Pervasive Game Flow: Understanding Player Enjoyment in Pervasive Gaming

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Player enjoyment is perhaps the most important issue in successful game design, but so far it has not been addressed in the area of pervasive games. Departing from the general gameflow model, this article presents an initial outline for a new model of pervasive player enjoyment, that is, the *pervasive gameflow model*, which is described and discussed in terms of additions and elaborations to the general gameflow model. It is intended to serve as a departure point for further empirical studies on player enjoyment in pervasive games.

Categories and Subject Descriptors: H.1.2 [**Models and Principles**]: User/Machine Systems—*Human factors*; H.5.1 [**Information Interfaces and Presentation**]: Multimedia Information Systems—*Artificial, augmented, and virtual realities*; H.5.2 [**Information Interfaces and Presentation**]: User Interfaces—*Evaluation/methodology, User-centered design*; J.7 [**Computer Applications**]: Computers In Other Systems—*Consumer products*

General Terms: Human Factors, Performance

Additional Key Words and Phrases: Pervasive gaming, gameplay, enjoyment, flow, evaluation

ACM Reference Format:
Jegers, K., 2007. Pervasive game flow: understanding player enjoyment in pervasive gaming. ACM Comput. Entertaint. 5, 1, Article 9 (January 2007), 11 pages. DOI = DOI 10.1145/1219124.1219133 http://doi.acm.org/ 10.1145/ 1219124.1219133

1. INTRODUCTION

Understanding what makes players enjoy a game is perhaps the most important issue in successful computer game design. The importance of this issue is specifically highlighted in the relatively new and evolving area of pervasive games. In order to successfully survive and transform into a mass-market phenomenon, commercial pervasive games must be designed on a solid knowledge of those qualities that cause people to enjoy this unique type of game. From a research perspective, an understanding of player enjoyment enriches the evaluation of experimental pervasive game prototypes and concepts. In addition, understanding player enjoyment in pervasive games allows us to also understand user experiences derived from use of pervasive technology in general. This is very important, since pervasive computing will eventually become an everyday phenomenon. In the literature on pervasive gaming, we find related work on technological, software architectural, and social/contextual dimensions [Benford et al. 2005; Björk et al. 2002; Cheok et al. 2002; Flintham et al. 2003; Magerkurth et al. 2004; Manninen 2002], but none of the related studies address player enjoyment explicitly.

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Hence we may conclude that there is a need for studies that establish a model for understanding player enjoyment in pervasive games. The gameflow model [Sweetser and Wyeth 2005] has recently been introduced in order to increase understanding of player enjoyment in traditional computer gaming. In this article the gameflow model is evaluated in relation to pervasive games. The purpose of this article is to conceptually and theoretically analyze and elaborate the gameflow model in terms of its applicability to pervasive gaming, and to present an initial model of pervasive player enjoyment.

2. MODELS OF USER ENJOYMENT

In the area of human-computer interaction (HCI) research, we find a number of different approaches to understanding user experience, but relatively few that specifically address user enjoyment. In traditional usability studies, user satisfaction [Nielsen 1993] is measured by means of questionnaires, whose focus is usually on aspects of importance for ensuring high productivity in the use of software. The overall goal of ensuring productivity is clearly different from that of designing for player enjoyment, which makes this approach less suited for understanding player enjoyment in pervasive games. The concept of playability, or the usability of computer games [Desuvire et al. 2004; Federoff 2003] provides an approach to understanding the important factors in designing and evaluating computer games. The three main aspects of this concept are the interface, mechanics, and gameplay, and are manifested in various heuristics and frameworks. While these aspects are of great importance for successful game design, they are focused on the software system and the overall player-game interaction during gaming sessions, and not specifically on player enjoyment. Unlike the previous approaches, the gameflow model [Sweetser and Wyeth 2005] gives a framework that specifically addresses player enjoyment, and thus seems like a very promising approach to understanding it in pervasive gaming as well. The gameflow framework is described in the next section.

2.1 The Gameflow Model for Player Enjoyment

Gameflow [Sweetser and Wyeth 2005] is based on two cornerstones: the theory of flow [Csikszentmihalyi 1990] integrated with appropriate criteria from computer game usability and user-experience literature (for a complete list of sources, see Sweetser and Wyeth [2005]). Briefly: flow theory [Csikszentmihalyi 1990] describes the fundamentals of an optimal experience of enjoyment that is the same in contexts and cultures the world over and is independent of any particular activity. An experience of flow is made up of eight elements:

a task that can be completed;
the ability to concentrate on the task;
concentration is possible because the task has clear goals;
concentration is possible because the task provides immediate feedback;
ability to exercise control over actions;
deep but effortless involvement that removes awareness of frustrations of everyday life;
concern for self disappears, but a stronger sense of self emerges afterwards;
sense of the duration of time is altered.

The gameflow model consists of eight core elements (derived from computer game literature), which in turn are based on a number of criteria related to flow elements. The core elements are concentration, challenge, skill, control, clear goals, feedback, immersion, and social engagement. Mapping flow via the gameflow model is described

Table 1.The GameFlow Model, from Sweetser and Wyeth [2005]

Element	Criteria
Concentration Games should require concentration and the player should be able to concentrate on the game	- games should provide a lot of stimuli from different sources - games must provide stimuli that are worth attending to - games should quickly grab the players' attention and maintain their focus throughout the game - players shouldn't be burdened with tasks that don't feel important - games should have a high workload while still being appropriate for the players' perceptual, cognitive and memory limits - players should not be distracted from tasks that they want or need to concentrate on
Challenge Games should be sufficiently challenging and match the player's skill level	- challenges in games must match the players' skill levels - games should provide different levels of challenge for different players - the level of challenge should increase as the player progresses through the game and increases their skill level - games should provide new challenges at an appropriate pace
Player skills Games must support player skill development and mastery	- players should be able to start playing the game without reading the manual - learning the game should not be boring, but be part of the fun - games should include online help so players don't need to exit the game - players should be taught to play the game through tutorials or initial levels that feel like playing the game - games should increase the players' skills at an appropriate pace as they progress through the game - players should be rewarded appropriately for their effort and skill development - game interfaces and mechanics should be easy to learn and use
Control Players should feel a sense of control over their actions in the game	- players should feel a sense of control over their characters or units and their movements and interactions in the game world - players should feel a sense of control over the game interface and input devices - players should feel a sense of control over the game shell (starting, stopping, saving, etc.) - players should not be able to make errors that are detrimental to the game and should be supported in recovering from errors - players should feel a sense of control and impact onto the game world (like their actions matter and they are shaping the game world) - players should feel a sense of control over the actions that they take and the strategies that they use and that they are free to play the game the way that they want (not simply discovering actions and strategies planned by the game developers)
Clear goals Games should provide the player with clear goals at appropriate times	- overriding goals should be clear and presented early - intermediate goals should be clear and presented at appropriate times

Feedback Players must receive appropriate feedback at appropriate times	- players should receive feedback on progress toward their goals - players should receive immediate feedback on their actions - players should always know their status or score
Immersion Players should experience deep but effortless involvement in the game	- players should become less aware of their surroundings - players should become less self-aware and less worried about everyday life or self - players should experience an altered sense of time - players should feel emotionally involved in the game - players should feel viscerally involved in the game
Social Interaction Games should support and create opportunities for social interaction	- games should support competition and cooperation between players - games should support social interaction between players (chat, etc.) - games should support social communities inside and outside the game

in Table I. The model includes an overall goal (the Element) and a set of central criteria that can be used to design and evaluate computer games.

3. ADDING THE PERVASIVE DIMENSION

To analyze the gameflow model in relation to pervasive games, we need to highlight some distinguishing characteristics and features of pervasive games. Considering some experimental prototypes and studies in related work [Benford et al. 2005; Björk et al. 2002; Cheok et al. 2002; Manninen 2002], we see three major characteristics, which, to various extents, appear in pervasive games. The experimental games all draw on one or several of the following dimensions: mobile/place-independent gameplay, social interaction between players, and integration of the physical and virtual worlds. Since the gameflow model of player enjoyment was originally developed from a foundation of research on traditional computer games, it is of great importance to clarify how the gameflow elements and criteria deal with unanticipated factors in pervasive games. In the following sections, the three dimensions of pervasive games will be elaborated and discussed in relation to traditional computer games to establish some initial criteria for comparison. The criteria will then be applied to the gameflow model to analyze its suitability for understanding player enjoyment in pervasive gaming.

3.1 Mobile/Place-Independent Gameplay

The place-independence of pervasive games implies that computer gaming may now be pursued not only in the relatively stable contexts of desktop computers, game consoles, and arcade halls, but potentially in all possible contexts of everyday life. Drawing on integrated platforms of mobile and desktop computing technology, pervasive games can implement game designs where the player have access to the game in virtually all everyday contexts and environments at all times. The ability to provide place- and time-independent gameplay allows for new kinds of game designs, where an ongoing game may be picked up by players at different times and situations. Instead of isolating gameplay to specific environments and limited sessions, as in the case with PC and console games, pervasive games allow greater degrees of freedom and new kinds of playing behavior often characterized as anytime, anywhere, gaming.

3.2 Social Interaction Among Players

Instead of providing challenges and experiences through various AI and pre-programmed solutions, designers of pervasive games often make extensive use of players in the final stages of the design process. By drawing on massively multiplayer solutions or on small-scale interactions among a few players, pervasive game design makes the social interaction among players the core of pervasive gameplay. Instead of presenting the players with fixed scenarios, pervasive games make use of the social factors and creativity of the players by giving them some overall goal(s) and tools for interaction and then leaving the field open for the players. The use of social interaction among players is not unique to pervasive games (cf. massively multiplayer online role-playing games), but the extent to which some of the pervasive games use the dimension of social interaction is unique.

3.3 Integrating Physical and Virtual Worlds

A common feature of pervasive games, not implemented in computer gaming previously, is the integration of the physical and virtual worlds when creating a game world. By placing virtual objects at physical locations or by enhancing physical locations with information presented in the virtual world, pervasive games expand the use of both the physical and the virtual in game design. Traditional computer games have a clear focus on the virtual world, as they build their game worlds almost exclusively on the virtual dimension.

4. FROM GAMEFLOW TO PERVASIVE GAMEFLOW

In this section, we extend the gameflow model to include and counter the specific aspects of modern computer gaming that are related to pervasive games. Emphasis is on identifying those parts, elements, and criteria of the gameflow model that may be problematic or need to be elaborated from a pervasive gaming perspective. First, the discussions and elaborations are presented in a structure that follows the elements of the gameflow model. An expanded table of elements and criteria then summarizes the discussions and presents some additional and elaborated aspects, forming an outline for a new model for understanding player enjoyment in pervasive games, that is, the *pervasive* gameflow model.

4.1 Concentration

Instead of suggesting the total elimination of surrounding distractions in order to concentrate on gameplay, a pervasive game should help the player divide his attention between in-game tasks and those in the surrounding environment, outside the game. Two gameflow criteria, i.e., *that players should not be distracted from tasks that they want or need to concentrate on and that games should quickly grab the player's attention and keep his focus throughout the game*, could be considered somewhat problematical in relation to the vision of anytime, anywhere gaming (place/time-independent gameplay) upheld by pervasive gaming. The gameflow model implies that

> "during play, distractions from major game tasks should be minimized by reducing nongame-related interactions and reducing the game interface to maximize the amount of screen taken up with game action" Johnson and Wiles, quoted in Sweetser and Wyeth [2005]

This is valid in traditional gaming contexts where the player is seated in front of a desktop computer or a console, but becomes problematic when the player interacts in a pervasive game in an everyday life context. Some of the everyday context distractions (e.g., alerts from surrounding traffic or objects such as fences or icy sidewalks) are of

much greater importance than any part of a gaming experience, and need to be monitored by the player even while playing a pervasive game.

4.2 Challenge

In the gameflow model, two criteria for the challenge element need to be enhanced to make it more suitable for pervasive gaming. In gameflow

> "the level of challenge should increase as the player progresses through the game… and the game should provide new challenges at an appropriate pace." Further, "games should present the players with an appropriate series of distinct and challenging situations (Smith, 1999) that are calculated from careful level and obstacle design." Pagulayan et al., quoted in Sweetser and Wyeth [2005]

These criteria are problematic, considering that the premise in pervasive gaming is that social interaction among players is the most important driving force in gameplay. When the development of a game and a game scenario become user-driven, as intended in pervasive gaming, the community of players will be in charge of the game world. Then the role of the game designer will be to provide the players with appropriate support for developing and managing their own gameplay experience. In this situation, pre-programmed scenarios, levels, obstacles, and pacing become subordinate to the pervasive gaming vision of social interaction among players. Instead of controlling the pace and level of challenge to the players, pervasive games should stimulate and support the players in their own creation of game scenarios and pacing. Pervasive games should help the players keep a balance in the creation of paths and developments in the game world, but not put too much control or constraints on the evolution of pacing and challenges.

4.3 Player Skills

From a pervasive gaming perspective, the player skills element seems unproblematic and relevant. However, one criterion for developing player skills, i.e., that *games should increase the player's skills at an appropriate pace as he or she progresses through the game,* needs to be elaborated in line with the discussion around the challenge element (see above). When progress in the game is player-driven, the game should be very flexible and enable a player's skills to be developed at a pace set by the player rather than presenting him or her with a fixed and preprogrammed structure.

4.4 Control

The control element has some criteria that need to be adjusted to suit pervasive games. The criterion that *players should feel a sense of control over the game shell (starting, stopping,, saving)* becomes problematic for pervasive gaming's place/time-independent requirement and the constant and ongoing gameplay this implies. An elaboration of the criterion above states that

> "[the players should be allowed to] turn the game on and off [Desurvire et al. 2004] and save the game in different states. These capabilities give players control over the game shell and the freedom to explore the game at their own pace [Federoff 2002]." in Sweetser and Wyeth [2005]

These recommendations would be difficult to carry out in a pervasive game that aims toward place/time-independent gameplay. Instead of offering the traditional shell control, pervasive games should enable the players to join a game easily in a constantly ongoing game and quickly get a picture of the current status of the game world (to assess how the game has evolved since the player's last visit).

4.5 Clear Goals

The criterion that *intermediate goals should be clear and presented at appropriate times* could be somewhat problematic, since it depends on a preset and controlled structure for

the game narrative. When social interaction is the driving force in a pervasive game, the role of the game changes to supporting the players in the creation of their personal intermediate goals. Personal goals could also be shared among a group of players in a framework of social interaction, which the game must then support. Thus, a pervasive game should support players in forming and communicating their own intermediate goals.

4.6 Feedback

From a pervasive gaming perspective, this element seems rather unproblematic, and is not currently in need of further elaboration.

4.7 Immersion

The immersion element becomes very interesting in contexts where the place/time-independent gameplay and integration of physical and virtual worlds aspects of pervasive gaming are considered in relation to the gameflow model. The criterion that *players should become less aware of their surroundings* becomes interesting from a pervasive gaming perspective. Elaborating on the gameflow model's criteria, it is stated that

> "games are often seen as a form of escape from the real world or social norms, or as a way to do things that people otherwise lack the skills, resources or social permission to do [Lazzaro 2004]." in Sweetser and Wyeth [2005]

When we try to relate the criterion above to the goals of integrating the physical and virtual worlds and to place/time independent gameplay, we encounter two major problematic and interesting aspects. First, the immersion referred to in the criterion mostly occurs in traditional HCI contexts in which a player sits in front of a desktop computer or a console in a private environment where the interface is limited to the game screen and controls and the game world appears only on the computer/console screen. In order to be immersed in the game world, the player must focus completely on what happens on the screen. When the game world changes from being completely virtual and visible only on screen, physical world settings such as streets, parks, diners, and town centers become difficult to incorporate and the immersion referred to in the gameflow model becomes difficult to support. Since the player might have to move physically in order to move in the virtual game world, the player's focus will constantly shift between the virtual world and the physical one. When the game world's surroundings actually become an important part of the game world, it becomes important for the player to keep track of them. Escape from real-world social norms (supported by the loss of awareness of one's surroundings) becomes very different in the case of pervasive gaming compared to traditional computer gaming. The virtual world supported by the computer or console is clearly separate from the contexts of the everyday world, which makes escape from social norms and other difficulties possible and convincing. When a pervasive game mixes the physical and the virtual worlds and enables anytime, anywhere gameplay, the everyday social norms and the game world become (in some cases) difficult to separate. The player of such a pervasive game will have to move between different social contexts in the everyday world. By necessity, the player must take into consideration and focus on not only the social world and norms upheld by the virtual parts of the game world, but also norms in the everyday world. An unexpected and incorrect action performed in a public space will always violate the current norm system in that space, even if it is the result of following the norms of a pervasive game. This mix of "real" everyday social norms and rules and the rules of the game world need to fit perfectly so as to support the

integration of the physical and virtual worlds. Hence pervasive games should support a seamless transition between different everyday contexts, and not imply or require player actions that might result in a violation of social norms in everyday contexts. Further, pervasive games should enable the player to shift focus between the virtual and physical parts of the game world without losing too much of the feeling of immersion.

4.8 Social Interaction

The gameflow criteria regarding social interaction are all very general, and in some way or other applicable to most computer games. When we consider the extensions to the criteria, however, it becomes obvious that they are too limited to absorb the full complexity of using social interaction as the driving force in gameplay, which pervasive gaming envisions. According to the extensions to gameflow criteria, games

> "should create opportunities for player competition, cooperation and connection" Lazzaro 2004 and Pagulayan et al. 2003, in Sweetser and Wyeth [2005]
> and further that "a game should support social interactions through chat and online boards" Lazzaro 2004 in Sweetser and Wyeth [2005]

To summarize the elaborations to the gameflow model criteria, we can conclude that the criteria are either too general to really say something substantive about social interaction as the driving force in gameplay (or about what would constitute good social interaction), or too focused on aspects outside the actual game system. In order to better suit the idea of pervasive games, the criteria should be refined and more focused on the quality and purpose of social interaction. A pervasive game should support and enable possibilities for game-oriented, meaningful and purposeful social interaction within the gaming system. The games should not only support features for communication among players, but should also incorporate triggers and structures (e.g., quests and events, factions, guilds, or gangs) that motivate the players to communicate and interact socially.

5. PERVASIVE GAMEFLOW

The results of the discussions in the previous section are summarized in Table II, which provides a suggested outline for a model of player enjoyment in pervasive games, that is, pervasive gameflow. Some of the criteria in the original gameflow model have been excluded in the pervasive gameflow model due to the evaluation presented above. Other criteria have been reformulated and, owing to the evaluation, some new criteria have been added. The additional criteria are presented in *italics* in Table II.

Table II. The Pervasive Player enjoyment Model: Pervasive Gameflow

Element	**Criteria**
Concentration Games should require concentration and the player should be able to concentrate on the game	- games should provide a lot of stimuli from different sources - games must provide stimuli that are worth attending to - players shouldn't be burdened with tasks that don't feel important - games should have a high workload while still being appropriate for the players' perceptual, cognitive and memory limits - *Pervasive games should support the player in the process of switching concentration between in-game tasks and surrounding factors of importance*

Challenge Games should be sufficiently challenging and match the player's skill level	- challenges in games must match the players' skill levels - games should provide different levels of challenge for different players *- Pervasive games should stimulate and support the players in their own creation of game scenarios and pacing* *- Pervasive games should help the players in keeping a balance in the creation of paths and developments in the game world, but not put too much control or constraints on the pacing and challenge evolving*
Player skills Games must support player skill development and mastery	- players should be able to start playing the game without reading the manual - learning the game should not be boring, but be part of the fun - games should include online help so players don't need to exit the game - players should be taught to play the game through tutorials or initial levels that feel like playing the game - players should be rewarded appropriately for their effort and skill development - game interfaces and mechanics should be easy to learn and use *- Pervasive games should be very flexible and enable the players' skills to be developed in a pace set by the players*
Control Players should feel a sense of control over their actions in the game	- players should feel a sense of control over their characters or units and their movements and interactions in the game world - players should feel a sense of control over the game interface and input devices - players should not be able to make errors that are detrimental to the game and should be supported in recovering from errors - players should feel a sense of control and impact onto the game world (like their actions matter and they are shaping the game world) - players should feel a sense of control over the actions that they take and the strategies that they use and that they are free to play the game the way that they want (not simply discovering actions and strategies planned by the game developers) *- Pervasive games should enable the players to easily pick up game play in a constantly ongoing game and quickly get a picture of the current status in the game world (in order to assess how the state of the game has evolved since the player last visited the game world)*
Clear goals Games should provide the player with clear goals at appropriate times	- overriding goals should be clear and presented early *- Pervasive games should support the players in forming and communicating their own intermediate goals*
Feedback Players must receive appropriate feedback at appropriate times	- players should receive feedback on progress toward their goals - players should receive immediate feedback on their actions - players should always know their status or score

Immersion Players should experience deep but effortless involvement in the game	- players should become less self-aware and less worried about everyday life or self - players should experience an altered sense of time - players should feel emotionally involved in the game - players should feel viscerally involved in the game *- Pervasive games should support a seamless transition between different everyday contexts, and not imply or require player actions that might result in a violation of social norms in everyday contexts* *- Pervasive games should enable the player to shift focus between the virtual and physical parts of the game world without losing too much of the feeling of immersion*
Social Interaction Games should support and create opportunities for social interaction	- games should support competition and cooperation between players - games should support social interaction between players (chat, etc.) - games should support social communities inside and outside the game *- Pervasive games should support and enable possibilities for game oriented, meaningful and purposeful social interaction within the gaming system* *- Pervasive games should incorporate triggers and structures (e.g. quests and events, factions, guilds or gangs) that motivate the players to communicate and interact socially*

6. CONCLUSIONS AND FUTURE WORK

The theoretical and conceptual analysis of the gameflow model shows that its use is promising and appropriate in gaining understanding of player enjoyment in pervasive games. Some additions, changes, and elaborations are suggested that result in an outline for a new model of player enjoyment in pervasive games, that is, the pervasive gameflow model. This model now needs to be empirically validated. Future work may include user-centered evaluation of various pervasive games using the pervasive gameflow model to verify the model and identify further elaborations and extensions that may be needed.

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Received April 2006; accepted June 2006