet). The user’s primary motivation is to achieve this goal and the desire to experience positive affect, if considered at all, is secondary to the achievement of the task at hand. It is proposed that researchers in the field of affective design have a great deal of subject matter at their disposal – video games.

1.1. Flow in Games

Attention has recently been directed towards understanding the means by which games generate positive affect in the user. Researchers (Draper, 2000; Jones, 1998; Pausch, 1994; Picard, 1997) have begun to explore the utility of the theory of “flow” (Csikszentmihalyi, 1992) as a means of understanding the popularity of, and positive affect associated with, games. Flow is a euphoric state of concentration and involvement, often claimed to be one of the most enjoyable and valuable experiences a person can have (Csikszentmihalyi, 1992). Almost by definition, a game that is able to create a sense

of flow in the user will be successful, as the user will have a strong sense of involvement and enjoyment when playing the game.

Based on Csikszentmihalyi's (1992) theory of flow, Jones (1998) considered a list of the components of flow and how they are manifested in video games, with the goal of informing the design of learning software. He describes the components and the way they manifest in video games as follows: a task that can be completed (the use of incrementing levels that culminates in completion of the game), the ability to concentrate on the task (the use of detailed worlds that draw the user in), the task has clear goals (consistently present in games although the topic is varied e.g., save the princess, build a civilisation), the task provides immediate feedback (consistently present in games although the form is varied e.g., points, the vanquishing of foes), deep but effortless involvement (a commonly reported experience of game players), exercising a sense of control over actions taken (an important part of most games is mastering the control system), concern for self disappears during flow, but sense of self is stronger after the flow activity (many games use a metaphor which allows greatly reduced concern for self e.g., shooting games, extreme sport games), and sense of duration of time is altered (many games run on an altered time system, but more importantly many gamers report devoting entire nights or weekends to playing games without consciously deciding to do so). In addition to these components, in an article considering the value of flow (and fun) as a software requirement, Draper (2000), suggested that Jones' list should include reference to the sense of engagement experienced during flow.

1.2. Flow and Affective Design

It is proposed that an understanding of the process by which games generate flow could inform the affective design of non-leisure software. As Bergman (2000) points out, the game design and HCI design communities have to date had limited awareness of each other's work. While a great deal of research has been directed towards discovering the features of non-leisure software that lead to maximal functionality and minimal negative user affect, very little research has looked at games. Furthermore, even less research has focused on bridging the gap between these two areas. The present paper represents an attempt to narrow this divide by exploring how games design can inform the affective design of other software applications.

Ultimately, empirical study in the form of user questionnaires and observational studies will provide the most detailed understanding of the association between flow and games. However, as a precursor to such research this paper provides a theoretical consideration of the interaction between flow and games in the context of traditional non-leisure software design. Specifically, this paper will consider whether, and in what way, computer games commonly contravene the accepted user interface design guidelines. In situations where user interface guidelines are contravened to the detriment of the user's experience of flow (or positive affect) insight will be gained into both, the design flaws which have a negative impact on user affect, and the ways that games can be improved. This insight will contribute to the small but growing body of research applying existing HCI knowledge to games design (Bergman, 2000; Johnson, 1998). Furthermore, given that games are fundamentally aimed at generating positive affect, there may be situations where user interface guidelines are contravened in a way that benefits the facilitation of flow. An awareness of such contraventions in games may indicate ways that enjoyment or flow can be improved in some non-leisure software applications. (It is not suggested that the principles of flow should replace existing HCI guidelines. It is hypothesised however, that for certain software applications (e.g., learning programs) greater facilitation of enjoyment and flow may be beneficial).

Extensive research has been conducted regarding effective software interface design. Heuristic evaluation, developed by Nielsen and Molich (1990), is a method for structuring the critique of a system using a set of general heuristics. The heuristic evaluation method requires a group of people to act as evaluators and independently critique a system and suggest usability problems. The evaluators use the list of heuristics to generate ideas while critiquing the system. The heuristics are as follows: visibility of system status, match between the system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, the need to help users recognise, diagnose and recover from errors, and the need to include help and documentation (for further detail on the heuristics see Nielsen & Molich, 1990; Nielsen, 1994a; Nielsen 1994b). Nielsen and Molich's guidelines for heuristic evaluation were considered appropriate for use in the present study as they provide a broad overview of interface design and because they are task-free which allows them to be applied universally to a variety

of games. It should be noted that since only person evaluated the games, the research done in this study is not intended to be a heuristic evaluation per se.

2. Present Study

The first author (who has extensive experience with computer games) undertook a review of a variety of games with the goal of identifying where and how games tended to contravene the user interface guidelines associated with heuristic evaluation. The review extended to games available on both personal computers (PC) and home consoles, for example, Sony Playstation™ and Sega Dreamcast™, as the majority of games are played on these platforms (Henry & Hause, 1999). The analysis was limited to situations where the guidelines were contravened in a manner that effected flow (or the user's experience of positive affect). An attempt was made to identify contraventions that facilitated flow and contraventions that prevented flow. The heuristics were used largely as a guide or starting point (as recommended by Dix et. al., 1998) and as such the problems identified are not necessarily linked solely to any specific heuristic.

2.1. Games Design that Interferes with Flow

Games often fail to satisfy the need for error prevention. One area in which this is generally seen is menu design. Many games have menus that are poorly and non-intuitively organized leading to confusion as to where a particular option can be found. Moreover the readability of menus in games is often sacrificed for aesthetics. Game menus generally look very attractive and suit the theme of the game well, however animations and eye-catching colours are often used at the expense of functionality. Anytime the user interacts with the menu system frustration may result. If the user wishes to access the menu during gameplay, this frustration is likely to break the flow experience.

Another common mistake in games design is the failure to achieve flexibility and efficiency by forcing the user to wait. Most games include movies (or animations) that open the game, link levels and generally provide ambience and context. However, often it is not possible to skip these movies. Even when it is possible to skip the movies the user must wait for the entire movie to load before telling the game not to screen it. Loading time can also be an issue when the user makes an error. The loading of the next scene of a game is generally dependent on the user taking a certain action (e.g., picking up an object, walking through a door). However, if the user takes an action by accident (which leads to the loading of the next scene), there is very rarely a way to cancel or undo the action. The user must wait for the new scene to load, then, if possible, reverse the action and wait for the original scene to reload. Perhaps the most destructive form of forcing the user to wait, in terms of interfering with flow, is forcing the user to reconfirm all options and selections at the conclusions of each game event. For example, in a particular car racing game reviewed for this paper an individual race may last between 2 and 15 minutes, irrespective of whether the user is successful in the race or not, at the conclusion of the race she is sent to a certain point in the game. To reattempt the same race, with the same settings (a common desire when the objective is failed), requires 18 button presses and over a minute of waiting. These situations, in which the user is forced to wait, are inherently frustrating, and moreover, they erode the user's sense of control of the environment, which further detracts from the flow experience.

The concept of online help is often ignored in games. Most games include an online explanation of the control system, but rarely is a soft version of the manual incorporated. If the user seeks information contained in the documentation they must remove themselves entirely from the game environment and consult the hardcopy of the manual. This forced departure from the game environment interferes with the sense of engagement inherent in flow.

The facilitation of flow in games is also often hindered by a failure to develop and adhere to platform conventions. For example, many games allow the user to restart an event before the natural conclusion of that event. When such an option is unavailable in a game, users may feel cheated and frustrated. Similarly, most multiplayer games allow two users to compete using the same character, thereby allowing an inherent equality to be incorporated in the competition if so desired. Once again, the failure to include this feature in competitive games can lead to negative affect on the part of the user.

2.2. Implications for Affective Design

The identification of these areas in which games commonly breach user interface guidelines at the expense of flow suggests ways that games can be improved. Moreover, it is proposed that some of these issues (and the need to avoid them) may prove to be relevant to the affective design of certain non-leisure software applications (for example, learning and educational programs). Although

traditional HCI guidelines identify the aforementioned design errors, that fact that they simultaneously interfere with flow highlights the need to avoid such errors when designing for positive affect.

2.3. Game Design that Facilitates Flow

It is perhaps unsurprising to realise that contraventions of HCI guidelines in games (as mentioned above) can interfere with flow, it is interesting however, to note that there exist contraventions of the HCI guidelines that facilitate flow in games. For example, many games provide minimal information to the user during actual gameplay. The vast majority of games are based on a structure whereby the user interacts with the system to set all options and preferences prior to commencing gameplay. During gameplay a minimum amount of information is displayed to the user, and often it is possible to elect to further decrease the amount of information displayed if so desired. Indeed, recently games have been released with the interface virtually absent during gameplay (for example, Lionhead Studios' game *Black and White*, copyright 2001). The entire screen is taken up with the action occurring and the user must deliberately request all other information. It is hypothesised that this focus on, and lack of distraction from, the major task contributes to the facilitation of flow. Immersion in the game is promoted when all distractions are removed.

Games also often display a context-dependant inconsistency in control systems. For example, the button for jump when on land may also be the button for swim towards the surface when underwater. On console games this is usually a necessity that results from limited button availability, however, this also occurs in PC games where a multitude of potential buttons are available. The use of a small core set of buttons leads to inconsistency but it has the advantages of requiring less cognition and promoting a sense of control on the part of the user. The user need only remember, for example, that button A generally means take an action with my hands (e.g., open the door, pick up the item) while button B means move downwards in some way (crouch on land or dive when underwater). With less cognition required for remembering or finding input commands, the user is better able to achieve concentration and engagement, and thereby flow, when completing the task.

The idea that wherever possible users should be prevented from making errors is largely contradictory to the manner in which games promote flow and positive affect. When playing a game, part of the challenge for the user is the fact that mistakes must be avoided. (This statement may seem contradictory to the assertions made regarding errors in section 2.1. However, there the focus is errors made while navigating the menu, the focus here is errors made during gameplay). During gameplay, the joy of success is dependant upon the possibility of failure. As Bergman (2000) points out (p. 301) "the pleasure of mastery only occurs by overcoming obstacles whose level of frustration has been carefully paced and tuned to not be excessive or annoying yet be sufficient to give a sense of accomplishment". It should be noted that not all games consistently achieve this difficult goal and many games are criticised for being too easy or too difficult.

2.4. Implications for Affective Design

These contraventions of the heuristics, that facilitate flow, suggest potential starting points for affective design. For example, in many non-leisure software applications the default settings involve the display of a fairly large amount of information – the design of games (which provide minimal information during gameplay) raises the question of whether this decreases the likelihood of flow for the user of non-leisure software. Similarly, the mapping of several commands to a particular input may prove beneficial to a subset of non-leisure software applications. In educational programs, for example, the decrease in cognition required for remembering or finding input commands may facilitate a sensation of flow. Furthermore, any decrease in the cognition required for interacting with the interface can be focussed on content, which will ultimately assist learning. Finally, the relationship between frustration and flow in games raises the question of whether the potential for errors on the part of the user can have any benefit in non-leisure software. This is not to suggest that the user interface guidelines encouraging error prevention are questionable or invalid. Rather it is a matter of realising that in some situations, it may promote positive affect in the user if the right decision is made under challenging conditions. Once again, educational software provides a good example, as, in learning environments, flow and a sense of achievement may be more likely to result where errors and mistakes are possible.

Thus, consideration of the relationship between flow and games in the context of existing HCI guidelines raises a number of interesting possibilities for the affective design of non-leisure software. All the findings mentioned above, however, require further research before any firm conclusion can be drawn. One important initial step is to confirm the aforementioned theoretical findings experimentally.

Moreover, the link between flow and games is yet to be experimentally validated. Exploration of the hypothesised links between games design (particularly that which contravenes HCI guidelines) and flow will require the study of users interacting with games. Given the dearth of research on games and game design a number of methodological issues need to be considered. One pertinent methodological issue stems from the fact that games are currently available to users on a variety of platforms. As mentioned, the majority of games are played on PC or home console. However, it may be inappropriate to assume that games are equivalent across platforms.

3. Cross-Platform Differences in Games

The population of console gamers is substantially larger than that of PC gamers. The ratio of console games sold to PC games sold is approximately 2 to 1 (Bergman, 2000). This disparity may be a result of differences across the platforms. Indeed, the relative merits of the two platforms have long been a hotly debated topic in gaming communities (e.g., Bateman & Matthews, n.d.). It has often been argued that the content and style of the games available for each platform differ; that consoles are dominated by action games whereas PC games tend to be more cognitively challenging (Bergman, 2000).

There are also cross-platform differences in terms of the means of interaction provided to the user.

Users of PCs largely rely on the use of a keyboard and mouse, whereas when playing a game on a console, the user communicates with the system using a controller (or joystick). While controllers are available for use with PCs and many of the latest consoles support mouse and keyboard input, the platforms are less commonly used with their respective alternative input devices. Moreover, games for each platform are almost exclusively authored with the more common input devices in mind.

In light of these differences and the fact that the majority of non-leisure applications are used on PCs, it could be argued that research exploring how game design and flow can inform the design of non-leisure software should be limited to the study of games on PCs. Although focusing on PC games would have the advantage of simplicity there are certain disadvantages inherent in ignoring console games in this field of study. Given the potential cross-platform differences in audience and game style, it is possible, for example, that console games generate flow to a far greater extent than PC games. Moreover, exploration of the exact nature and impact of the cross-platform differences may prove informative. Finally, on a strictly pragmatic level, as the number of console gamers is approximately twice the number of PC gamers, researchers will have a far larger population to study if research is not limited to the consideration of PC games.

4. Follow-up Study

Given the advantages of including console games in future research it is important to explore the nature of the existing cross-platform differences. A comprehensive comparative review of games available on each platform, supplemented with extensive user interviews would allow the most informative exploration of this issue. Given the dearth of research in this area, however, it was considered prudent to begin with a smaller pilot study in order to identify the relevant issues and areas of interest.

A comprehensive analysis was conducted that compared two games that are available on both PC and console (thus, a total of four games were studied; two titles across the two platforms). The titles analysed were Tony Hawk Pro Skater 2 (copyright 1999, 2000 Activision; hereafter referred to as Game A) and Quake 3 Arena (copyright 2000 id Software; hereafter referred to as Game B). All four user interfaces were fully mapped and compared. That is, each screen displayed in a game was reproduced using paper and pencil and then points where cross-platform differences arose were noted. The goal of the analysis was simply to identify where and how the user interfaces differed across platform. Four subjects who had not played the games on either platform before were given time to play the games and their experiences were assessed through a semi-structured informal interview. (Inexperienced subjects were used, as most potential subjects who had played the games before, had played exclusively on one platform. It is believed that such subjects would be predisposed to preferring the familiar platform to the unfamiliar one). The case study was design to explore whether user's affective experiences differed across platforms.

4.1. Cross-Platform User-Interface comparison

Many of the differences discovered were content related, that is they resulted from the need to offer different options and preferences across the platforms. For example, in Game A for the Sega Dreamcast™ there is no need to offer keyboard set-up options. Similarly, in Game B for the PC there is no need to include a single screen allowing for up to four users to join the game, as in a multiplayer

game played across PCs each player would have their own computer. Differences such as these are to be expected and are relevant to research in this area in as much as they highlight the fact that the interfaces will differ as a function of the platform they are provided on.

Beyond these basic content differences there exists the possibility of substantive design differences. Analysis of Game A revealed no such differences, however there were several substantive design differences across platform in Game B. The menu system in Game B is reasonably complex with a large variety of options and preferences available to the user. Generally, the Sega Dreamcast™ version of Game B appears to be far less effectively designed. The PC version of game B consistently provides the user with more useful information than the console version, and the information is laid out in a far more understandable and intuitive style. For example, in one section of the setup menu, Game B offers 5 subcategories each containing several options. On the PC these 5 subcategories appear running down the left of the screen. When selected these subcategories remain on screen and the options included within appear on the right of the screen. The same content on the Sega Dreamcast™ is represented very differently. The 5 subcategories never appear on screen simultaneously. The user must recognise that the name of the first subcategory, which appears at the top of the screen, is actually a sub menu that can be manipulated to access the other four subcategories and their associated options. This is done by highlighting the name of the first subcategory and pushing left or right on the controller to scroll through the other available subcategories, the associated options then appear below each subcategory. It is suggested that this is a far less intuitive and understandable design that is likely to lead to frustration on the part of the user.

In the interest of further exploring this difference a small user evaluation was undertaken with two subjects who were asked to perform a task that involved negotiating the menu in question. When interacting with the Sega Dreamcast™ both users spoke of confusion when trying to find the option they were looking for. Moreover, both users made negative comments about the design of the interface when they realised what was required to access the subcategories. Such confusion and negative affect did not arise when the users interacted with Game B on the PC.

The aforementioned cross-platform differences were all found within the menu system that is presented to users prior to actual gameplay. In terms of the interface displayed while gameplay is occurring both games were identical across platform. The input devices and associated controls differed, but the nature of the gameplay and it's onscreen representation were the same.

4.2. Implications for Affective Design

These findings suggest that researchers interested in studying affective design in games (whether to improve games or other software applications) need to be aware that the menu systems (separate to the actual gameplay) can differ substantively across platforms. These differences are not limited to what could be expected based on physical differences between the platforms. Rather they extend to variations that can influence the affective impact of the games. It could be concluded that researchers interested only in the actual gameplay component of games may find very little evidence of cross-platform differences. However this ignores the possibility (dealt with in the next section) that although the gameplay looks identical across platforms, the differing input devices may make the games a qualitatively different experience in terms of user affect.

4.3. Cross-Platform Case Studies of User's Affective Experience

Four inexperienced users were asked to play Game A and Game B on a Sega Dreamcast™ console and on a personal computer (the computer had a Pentium III 733mhz processor, 256mb ram, a 32mb video card and a 16 bit sound card). The users were inexperienced in that they had played neither Game A nor Game B before, and they all reported that, on average, they played games for less than half an hour a week. The subjects were a 25 year old male (referred to as m25), a 35 year old male (m35), a 23 year old male (m23), and a 33 year old female (f33). All subjects played one title on both platforms and were interviewed regarding that title, they then played the other title on both platforms, and were interviewed regarding the second title and the differences between their experience of the platforms overall. The order of the titles played and the platform on which the games were played were counterbalanced across subjects. Subjects were provided with an instruction sheet for each game which consisted of a diagram of the relevant control device with commands mapped to input points. During the semi-structured informal interview subjects were asked to report on their experience of the game on each platform, if they felt they were different, if they enjoyed one more than the other and

why, and which they would prefer to play in the future. The subjects were given a great deal of freedom in the interviews and encouraged to discuss any aspect of the games that came to mind.

Subjects expressed a strong preference for each game on one platform or the other. All subjects preferred game B on the PC and indicated that were they to play game B again they would prefer to play it on the PC, however opinions on Game A varied. In expressing their preference subjects made affect laden comments, for example, when discussing game A m23 mentioned "... I can see that the game looks a little better on the computer, but playing on the [Sega] Dreamcast is still more fun", and f33 espoused, "...I had a good time playing both ...but, [Game A] was more satisfying on the computer". The interviews conducted supported the general notion that games are a software application that successfully generates positive affect in users. However, researchers exploring affective design should be aware that the degree of positive affect generated for particular users can vary across platforms.

All subjects made unprompted direct references to the control system in the discussion of each game. This is perhaps unsurprising given that the gameplay itself is identical across platforms and hence, the most obvious difference is the input device. However, it highlights the relevance of the input device to the affective experience of a game and supports Jones' (1998) hypothesis that a sense of control is an important prerequisite for the achievement of flow. In discussion of game B, all users were positive about the control system on the PC relative to the control system on the Sega Dreamcast™. For example when discussing game B, m25 stated "... just easier to co-ordinate your hands on the PC version ...", and 35m espoused that "... the movement keys on the computer were easier to get hold of". There was far less consensus regarding the relative merits of the control systems for game A. For example, m23 mentioned "... [game A] ... felt more natural with the [Sega Dreamcast™] controller ... easier to work out what to do ... more fun", whereas, m35 felt that "... really prefer the computer 'cause the movement on the [Sega] Dreamcast is really hard to control ... sloshing all over the place ... computer was much better". Thus, it does not appear to be a simple matter of certain games suiting particular control systems. Nor do particular users prefer one control system to the other irrespective of the game.

The comments made by subjects also support the idea of a state of flow during gameplay. Although arguably the subjects may not have had time to experience flow during the case study, the comments made often implied an expectation that flow could or would occur during gameplay. When discussing the relative cross-platform merits of game A, m35 stated "... feel like the learning curve on the computer would be less ... but the [Sega] Dreamcast is likely to become a more immersive environment...". Similarly, m25 espoused that "... the [Sega] Dreamcast version was better at drawing me in ... I felt more involved...". The subjects indirectly alluded to the presence of certain components of flow during gameplay, in the absence of any knowledge of the relevance of flow to the study.

4.4. Implications for Affective Design

These results provide interesting insights for researchers exploring affective design. A variety of comments were made which stated or implied the experience of positive affect while playing the games. These comments support the basic assumption that games are a software application that can generate positive affect and thus, that research on games is likely to be informative for the design of non-leisure software. Moreover, the results of the present study raise the possibility that for different users, certain games are more enjoyable with certain control systems. The use of the mouse and keyboard is standardised across the majority of software applications, however the present study supports the idea that for some users increased positive affect may result from an alternative input device. Subjects also made spontaneous remarks that implied that flow could result from playing the games, highlighting the value of further research on the presence and precursors of flow during gameplay. Knowledge of the precursors of flow would benefit research on the generation of positive affect in non-leisure software applications.

Considering the results of the two studies together (the user-interface comparison and the user evaluation) it becomes clear that important cross-platform differences exist. The pre-gameplay user-interfaces differ and although the user-interfaces displayed during gameplay appear equivalent, users' affective experience of gameplay tends to differ across platform.

5. Conclusions

It is important to explore the factors that lead to positive affect in software users. This paper attempts to facilitate this exploration by considering some of the initial issues. Games are a software genre that can potentially contribute a great deal to the study of affective design as they contravene the accepted user-interface guidelines in a way that promotes positive affect and flow on the part of the user. These contraventions suggest ways in which certain software applications, particularly educational software, could be more affectively designed. Overall, there is evidence to support the further study of games as a means of understanding flow in software users.

The paper provides evidence to show that researchers interested in the ways games can inform affective design should be aware of the cross-platform differences that exist. Substantive design differences exist such that, a particular title cannot be considered to be identical on different platforms. Moreover, users' affective experiences of particular titles tend to differ across platforms.

5.1. Future Research

Further research is needed in order to validate and generalise the findings listed above. To date all research regarding the association of flow and games has been theoretical. Empirical evidence of this association would provide converging evidence for the existing theory and allow for more in-depth exploration of the causes and pre-requisites of the relationship. A deeper understanding of flow in games will contribute greatly to research on affective design. The value of such research is undeniable; after all, what is more important than a good time for the user?

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