FOUNDATIONS OF GAMEPLAY

Jussi Holopainen

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Dedicated to my family: Eira, Eino, Yrjö, Petra, Ville, Terhi, and Hilla Emilia.

ABSTRACT

People in all known cultures play games and today digital gaming is an important leisure activity for hundreds of millions of people. At the same time game design has developed into a profession of its own. There are several practical game design guidelines and text books but they rarely manage to connect their findings into relevant areas of research such as psychology and design research. Understanding game design, both as an activity and as an end result of that activity, in a more profound way could alleviate this problem.

The main goals of this thesis are to understand in a more profound way how to design games and based on that understanding develop frameworks and methods for aiding game design. By extending knowledge about game design can not only improve the quality of the end-products but also expand the potential design space even in unpredictable ways.

Game design contains many sub-areas. Character, story, and environment design are integral parts of the current game development projects. The aim of this thesis, however, is to have a critical and exploratory look at structures of gameplay as design material. Gameplay is the interaction between the game rules, challenges, elements, and players.In one sense gameplay defines the game.

The focus of the thesis is mainly analytical, although parts of the results are based on practical research through design activities. The thesis contributes to game research in three interralated ways:

(1) An analytical contribution to understanding gameplay was done in the gameplay design patterns work. The patterns are described as an approach to both analyse existing games and aid in designing new games. The patterns describe recurrent gameplay structures and also analyse these structures from the design material point of view.

(2) A theoretical study of basis for gameplay experiences was conducted through review of relevant models and theories in neuroaesthetics, cognitive and social psychology and game research. The framework offered in the thesis explains why certain gameplay structures are more recurrent based on defining gameplay as caricatures of intentional behaviour.

(3) The game design patterns approach and research through design projects have contributed to the analysis of game design as an activity and practical guidelines for concrete design work in more specific areas of game design.

The goals of this thesis are ambitious and many questions are left unanswered. Using the patterns approach in conjunction with game design and ideation methods is still in its infancy. The concept of gameplay as caricatures of intentional behaviour should be explored further, especially in conjunction with other theories and frameworks relevant for understanding gameplay experience such as user engagement, immersion, and presence. Empirical experiments validating or falsifying

this view on gameplay would be valuable as further contributions to game research.

PUBLICATIONS

Publications included in this thesis

I Björk, S. and Holopainen, J. (2005) Patterns in Game Design, Charles River Media, 2005.

II Björk, S. and Holopainen, J. (2005) "Games and Design Patterns" in The Game Design Reader: A Rules of Play Anthology, MIT Press, 2005.

III Holopainen, J., Björk, S., Kuittinen, J. (2007) "Teaching Gameplay Design Patterns". Proceedings of ISAGA 2007, July 2007, Nijmegen, Netherlands. Won the Best Paper Award of the conference.

IV Holopainen, J., Björk, S. (2008) "Gameplay Design Patterns for Motivation". Proceedings of ISAGA 2008, July 2008, Kaunas, Lithuania.

V Holopainen, J., Meyers, S. (2000) "Neuropsychology and Game Design". Paper at Consciousness Reframed III, 2000, Newport, UK. Available at http://stephan.com/NeuroBio.html.

VI Holopainen, J. (2008) "Play, Games, and Fun" in Extending Experiences, University of Lapland, 2008.

VII Holopainen, J. and Järvinen, A. (2005) "Ludology for Game Developers" in Introduction to Game Development, Charles River Media, 2005.

VIII Ollila, E.M.I, Suomela, R., Holopainen, J. (2008) "Using prototypes in early pervasive game development", Computers in Entertainment, Volume 6, Issue 2 (April/June 2008).

IX Holopainen, J., Waern, A. (2009) “Designing Pervasive Games for Mobile Phones” in Pervasive Games: Theory and Design, Morgan Kaufmann, 2009.

X Kuittinen, J., Holopainen, J. (2009) "Some Notes on the Nature of Game Design", DIGRA 2009 Conference, September 2009, London, UK.

Other publications not included in the thesis

1 Björk, S., Holopainen, J., Ljungstrand, P., and Mandryk, R. (2002b). Special issue on ubiquitous games. Personal Ubiquitous Comput., 6(5- 6):358–361.

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CONTENTS

Part I

RESEARCH SUMMARY

1 INTRODUCTION

Games are big business. Digital games alone have grown into a considerable market force with yearly revenues of around 20 billion U.S. dollars in 2009 in the United States[1] alone. Digital games have also become an important leisure activity, especially amongst young men[2]. Card, board, computer, console, handheld, mobile, online, and social games are played by billions of people around the globe Games as a cultural form have, until recently, received surprisingly little attention as compared to, for example, pop-music and film. The developers and designers of these games have mainly tacit knowledge about the limitations and opportunities of games as a cultural form. This might be one of the reasons why digital games have often been blamed as being trite entertainment with little innovation happening over the years. Current block-buster games are often structurally similar to each other and the differentiating factors lie on the fidelity of the technical implementation or "coolness" of the game's theme. Technological advancement during the recent decade has been tremendous but according to some critics, such as Ian Bogost[3], that development has actually had a negative impact on the quality and innovativeness of game design itself. Understanding game design, both as an activity and as an end result of that activity, in a more profound way could alleviate this problem. This could result in not only better and more varied games, but also in the establishment of games as an important cultural form alongside with other media such as literature and film.

1.1 RESEARCH QUESTIONS

There are three main intertwined research questions in this thesis:

1. What is the material for designing gameplay, in other words, what are the things and issues one has to take into account in gameplay design?
2. What gameplay structures are more recurring and why?
3. How can gameplay design be described and analyzed as a design activity?

These three questions are closely related to each other and there are feedback-loops between them. Understanding and describing the material for gameplay design will help to identify recurrent gameplay structures. Explaining why certain gameplay structures are more recurrent or more engaging from the gameplay experience point of view will

1 According to yearly report by NPD Group, retrieved on December 21, 2010 form http://www.npd.com/press/releases/press_100114.html.

2 eMarketer: "Favorite Leisure Activities." Retrieved on December 21, 2010 from http://www.emarketer.com/Article.aspx?R=1007190.

3 See, for example, "Persuasive Games: Plumbing the Depths" column at Gamasutra. Retrieved on December 21, 2010 from http://www.gamasutra.com/view/feature/5880/persuasive_games_plumbing_the_.php.

clarify and possibly expand the issue of gameplay material. For example, identifying that the gameplay designers often deal with different kinds of goal structures, that is, goal structures are part of the material for game design, will lead to the question why goals are important for gameplay. Elaborating this issue from, for example, cognitive and neuropsychology point of view enables a more fine grained analysis of different goal structures, which in turn will assist in the analysis of gameplay materials. Another strong feed-back loop is between question 1 (the gameplay material) and question 3 (the similarities and differences between design activity in different domains). Understanding the design material allows for a more elaborate analysis of the differences and similarities between the materials of different design domains. This can shed light on how and why gameplay designers adopt certain methods and strategies for design as an activity.

1.2 GOALS, OUTCOMES, AND SCOPE

The main goals of the projects involved in this thesis were to understand in a more profound way how to design games and based on that understanding to develop frameworks and methods for aiding game design, especially experimental game design. The overall assumption is that by extending knowledge about game design it is possible to, first, improve the quality of the end-products (games), second, to expand the potential design space even in unpredictable ways, and third, to improve the recognition and self-reflection among practitioners and within the wider cultural context. Other design domains, such as industrial and graphics design, are already recognized as valuable and important cultural domains. In that respect, game design has already reached similar status in certain circles and the public awareness of game design as a profession is getting better everyday. The hope is that game design research could help in this process.

Another starting point is that game-like structures and interactions are becoming more and more widespread in today's technologically saturated society. For example, Lindley (2004) has argued that this trend will, in the end, dissolve the distinction between work and play and even make computer-supported work tasks more enjoyable. Echoing similar sentiments Jesse Schell, a renowned game designer, has discussed how introducing game mechanics into "normal" products will make them more engaging (Schell, 2010). Thus lessons learned from game design research might have wider implications in the whole human-computer interaction field than just entertainment industry.

The focus of this thesis has been mainly analytical and theoretical but part of the work is based on practical research through design activities (see Design Research section for more details). The primary outcomes of this thesis are:

1 An analytical contribution to understanding gameplay was done in the gameplay design patterns work. The patterns are described as an approach to both analyze existing games and aid in designing new games. The patterns describe recurrent gameplay structures (research question 2) and also analyse these structures from the design material point of view (research question 1). The patterns approach is discussed in publications I Björk

and Holopainen (2005b), II Björk and Holopainen (2005a), III Holopainen et al. (2007), and IV Holopainen and Björk (2008).

2 A theoretical study of basis for gameplay experiences was conducted through review of relevant models and theories in neuroaesthetics, cognitive and social psychology, and game research. The framework offered in the thesis explains why certain gameplay structures are more recurrent (research question 2) and also points towards more specific issues in explaining and measuring player experiences. The explanation is based on defining gameplay as caricatures of intentional behaviour. These issues are discussed in publications V Holopainen and Meyers (2000) and VI Holopainen (2008c) and in the Foundations of Gameplay section of the introduction.

3 The game design patterns approach and research through design projects have contributed to the analysis of game design as an activity (research question 3) and to the development of practical guidelines for concrete design work in more specific areas of game design (research question 1). Publications VII Holopainen and Järvinen (2005), VIII Ollila et al. (2008), IX Holopainen and Waern (2009), and X Kuittinen and Holopainen (2009) present results and discuss these design research issues.

The rest of the introduction is structured in the following way. First, an overview of individual publications and their contributions to the research questions is presented. Second, a theoretical description of the foundations of gameplay is described focusing on the research question 2. Third, design research approach and its relevance to research questions 1 and 3 is discussed. Fourth, game design patterns approach is introduced in more detail and how it has contributed to research questions 1 and 2. Finally, a discussion of potential future work is presented.

1.3 SUMMARY OF PUBLICATIONS

I Patterns in Game Design (Björk and Holopainen, 2005b)

This book provides a tool for understanding and creating games. The tool is game design patterns, a collection of design choices possible in games. The patterns can help in making design choices when creating a game, understanding how others' games work, and can also be used to inspire game ideas. The patterns are focused on gameplay. For the interest of this discussion gameplay is defined simply as the structures of player interaction with the game system and with the other players in the game. Understanding gameplay is important for analysing details about a specific game, for comparing two different games or genres, and for discussing benefits and disadvantages between two different design options. The book consists of two main parts. The first more theoretical part provides a framework for analysing games and describes the template used for the game design patterns. The second part, which is the majority of the book volume, is a collection of game design patterns. The pattern collection is divided into chapters based on what aspect of gameplay the patterns concern. Reading the collection can be done in any order, similar to how a dictionary or encyclopedia is used. The

collection contains nearly 300 patterns divided into separate areas of gameplay such as goals, goal structures and social interaction.

Contribution: The game design patterns project was initiated by the author. The authors shared the research work and writing on equal basis.

II Games and Design Patterns (Björk and Holopainen, 2005a)

An overview of the game design patterns approach is described. The component framework and its main components are briefly introduced. The reasons for developing the game design pattern approach and its importance are discussed. Finally, comparisons with other approaches such as formal abstract design tools and the 400 Project are presented. The development of the game design patterns is described on both theoretical and empirical levels. This view of game design has been called second-order design, since the actual interaction cannot be design, but rather the artifacts and rules that encourage or discourage the interaction. Further, the pattern approach opens up the possibility to view game design as a part of Interaction Design, which looks at both analyzing and designing systems with the focus on how they are used. The development of a suitable pattern template, the individual game design patterns, and the overarching structure of the approach was done by gathering data through three methods: transforming game mechanics into game design patterns, harvesting game design patterns through analyzing games, and interviewing game developers to validate ideas and concepts.

Contribution: The article was based on the game design patterns work, which was shared between the authors on equal basis. The first author, Staffan Björk, was leading the writing work. The author contributed a bit less than half to the written material.

I**II Teaching gameplay design patterns** (Holopainen et al., 2007)

The gameplay design patterns approach to designing games is introduced and three main challenges (romantic vision of game design, transferring explicit knowledge to tacit knowledge and vice versa) in teaching the approach are identified and described. Using gameplay design patterns to teach game design is illustrated with examples from game design courses, workshops, and a description of a design tool called CAGE. The problems encountered in the examples are discussed in the light of the identified challenges. Strengths and weaknesses of the teaching methods and the approach itself are discussed and some improvements are suggested.

Contribution: First author. The majority of the text was written together with Staffan Björk on equal basis. The material was based on the workshops and game design courses designed and conducted by the author and Staffan Björk. Jussi Kuittinen added the design tool description.

IV Gameplay Design Patterns for Motivation (Holopainen and Björk, 2008)

This paper presents a limited exploration of how games provide motivation by using gameplay design patterns to codify the results. To identify patterns, four well-known and commercially successful games (Civilization IV, Elder Scrolls IV: Oblivion, The Sims, and World of

Warcraft) were analysed. The choice of games was based upon meeting the requirements that players in these games need to consciously make plans or define their own goals. This was done to ensure that the game design has a strong component of encouraging motivation encapsulated within the gameplay and not depending on other aspects of the game experience, such as theme, narration, and representation. Based upon analysis of four games, the patterns Progress Indicators, Player-Designed Characters, Planned Character Development, Social Status, and Player Defined Goals are expanded. In addition, the new design patterns Overlapping Closure Arcs and Memorabilia are introduced.

Contribution: First author. The authors shared the analysis work and writing on equal basis.

V Neuropsychology and Game Design (Holopainen and Meyers, 2000)

This paper discusses the role of dramatic and predictive closure and temporal and somatic displacement in the design of games, especially computer games. Each of these elements is drawn on the physical characteristics of the human brain and corresponding mind structures. We further argue that enjoyment in game play is a product of these evolutionary features, and that the most successful game design presents the user with the opportunity to seek closure and to displace the sense of self.

Contribution: First author. The background research was conducted by the author. Most of the text was written by the author and it was discussed with the second author.

VI Play, Games, and Fun (Holopainen, 2008c)

Play behaviour is present in all mammals and even fish seem to play in certain situations. The more developed the species is in evolutionary terms the more elaborate the play patterns are. Animals, however, do not play games as such, although there are some reports of "proto-games", such as king of the hill played by chimpanzees and simple racing by dolphins. Games and game playing is present in every human culture and there is some archaeological evidence that games emerged during the same period as the first symbolic expressions, such as cave art, appeared. Thus it can be claimed that playing games is fundamentally human. Games are also fun. A player can be so engrossed in playing a game that even the physiological needs are suppressed. The chapter traces the evolution of gameplay features from the animal play through ancient games to modern computer games by following the basic tenet, which states that games are caricatures of intentional activities. Findings from modern philosophy of mind and cognitive neuroscience are used to further support and elaborate the exploration of how games and play are fundamental features of being a human.

Contribution: Sole author.

VII Ludology for Game Developers (Holopainen and Järvinen, 2005)

There has been a recent rise in academic studies of games, and the term ludology has been coined to characterize this new discipline. In truth, ludology is a term for a host of different methods with which to study, teach and even design games. This chapter introduces various aspects of ludology, and suggests means to apply ludology for practical

game development purposes. Numerous references and pointers to ludological resources encourage the reader into getting familiar with ludology and into making his or her own interpretation of the field. For a game developer interested in broadening his or her understanding of games across different media and technology, the general rise in interest towards games presents fresh opportunities to get familiar with both early and contemporary contributions to ludology and feed off their findings. Thus, the neologism that constitutes our topic is not just a buzzword to promote academic activities in the present, but also a tool to give new worth and usefulness to earlier theoretical discussions on games.The chapter concludes with a dialogue where various aspects and applications of ludology are discussed through concrete examples.

Contribution: First author of the paper. Most of the text was written by the author.

VIII Using prototypes in early pervasive game development (Ollila et al., 2008)

In this paper various prototyping methods in early pervasive game development are discussed. The focus is on pervasive games that are played with mobile phones. Choosing the right prototyping method is crucial in achieving results that can be used for validating or developing further design ideas. In this paper, guidelines are provided that help the selection process and also give ideas of methods that can be used in different situations. Pervasive game prototypes were playtested using agile software prototype development methods, forum prototypes, and guided paper prototyping methods. Examples of five pervasive games where these kinds of prototyping methods are used are given. In the end, the results are compared with a discussion of benefits and disadvantages of their use in the game development process i.e. when the methods should be used and what should be considered when using them.

Contribution: The forum prototyping and play testing was conducted by the author. The forum prototyping section was written by the author.

IX Designing Pervasive Games for Mobile Phones (Holopainen and Waern, 2009)

Mobile phones are a powerful platform for making and staging all kinds of pervasive games. The phone can be used as an additional device providing computation and communication capabilities. Furthermore, the design of the game can focus on the specific affordances provided by the phone with the associated sensors and services providing additional environmental context. The design strategies elaborated in this chapter highlight mobile phone specific opportunities and constraints but they are also relevant for all kinds of pervasive games. Mobile phones are devices for social interaction and they have sometimes even sophisticated online capabilities. Also pervasive games can use the real world as a part of the game and real world is, as we all know, a shared world. These facts make mobile phones suitable for multiplayer games. Pervasive mobile phone games can blend the real world and the game world in a compelling manner and at the same time offer natural multiplayer features. In a pervasive game, the designers desire to make players feel that the game game extends beyond the the tiny screen, creating a world that is integrated with the ordinary world, and

that the players are able to act in this world through their device interaction. Player and game world identification, player-to-player interaction especially when the game supports the formation of communities, and many of the design strategies described later in the chapter enhance this sense of presence. When designing pervasive games for mobile phones, it is important to consider the use situations and the natural affordances of the device. These design strategies discuss the issues the game designer needs to consider particularly when developing pervasive games for mobile phones. Design strategies such as viral invitations, communication outside the game world, and activity blending are discussed in more detail.

Contribution: First author of the paper. The majority of the text was written by the author and was based on the research conducted by the author in the IPerG project.

X Some notes on the nature of game design (Kuittinen and Holopainen, 2009)

This paper is focused on a critical look at the current game design literature through the analytical lenses of the current state of the art in design research. The aim is not to create yet another prescriptive framework for game design but rather an attempt to connect the game design studies to general design studies in a stimulating way. First, what has been said about design in general, including industrial and graphic design, engineering, architecture, and even software design is discussed. Next, the discussion continues on comparing game design to the design in general and pointing out similarities and especially differences. This leads to a somewhat obvious claim that doing game design is an activity similar to any other design field but that the form and the content are specific to the game design context. Even though this claim might sound obvious it has some unexpected consequences: firstly, it grounds game design in the large body of existing design research and, secondly, it helps in identifying the crucial activities, forms, contents, and contexts that determine the nature of game design. Six game design books are analysed through two distinct but mutually supporting models of design in general. The focus is on understanding game design as a situated activity and seeing how this notion is discussed in the game design literature.

Contribution: The authors shared the work for the research design, the research itself, and writing the article on equal basis

1.4 FOUNDATIONS OF GAMEPLAY

Games are an integral part of human culture. There is archaeological evidence from dice games being played with incised astragali (knuckle bones of sheep, pigs, or dogs) already millennia ago (Dandoy and Dandoy, 1996, Gilmour, 1997). Play itself has been with us throughout the evolutionary history. Some reptiles and fish play Burghardt (2005) and virtually every mammal exhibits play behaviour at least in parts of its development (Pellegrini, 2009, Fagen, 1981, Burghardt, 2005). Play for humans is not limited only to a certain stage of development. Normal humans continue to play through all their life, although the forms of play usually change. Most notably the Dutch historian and anthropologist Johan Huizinga suggested in his celebrated Homo Ludens

Huizinga (1955)that the whole human culture is being built on forms of play.

Play is an elusive concept in itself. The famous play researcher Brian Sutton-Smith proposed in his Ambiguity of Play Sutton-Smith (1997)that the definitions of play can be differentiated into seven rhetorics, which each highlight certain aspects of play while neglecting others. For example, the play rhetoric of self focuses on the enjoyment or fun aspect of playing and the play rhetoric of power frames playing as a representation of conflict.

Salen and Zimmerman discern between three types of play: "Game Play" as "formalized interaction that occurs when players follow the rules of a game and experience its system through play." (Salen and Zimmerman, 2003, p. 303 - 305), "Ludic Activities" include all non-game behaviour, which we would think as play such as rough-and-tumble between schoolkids, and finally "Being Playful" as an attitude refers to "also to the idea of being in a playful state of mind, where a spirit of play is injected into some other action." Leino (2010, p.65-66) argues that this three-fold separation should not be taken as demarcating one dimension of play, but that there should be a separation between the form of activity and the experiential (the subjective feeling) mode. It is possible to play golf in a non-playful mode and work in a playful mode (Apter, 2006). For the argument stated here, however, it does not matter if a player of a videogame does not always have "a playful framing" or he or she is not always in a "paratelic metamotivational state". The main point is that it is useful to look at different forms of gameplay from the more generic play point of view.

The evolution of games can be traced to emergence of more and more elaborate play patterns in higher mammals. Game mechanisms such as hide-and-seek, tag, and handicapping can be found in play behaviour of many mammals. Finally, some hominids and cetaceans play "proto-games" such as racing and king-of-the-hill, where the play behaviour seems to be governed by rule-like agreements between the participants.

As far as human beings are concerned, this line of thought leads to the distinction between natural games, evolved games and designed games. The natural games are based on the more elaborate play patterns and commonly have vague and implicitly understood rule system and do not necessarily employ external objects as game elements. Examples of natural games are many children's games such as king-of-the-hill or tag. In evolved games the play patterns are even more elaborate and abstract, there is an attempt at making the rules explicit, and the games often employ external objects, such as a ball in proto-football or counters in board games, as game elements. The games are, however, not designed in an explicit way nor there is a specific designer. The games have continued to evolve over numerous generations, rules are added, changed, and removed depending on the play situations. Many of the evolved games have been forgotten but some of them, perhaps the most 'fit' ones, have reached the stage where the rules are made explicit and are become resistant to change. Examples of such games are chess and many traditional card games. The designed games, on the contrary, are purposefully designed by a central authority, the game designer or designers. Here the designer consciously ponders over the rules and game elements to make a playable and communicable game.

The difference between evolved and designed games is similar to stories and epics emerging from oral culture to specifically authored novels. This distinction also gives rise to a certain kind of activity, namely game design.

Current designed games range from commercially available board and card games to elaborate video and computer games. The media, themes and interaction methods can be vastly different from game to game and the nature of design work can seem to be totally different when comparing board games to high-end videogames. Many of the differences are true. Moving wooden tokens on a hexagonal map is different from controlling detailed 3D representations of tanks and armies on a computer screen. The similarities, however, are also striking. When the representational media and interaction methods are abstracted out, the goal and conflict structures and the relationships between different game elements can be surprisingly similar, even the same.

1.4.1 *Defining Gameplay*

The strategy being followed here is to first propose a stipulative definition of gameplay as caricatures (exaggerated, transformed and transposed abstractions) of intentional behaviour within rule-governed, symbolic structures and then explore the consequences and opportunities of the new definition. Intentional behaviour is doing goal directed actions requiring a set of cognitive and sensory-motoric capabilities. This definition of gameplay is an elaboration of the games as caricatures of intentional behaviour one proposed in publication VI Holopainen (2008c). The definition is artificially narrow, excluding many factors which are important to the whole experience of playing games. This is also in line with the strategy; the stipulative definition illuminates and focuses on aspects which otherwise would have been neglected.

According to this definition of gameplay, playing a game does not have to be free, voluntary, and for the sake of itself as is claimed, for example, by Callois (1961). Playing a game does not necessarily have to be fun either. Greek men deeply engaged in playing zaria "could nonetheless demonstrate an utter lack of conviviality and evident pleasure" Malaby (2007) and it is questionable whether the Chinese gold-farmers are having anything even remotely resembling "fun". What is more important than fun is that the games are capable of engaging the players in cognitive, sensory-motoric, and affective fashion. Even though Malaby (2007) warns us against associating play as something fundamental to games, it is still worthwhile to look at how how playing games shares many crucial experiental characteristics with innate free-form play.

One crucial aspect of play behaviour for this discussion is "[...] that it differs from the 'serious' performance of ethotypic behavior structurally or temporally in at least one respect: it is incomplete (generally through inhibited or dropped final elements), exaggerated, awkward, or precocious; or it involves behavior patterns with modified form, sequencing or targeting" (Burghardt, 2005). Ethotypic behaviour means behaviour which is typical for an animal species in a given environment. Here the caricature principle is in operation; the behaviour is

"incomplete", "exaggerated", and "involves patterns with modified form".

In their Understanding Video Games, Egenfeldt-Nielson et al. (2008) define gameplay as "the game dynamics emerging from the interplay between rules and game geography" (p. 102). They essentially define the formal properties, rules and game geography, of games which give rise to the aesthetic properties of gameplay. Thus it is possible to make aesthetic evaluations of gameplay, for example, the gameplay of Super Monkey Ball is hectic and competitive and that chess is more contemplative but also competitive because their rules and game geography are designed that way.

The definition provided by Egenfeldt-Nielson et al. (2008) is adequate in some contexts, but it also lacks something. It does point out that rules and game geography are the culprits of good and bad gameplay but it does not provide enough anchor points for further explorations of why certain configurations of rules and game geography work and others do not.

Lindley and Sennersten (2006)propose that gameplay schemas can provide a sufficient explanation of gameplay. "Schemas are cognitive structures that link declarative (or factual) and procedural (or performative) knowledge together with other cognitive resources (such as memory, attention, perception, etc.) in patterns that facilitate the manifestation of appropriate actions within a context". The gameplay schemas are in more than one way congruent with our definition of gameplay. A schema is in fact a detailed description of how intentional behaviour is caricatured in a game. Our notion of gameplay implies interactivity; there can be no intentional behaviour without actions and intentionality assumes that there is a world responding to the actions.

Juul has mentioned that games are stylized and abstracted simulations (Juul, 2005). Juul continues this line of argumentation in his "A Certain Level of Abstraction" paper (Juul, 2007), where he states that "[...] playing games is actually a process of exploring abstraction". In the similar vein Grodal argues that videogames, "are simulations of basic modes of real-life experiences" (Grodal, 2003). This aspect of games has similarities to our initial definition of gameplay and there is considerable overlap in their extensions, especially in the domain of video games. On the other hand, there are some crucial differences. Firstly, our definition of gameplay applies better to many other kinds of games than just videogames such as board and card games and abstract video games. This can be regarded as a failure to produce a strict enough definition but later it will be shown that even though the relevant extension of our definition is larger, the definition itself is clearer and better demarcated. Secondly, regarding games as caricatures of intentional behaviour highlights aspects of gameplay which open up new avenues of investigation, in other words, our definition is more fertile than regarding games as stylized and abstracted simulations.

In summary, the definitions discussed here are highlighting certain aspects of gameplay and thus are more complementary than contradictory. The definition presented in this thesis, that gameplay can be understood as caricatures of intentional behaviour within rule-governed symbolic structures, does not contradict the other definitions. Instead, it reveals aspects of gameplay for further scrutiny from fields such as cognitive psychology and even neuroscience.

1.4.2 *Intentional Behaviour*

Next, some aspects of intentional behaviour which are relevant in games are discussed. The main point of departure here is cognitive psychology with some forays into neurosciences. Some of the capacities discussed below may seem to be self-evident and trivial but they provide necessary background for the further discussion.

First, what isintentional behaviour? The standard definition, and the one followed here, is that intentional behaviour is doing goal directed actions requiring a set of cognitive and sensory-motoric capabilities. Human cognition is based on the view that our sensory-motor world consists of permanent objects arrayed in a representational space (Tomasello, 2001). That is, it can be assumed that there are discernible objects in our environment that are permanent to a certain degree and that human beings are capable of positioning them, again at least to a certain degree, in relation to themselves. Human beings share this sensory-motory world with basically all mammals, but many mammalian species, and especially primates, are able to cognitively represent categorical and quantitative relations among the objects. This set of cognitive abilities entails (Tomasello, 2001, p. 16), among others, that they are able to

1 remember where things are in the local environment
2 take novel detours and shortcuts in navigating through space
3 follow the visible and invisible movement of objects
4 categorize objects based on their perceptual similarities
5 understand and thus match small numerosities of objects
6 use insight in problem solving

This list is by no means exhaustive; there are other relevant basic cognitive capabilities which are not discussed here. The principle, however, is the same: the game mechanics tap into or exploit the way we as human beings understand and position ourselves to the world and other intentional beings.

It is easy to see that many game mechanics are based on these capabilities. For example, the basic game mechanic used in popular match-three casual games (Bejeweled and so on) highlights capabilities 4. (categorize objects) and 5. (match numbers of objects). Further, the mechanics rely on more basic capabilities of remembering where things are in the environment (capability 1) and following the visible and invisible movement of objects (capability 3). These capabilities are reflected in many descriptive game design frameworks, such as game design patterns presented in publication I and II (Björk and Holopainen, 2005b,a) and game ontology project (Zagal et al., 2005). For example, the basic goal patterns described by Björk and Holopainen (2005b) include patterns such as Chase, Alignment, and Contact, which are either directly based on the cognitive capabilities or are a combination of them.

Furthermore, as primates are social creatures the following capabilities are crucial (Tomasello, 2001, p. 17):

1 to recognize individuals in their group

2 to form direct relationships with other individuals based on such things as kinship, friendship, and dominance rank

3 to predict the behaviour of individual based on such things as their emotional state, their direction of locomotion, and their available resources

4 to use many types of social and communicative strategies to outcompete groupmates for valued resources

5 to cooperate in problem-solving tasks and in forming social coalitions and alliances

6 to engage in various forms of social learning in which they learn valuable things from each other

Again, this list sounds like directly taken from a game description of a Massively Multiplayer Online Game. In a way all multiplayer game mechanics, regardless of their genre or medium, are based on one or more of these capabilities. It is worthwhile to note that these cognitive capabilities are basic for us humans as well as other primates. Perhaps for this reason these gameplay mechanics are so often and successfully used in many types of games.

Building on Carroll's work (Carroll, 1993) Aki Järvinen in his Games without Frontiers (Järvinen, 2008) analyses a large set of human abilities and their relevance to games and game mechanics. Carroll's abilities are clustered into three categories: cognitive, psychomotoric, and physical. Järvinen analyses each of these abilities according to their relevance to games and labels them as trivial (the ability might be required from the players but the development of the ability is not directly embodied in the goals of the game), non-applicable (the ability does not pertain to games), or non-trivial (the ability is required from the players and it can be developed by performing the game mechanics). The non-trivial abilities include basic blocks of game mechanics such as Visualization (apprehending and manipulating visual or spatial patterns), Perceptual speed (speed of making correct comparisons of symbols or patterns in a visual field, sometimes with distracting stimuli), and Wrist-finger speed (speed with which discrete movements of the fingers, hands, and wrists can be made).

It is clear that games employ our basic skills, especially cognitive ones, in an engaging manner. That is, game designs apply the caricature principle to the cognitive capabilities underlying our intentional behaviour. By caricature we mean that the involved forms are compressed, abstracted, exaggerated or otherwise transformed, and that they might be also "blended" with other forms. The forms that matter for gameplay are the intentional activities requiring the cognitive capabilities described above. The caricature principle is, of course, also used on the representational level in games in a similar way as it is used in any kind of representation.

Ramachandran and Hirstein (1999) claim that caricatured forms are engaging because of the peak-shift effect, which is a psychological phenomenon appearing in studies of animal learning. When an animal has been trained to discern between negative and positive stimuli on the same stimulus dimension, such as squares from rectangles, the animal response is greater to a stimulus further away from the negative stimulus than for the original positive stimulus. For example, if a rat

has been trained to differentiate squares (no reward) from 3:2 rectangles (reward) the rat will respond with greater intensity to a 4:2 rectangle than to the original 3:2 rectangle. It is, of course, a long leap of faith from trained rats to human beings appreciating visual arts but there is some further evidence for claims that caricatured forms can engage human beings more than the original forms.

The peak-shift effect can thus explain, at least partly, the fascination with exaggerated forms but what about the compressed and abstracted ones? Looking at neuroaesthetics of visual arts we can see that compression and abstraction, in other words removing dimensions from the stimulus does have an effect in our response to visual stimuli. Our visual brain is a modular one, comprising several systems which are responsible for detecting different things from the visual field such as different systems for colour and motion (Banich, 2004). According to Semir Zeki the artists have been "exploiting the characteristics of the parallel processing-perceptual systems of the brain to create their works, sometimes even restricting themselves wholly to one system, as in kinetic art" (Zeki, 2000, p. 80).

The claim here is that the same caricature principle applied to the intentional behaviour can be used to explain the experience of gameplay. First, the dimensions of different relevant actions possible are reduced when playing a game. When children play Tag they are not supposed to start hitting each other with baseball bats but rather limit their actions to movement (running, mainly). Second, the relevant goal structures (Björk and Holopainen, 2005b) within the game are compressed and exaggerated. Continuing with the Tag example there are basically two goals in the game: if you are "it" you have to catch other players and if you are not you have to evade "it". Other kinds of intentional behaviour are not relevant within the context of the game. Having an option to beat the other kids with a baseball bat, or to do pretty much anything else than chase or be chased, will ruin the gameplay experience of Tag.

It would be possible to set up an empirical experiment testing the caricature hypothesis. Two or more different versions of a situation requiring the same intentional behaviour are set up. The control version is as normal and plain as possible. The other versions add caricatured features for the intentional behaviour, for example making the goal structures more explicit or adding exaggerations such as explicit progress indicators. The research design should ensure that other possible contributing factors such as effects of attentional demand on the sense of engagement are controlled properly. The subjects' gameplay experience is assessed using methods from affective ludology together with methods from user experience research such as psychophysiological measurements and self-reports. The hypothesis is that the caricatured versions are more engaging and elicit stronger emotional responses from the subjects.

1.4.3 *Closures*

Intentional behaviour is goal-directed. In the traditional game model the game ends in a quantifiable outcome; the player either wins or loses the game (Juul, 2007). Many of the current Massively Multiplayer Online Roleplaying Games do not have such an end condition, rather the

game can continue until the player decides to cease playing the game or the company pulls the plugs from the servers. It would be better to change the quantifiable outcome into a series of quantifiable outcomes where the final one might be the most significant. Björk and Holopainen (2005b) call these quantifiable (sub-)outcomes closures. Holopainen and Meyers (2000) distinguish between dramatic and predictive closures. The focus here is on the all possible "dramatic" closures, both minor and major, which can happen while playing the game. From the psychological, and enjoyment, point of view the subclosures can be as meaningful for the whole game experience as the final outcome. Thus the closures are meaningful changes in the game state that elicit sense of achievement or failure to the players

The check-mate in Chess is a closure and so it is eating one pill in Pac-Man, although the latter is, of course, of less significance and thus the sense of achievement is weaker. The closures are closely related to the goal achievement and goal progression in the game. Players can also set goals for themselves which are not dictated by the game system. For example, The Sims series has vague, open-ended, and implicit goals formulated by the game system itself but players often, if not always, construct their own goals and these, of course, can change during the playing.

The closures in games follow the caricature principle. The goal (and sub-goal) achievement closures are often associated with exaggerated and artificial rewards, such as grandiose audio-visual effects. The failure closures are equally conspicuous. Sometimes the failure is even pointed out with near-miss indicators (Björk and Holopainen, 2005b) explicitly telling the player that they were very close to reaching the goal but still failed.

Ravaja et al. (2006a, 2005, 2004) have made psychophysiological studies about game events that elicit different types of emotions such as joy, grief, and fear. Their findings suggest that both the lower level achievement and failure sub-closures are important in shaping the player experience. Reaching different goals in Super Monkey Ball elicits joy or sense of achievement according to the relevance of these goals to the players. Picking up one extra banana is not as significant as getting a bunch of bananas, which in turn is not as significant as successfully completing a level. All these closures are associated with extra-rewards and audio-visual closure indicators. The same applies to failures: when the monkey falls of the cliff it is associated with strong vertigo like visual cues and even a replay of the events leading to the fall. The difference between goals and closures is that the goals are designed to the game (not forgetting that the players can construct their own goals besides of the goals explicitly or implicitly provided by the game) and that the closures happen while playing the game.

Closures and sub-closures are an integral part of intentional behaviour. Closures shape the experience into meaningful achievements and failures. In games the closures are caricatured, both achievements and failures are exaggerated and often explicitly displayed to the players.

1.4.4 *Flow*

It is notable that both play behaviour in general, including animal play, and the "flow" experience share the characteristics of being caricatures of intentional behaviour. The flow experience, according to Csikszentmihalyi (1990), consists of eight elements:

1 that a task that can be completed
2 that the person is able to concentrate on the task
3 that concentration is possible because the task has clear goals
4 that concentration is possible because the task provides immediate feedback
5 that the person is able to exercise a sense of control over actions
6 that there is a deep but effortless involvement that removes awareness of the frustrations of everyday life
7 that the concern for self disappears, but sense of self emerges stronger afterwards
8 that the sense of the duration of time is altered.

Although all these elements are evident in gameplay experiences (Sweetser and Wyeth, 2005) and media enjoyment in general (Sherry, 2004) the first five ones are relevant from the caricature principle point of view. Elements 1, 3, and 5 are related to goal structures as caricatures. In normal day-to-day behaviour the goals are not necessarily clear and it is not always evident if the task can be completed or not. An exaggerated goal structure posits clear goals and also explicit indications if the task has been completed. Some of the games, such as Tetris, do not have clear main goals which can be completed but the end condition is reverse; the game ends or the task is completed when the player fails. These games, however, provide the players with clear subgoals which can be completed, for example, filling in a row in Tetris. The immediate, and often explicit, feedback from the actions is evident in games. One of the game design principles is to give adequate and immediate feedback to the player. Again, the caricature principle is in operation. The feedback provided by games is often exaggerated and sometimes even transformed into explicit progress indicators towards the goal. The ability to exercise a sense of control over actions is heightened in games because the field of possible actions is artificially limited by rules (Klimmt, 2003). This, together with caricatured goal structures, provides the players further means to be able to concentrate on the goals at hand. The last three elements are describing the experiential consequences of the caricature principle in effect rather than describing the structural features enabling the experience in the first place.

1.5 DESIGN RESEARCH

Two strands of this thesis, the game design patterns (GDP) approach and the design activity analysis, are rooted in the more general design research tradition. Design research is a field of study which investigates the design activity, the design process, and the resulting artifacts in all design domains from architecture to electronic design. As there

are many and diverse approaches possible to design, from arts to psychology to engineering, the field is notably multidisciplinary. Design research as a field of study emerged around 1960s (Michel, 2007) and in 1966 the international Design Research Society was founded to promote the field of study. The design research community has been concerned with issues such as design methods (Jones, 1992), the nature of design as an activity (Lawson, 2005), and design knowledge (Lawson, 2004b). Christopher Alexander's work on design patterns for architecture (Alexander et al., 1977) was also rooted in the design research concern on how to do good design. The GDP approach is related to the design methods tradition. Design methods are often prescriptive descriptions of how the design as an activity or a process should proceed. In that way The 400 Project Falstein and Barwoodis more closely related to design methods than the GDP approach. One of the guiding principles during the development of GDPs was to keep them as neutral as possible regarding how the designer should approach the problem. This descriptive nature of GDPs allows them to be used first as a tool for game analysis but that they also can be used as a part of many other methods from idea generation to day to day design work. As was stated already earlier, patterns describe the material for gameplay design; the gameplay designer works with goal structures, information systems, and game resource management systems much in the same way as a software engineer works with variables and procedures or an organization designer with forms of communication and power structures.

Christopher Frayling cited in Laurel (2003) suggested that there are three main modes of design research: theoretical-conceptual research into design, methodological research for design, and experimental research through design. The research conducted in this thesis can be categorized accordingly. First, as a background research the author has been involved in several research through design projects such as the early ubiquituous computing game Pirates! reported in Falk et al. (2001) and pervasive mobile phone game explorations (Holopainen and Harris, 2006, Holopainen, 2008a,b, Paavilainen et al., 2009) in Integrated Project on Pervasive Games (IPerG)[4]. There have also been several experimental game design projects within Nokia Research Center, which have not been reported in scientific venues. In the research through design projects the aim has been to explore the game design space in a specific technological domain. For example, Pirates! (Falk et al., 2001) was looking at how to use proximity sensors together with wirelessly connected Personal Digital Assistants (PDAs) in game design. The IPerG prototype games were focusing on the pervasive aspects of mobile phone technologies and how to exploit them for meaningful gameplay. In research through design knowledge is gained by actually designing, implementing, and evaluating a prototype or a finished artifact. Normally the design drivers for the prototype are derived from the research questions of the project. One part of this process is described in publication VIII (Ollila et al., 2008). The prototypes are research results in themselves but the lessons learned from designing, implementing, deploying, and evaluating the games can then be abstracted into design guidelines and considerations as reported in publication IX (Holopainen and Waern, 2009) and Massively Multiplayer Mobile

4 More information about the project available at http://www.iperg.org/. Retrieved December 21, 2010.

Phone Games Design Kit (Holopainen et al., 2008) produced within IPerG. This research into design aims at generalizing the findings from creation of particular artifacts to be usable in further design projects, either for other research through design projects or even commercial game development.

1.5.1 *Interaction Design Research*

Fallman (2008)presents another view on the interaction design research. He proposes a simple triangular model for design research activities. The three extremes, the three corners in the triangle are "design practice", "design studies", and "design exploration". A specific design research activity can then be plotted on the two-dimensional space within this triangle. The design practice is closely related or identical to the design activities the interaction designer would encounter in commercial environment. Design exploration consists of similar kinds of activities to design practice as the researcher will produce an artifact. The important difference, however, is that in design exploration the focus is on exploring the unknown design possibilities and calling into question the current paradigms and trends. Design exploration is not usually driven by market or even user research but it rather makes a statement of what is possible, what could be done, and what could be the alternatives. Finally, the design studies extreme is removed from the synthetic nature of the previous two and focuses on analytical work. The body of knowledge created in design studies is not anymore interested in particulars. Rather, design studies try to accumulate generalizable and re-applicable knowledge by describing and understanding design as an activity.

Fallman (2008) states that the most interesting interaction design research stance is not to take any of the extreme positions but move within the triangle. During the work the researcher changes perspectives according to the three extremes. The work done in this thesis follows Fallmän's model. However, it is more concerned with design exploration and design studies than design practice. Even though some of the Nokia Research Center internal projects were aiming at creating concepts for possible commercial products the focus was more or less on the design exploration; the aim was to show what could be possible to bring to the markets at that moment. The prototypes created in the IPerG project were of exploratory nature. During the design and development of the prototypes the researchers, however, were always striving towards generalizations and accumulating knowledge that could be transferred to future projects. The outcomes of this design studies stance were the publications VIII (Ollila et al., 2008) and IX (Holopainen and Waern, 2009) and Massively Multiplayer Mobile Phone Games Design Kit (Holopainen et al., 2008) reported within IPerG.

The analytic design studies approach in this thesis is exemplified by publications X (Kuittinen and Holopainen, 2009) and VII (Holopainen and Järvinen, 2005). The aim of the publication X was to analyze how the current game design literature deals with design as an activity through two complementary models of design: Lawson's design activity categorization (Lawson, 2005) and Löwgren and Stolterman's (Löwgren and Stolterman, 2007) abstraction layers. The

analysis revealed that the models of design activity in general were useful for highlighting the similarities and also shortcomings of the current game design literature. The publication VII (Holopainen and Järvinen, 2005) offers guidelines for game developers to apply findings from game studies in their day-to-day design and development work. The difficulties in both presenting the results by game researchers and the adoption of the research results by developers are discussed. It also provides an overview of game studies areas which are of interest to game developers. The authors position game research as important in itself and also as useful for game developers.

1.6 GAMEPLAY DESIGN PATTERNS

The game design patterns project was started by Staffan Björk and the author around year 2002 from the frustration of designing experimental games for ubiquituous computing environments (Björk et al., 2002b,a). The game design literature at the time was, in our opinion, dealing with gameplay issues in an inadequate and fragmented manner, mainly focusing on practical aspects such as how to write design documents (see Crawford (1984), Rouse (2001)). The first goal of the project was to give us as researchers and designers tools for thinking about gameplay design in comprehensive, suitably abstract, structured, and useful ways. One of the main inspirations was Doug Church's Formal Abstract Design Tools (Church, 1999) approach, which is an attempt to provide a common design vocabulary. The underlying assumption was that even though games are wide and varied there are recurrent characteristics which pop up regardless of the genre or the medium. These recurrent characteristics can be understood as the material for game design.

Quite soon, in the beginning of the project, we realized that there are at least two layers of recurrency. The first one consists of the components which, in our view, all games must have. This layer was later moulded in to the component framework described first in (Björk and Holopainen, 2003) and later also in publications I and II (Björk and Holopainen, 2005b,a). The second layer was a trickier one as it should describe and perhaps even explain how different component configurations give rise to different kinds of gameplay and player experiences. The patterns approach was adopted from Christopher Alexander's patterns work in architecture (Alexander et al., 1977) as a suitable way to encapsulate the recurrent characteristics of gameplay. The pattern approach was chosen because, first, it had been successfully adopted in other fields such as software engineering, and second, it would provide a uniform way to describe and understand gameplay features (see (Björk et al., 2003) and publication I (Björk and Holopainen, 2005b) for further information about the development of the pattern approach). The current state of game design literature is much better than in the beginning of the patterns project (see, for example, Schell (2008), Fullerton (2008), Adams and Rollings (2006), Bateman and Boon (2005), Salen and Zimmerman (2003, 2005)). Still, there are no as comprehensive views on gameplay issues as the ones offered by the patterns approach. The closest matches are the game mechanics analysis in Aki Järvinen's doctoral dissertation Games without Frontiers (Järvinen, 2008) and Game Ontology Project(Zagal et al., 2005).

The first collection of patterns was published in publication I (Björk and Holopainen, 2005b). Later the collection has been enlarged by separate collections such as patterns for mobile games (Kam et al., 2007), player motivation (Holopainen and Björk, 2008), NPCs (Lankoski and Björk, 2007), dialogue systems (Brusk and Björk, 2009), and pervasive games (Björk and Peitz, 2007). The patterns have been not only used explicitly in several experimental game design projects and but also in game design courses in universities and other educational institutes. The challenges and opportunities of using patterns in teaching game design are reported in publication III (Holopainen et al., 2007).

The first pattern collection was created by analyzing existing games from many different genres and from the authors' experiences in research through design for new entertainment possibilities in ubiquituous computing (Björk et al., 2002a). Both authors of Patterns in Game Design were avid players of many different types of games. This kind of ludoliteracy (Zagal, 2010) was the background for selecting specific games for further analysis. The focus of the analysis was on the gameplay. Many pattern candidates were rejected because they were deemed to focus on issues which were not directly related to gameplay, although the border has been hazy.

The method of analysis was to first create a collection of pattern candidates focusing on specific areas of gameplay. The areas of gameplay were not set in stone in the beginning, even though we knew that some of the areas would be more important than others. For example, based on the review of existing game design literature and the preliminary analysis of games goals, goal structures, and information patterns were regarded important. Depending on the pattern area a background review of related research was also used in formulation of the patterns. For example, the information patterns such as Asymmetric Information and Perfect Information were derived not only from the analysis of existing games but also from economics and information theory.

Later during the analysis work, unsuitable or problematic candidates were first culled. Then, the initial relationships between remaining patterns were identified and this was used as the basis for the more detailed pattern descriptions. Even after this stage, the collection was not static. The more detailed descriptions of the patterns almost always raised questions of further relations to other patterns and often the pattern candidates were merged or a complex pattern was split up to separate patterns. There was a constant struggle at identifying and maintaining suitable levels of abstraction. The patterns form different kinds of hierarchies based on the instantiation relation but these hierarchies do not necessarily imply different layers of abstraction. This problem still remains with the patterns approach; the abstraction layers are not clearly identified as some patterns, such as Tension, describe potential player experiences, while others are clearly focused on game mechanics such as Capture. One possibility would be to demarcate the patterns according to the Mechanics-Dynamics-Aesthetics (MDA) model described in Hunicke et al. (2004).

The game design patterns approach has similar goals to Game Ontology Project (GOP) (Zagal et al., 2005) as both try to provide a framework for analyzing and describing games. In a similar manner to game design patterns, "[T]he Game Ontology Project's approach is to develop a game ontology that identifies the important structural

elements of games and the relationships between them, organizing them hierarchically." (www.gameontology.org). The main difference is that GOP is almost solely focused on analysis of gameplay features whereas GDP also tackles the problem of design implications as in Using the patterns and Consequences sections of the pattern template. Noah Falstein's and Hal Barwood's The 400 Project Falstein and Barwood aims to create a collection of informal rules for designing better games. The collection so far contains over 100 such rules, some of them described in detail and many with just a couple of descriptive sentences. The 400 Project's aim is slightly different from GDP. The rules are prescriptive, that is, they state more or less how the designer should or could approach specific design situations. In GDP the tone is intentionally non-prescriptive. These three approaches (GOP, GDP, and The 400 Project) are more or less complementary frameworks for game design.

1.7 CONCLUSION AND FUTURE WORK

There were three main intertwined research questions in this thesis:

1 What is the material for designing gameplay, in other words, what are the things and issues the designer has to take into account in gameplay design?

2 What gameplay structures are more recurring and why?

3 How can gameplay design be described and analyzed as a design activity?

Question 1, what is the material for designing gameplay, was tackled by offering gameplay design patterns as one way of looking at material for designing gameplay. The patterns can be used as building blocks in designing games. The gameplay design patterns also describe recurrent gameplay structures, thus relating to question 2. The latter part of question 2, why these structures are more recurrent than others was answered by looking at gameplay as caricatures of intentional behaviour within rule-governed, symbolic structures. This caricature principle was discussed on the light of findings from different fields of psychology and neuroscience. According to this view, the game mechanics tap into or exploit the way we as human beings understand and position ourselves to the world and other intentional beings. Gameplay design patterns is one way of describing these recurring gameplay structures based on the caricature principle. For example, the goal patterns describe caricatures of certain basic cognitive capabilities regarding object recognition, navigation in an environment, and dealing with other intentional beings. The last question about gameplay design as a design activity was discussed in light of concrete guidelines for doing specific game design, namely pervasive games, and also from analytical design activity models point of view. The models of design activity were useful for highlighting the similarities and also shortcomings of the current game design literature and raised awareness of how game design as an activity can be described.

The goals of this thesis are ambitious and obviously there are many questions left unanswered and issues untouched. The gameplay design patterns project still continues. The aim is to expand the current

collection with patterns addressing specific design areas and also to reorganize the collection to take into account different layers of design problems, situations, and consequences. Lundgren et al. (2009) have already published a paper describing aesthetic ideals as one such layer. The reorganization of current patterns will also most probably result in refocusing and rewriting parts of the collection. The real value of the patterns in ideation, concepting, and specific game design situations is not yet proven, even though there are already some qualitative positive results from game designers and game design students interviews.

The impact of game design insights on interaction design in general is an interesting area to explore further as discussed in Lindley (2004) and Schell (2010). The possible importance of playfulness to user experience and interaction design has been described in Korhonen et al. (2009). A more thorough analysis of using gameplay structures to make "normal" applications more fun and engaging could have a real impact on design practices and values especially for social media Kim (2009).

Designing and implementing controlled experiments to measure the impact of the game design patterns approach and the associated methods in design thinking would be a huge task. The methods and techniques of using patterns in real game design situations are still under construction. Combining the patterns approach with structured ideation tools could lead into more useful and better conceptually grounded tools for game design. The idea of CAD (computer aided design) applications using the patterns approach has been discussed in Jussi Kuittinen's master's thesis (Kuittinen, 2008). Implementing a semi-automated tool for documenting and visualizing the game design process using the patterns approach seems to be a viable option, but it would require a lot of effort.

Even though the concept of gameplay as caricatures of intentional behaviour seems to be an interesting and useful approach to explaining gameplay and gameplay experiences, the argumentation is still quite underdeveloped, even haphazard. There are also various other theories and frameworks relevant for understanding gameplay experience such as user engagement (O'Brien and Toms, 2008), immersion (Ermi and Mäyrä, 2005, Calleja, 2007), and presence (Ravaja et al., 2006b). More conceptual and theoretical work is needed to crystallize the concept itself and chart out the possible counterarguments and theoretical implications of the concept in regard to these frameworks. This theoretical work should, in the end, lead to empirical operationalisations, which could help not only to understand the nature of gameplay in general but also assist current research efforts in affective ludology Nacke (2009). One interesting path to follow is to use operational constructs from reversal theory (O'Connell and Calhoun, 2001, Apter, 2006) together with research methods and instruments provided by affective ludology in more specific areas of gameplay such as exploration, challenge, and goal-directedness.

Part II

PUBLICATIONS

2

PATTERNS IN GAME DESIGN

Staffan Björk and Jussi Holopainen

Published 2005 as *Patterns in Game Design*. Game development series. Charles River Media, Hingham (Mass.).

Not included in the printed thesis because of republishing limitations.

3

GAMES AND DESIGN PATTERNS

Staffan Björk and Jussi Holopainen

Published 2005 in Salen, K. and Zimmerman, E., editors, *The Game Design Reader: A Rules of Play Anthology*. MIT Press.

The following text is a merged, revised, and updated version of the two papers "Game Design Patterns" and "Describing Games: An Interaction-Centric Structural Framework," which were presented at the Level Up Digital Games Research Conference (Utrecht, 2003). In it, we describe two main concepts that together provide a framework and language for game play and game design. The text is a snapshot of our work on the Game Design Patterns Project, which explores the fundamental components of game design. The initial objective of the project, to provide a conceptual tool for aiding the experimental design of games for future technologies, was later expanded to include the design of all kinds of games. The pattern examples are from our book Patterns in Game Design (Charles River Media, 2005).

3.1 INTRODUCTION

Interest in developing the field of game research, ludology, has grown steadily over the last few years. But because games vary greatly, not only in their content and game play, but also in their medium and the reasons they are played, there are many approaches to the subject. This can be observed by looking at current research, which applies the methods and concepts of a wide range of research fields, from sociology and pedagogy, to literature and media studies, to computer science. Common research topics include player activities, narrative structures, and best practices for game development and for meeting artistic challenges.

Although different research fields can provide different perspectives on a given research topic, because these fields publish their results in different places, the results found in one field can easily be overlooked by workers in other fields. And because their frameworks and terminology also differ, even when researchers and practitioners meet in multidisciplinary environments they run the risk of misunderstanding one another.

A unified approach to game research may avoid misunderstandings and make possible the mutually beneficial exchange of results and findings between research fields. Although the methods and goals of research on games will, of course, always differ from field to field, communication between the different fields could be facilitated if there were a common framework and terminology for the essential "gameness" of a game. We argue that the focus of game research should be

is game play, a concept that incorporates both the functional and the experiential aspects of a game—what is done when playing a game ("The game play was repetitious") and how playing a game is perceived ("The game play was good").

In this essay we present our approach to describing games, one that is independent of existing research fields or—perhaps more accurately—that is part of the budding research field of game research. Our approach relies on two main concepts: component framework, which we define as the invariant aspects of game play onto which specific components of a game can be mapped, and game design patterns, which we define as semi-formalized interdependent descriptions of commonly reoccurring parts of the design of a game that concern game play. These concepts allow one to describe how the specific configuration of and interrelation between game components affect game play. The component framework provides the medium in which the game design patterns can occur; the game design patterns describe specific reoccurring interactions, dynamics, and characteristics that emerge from component configurations. The two concepts allow analysis and design of games to be structured with a focus on both static and dynamic aspects of game play.

3.2 THE NEED FOR A COMMON LANGUAGE FOR GAMES

Whether one looks at the work conducted within academia or within the game industry itself, it is obvious that there is a need for a language to be able to talk about game play both while designing and while analyzing games. To maximize the transfer of knowledge, a game-centric language should be usable by all the interested parties. Although it can and should incorporate concepts, methods, and theories from numerous fields, we believe that a conceptual game language should be created from studying games as a phenomenon in itself.

In the following, we discuss earlier approaches to describe games that have informed and influenced our approach.

3.2.1 *Genres*

Computer games are most commonly marketed by their genres—as sports games, first-person shooters, strategy games, and so on. But because "genre conceptions originate mostly from game journalism, not systematic study" (**?**), not surprisingly, the definitions of genres are strongly affected by the popularity of particular games. Some researchers, (Knizia, 1999; Parlett, 1999; but see Crawford, 1984) seem to view game taxonomies as genre collections without explicitly using the term genre. Others (Wolf, 2002), have concluded that basing genre identification on the interaction found in games can easily result in as many as 42 different genres, something still others (Järvinen, 2003) argue could limit their usefulness. Moreover, as cross-genre games show, a game can belong to more than one genre, and even when it does not, the exact requirements for belonging to any given genre cannot be easily specified.

The problems encountered in trying to define genres that are both generic and relevant within a specific subcategory of game types leads us to believe that the basis for a common language of game research lies not in redefining the concept of genre, but instead in identifying game components that can be used to more clearly define specific genres.

3.2.2 *Game Mechanics*

A natural starting point in identifying such components is to find the common components in games that are used to exemplify a given genre. When studying various communities of gamers and game designers, we found that many used the concept of game mechanics (or mechanisms), although the definition of a game mechanic is too general—"part of a game's rule system that covers one general or specific aspect of the game" (Boardgamegeek, 2005)—to be useful for academic research. A typical game mechanic is "roll and move," which simply states that dice are rolled and that something else is moved based on the outcome of the roll. The mechanic does not state how or why something should be moved; this is determined by the rules for the particular game. Computer game designers also frequently use the term game mechanics, but the term is not strictly defined—and is used in board games and technical programming contexts alike (Lundgren, 2002). However useful regarding a game as an entity put together by a number of smaller components might seem to be, some researchers (Järvinen, 2003, Lundgren and Björk, 2003), have stressed the need for a structure to define game mechanics more rigorously and to describe both how they relate to other mechanics and how to apply them when designing games (Järvinen, 2003, Lundgren and Björk, 2003).

3.2.3 *Other Related Models*

In addition to genres and game mechanics, a number of alternative approaches to a common game language have been suggested, primarily by professional game designers. Although not widely applied within either the game industry or academia, they are mentioned here as important influences on our approach. Writing to a designer audience, Church (Church, 1999) introduced the concept of formal abstract design tools (FADTs) as a way to reach a shared design vocabulary. Despite his emphasis on formalism and abstracting from specific instances, however, his FADTs are one-sentence descriptions: the FADT "perceivable consequences," for example, is defined solely as "a clear reaction from the game world to the action of the player." A more formalized method has been introduced by Barwood and Falstein, in the 400 Rules Project (Falstein, 2002), which collects proven game design rules and techniques, stating these as instructions. As can be seen from Falstein's section titles, however ("Imperative Statement," "Domain of Application," "Dominated Rules," "Dominating Rules," and "Examples"), the rules are intended for practical game design and are less suitable for analytic studies.

3.3 A GAME PLAY-CENTRIC COMPONENT FRAMEWORK OF GAMES

The more general part of our results was a component framework focused on game play. Although developed after we started collecting game design patterns, it frames our approach and is therefore described first.

While investigating the feasibility of a design pattern approach to games, we determined that the patterns needed to be grounded in invariant aspects of games. This would allow us, first, to navigate a collection of design patterns that could easily number into the hundreds; and, second, to more explicitly define the medium in which game design pattern emerge (to include both characteristics and specific elements of the medium)—and thus to more succinctly define the patterns themselves. To arrive at game design patterns that could describe how configurations of the physical and logical components of games affect gameplay, we needed a framework for these components.

From an analysis of the concepts used in the models described in the previous section, we developed an initial component framework. This framework was then expanded and refined by examining the relationship between its terms and by using it to describe games and interaction in games.

The components derived for the framework—what we identified as the basic "building blocks" of games with respect to game play—were selected on the basis of three principal criteria: (1) they could be clearly identified in archetypical games, (2) they did not overlap; and (3) they had a natural relationship with other identified components. This does not mean, of course, that all framework components are present in all games or that the framework optimally describes any given specific game genre. Nevertheless, and even though the components themselves may seem obvious or even trivial, study of how they are realized within games provides an analysis of a game on several levels, which are connected through the relations we have identified between the components. To structure the relation between the game components, we have divided them into four categories: (1) holistic components, which relate to the activity of gaming as a whole; (2) bounding components, which relate to gaming as an activity that can voluntarily be entered or left; (3) temporal components, which relate to it as a temporal sequence of events and action; and (4) structural components, which relate to gaming as an activity consisting of physical and logical components.

3.3.1 *Holistic Components*

Given a definition of what is required for an activity to be a game, we can then proceed to explore components that relate to the game as a holistic entity. These components help both to define how gaming differs from other activities and to describe how players can join—and end—a specific game.

Game Instance

A trivial observation of how a game is played is that every time it is played is unlike previous times, either in the constitution or experience of the game's players, the place where it is played, or the external circumstances under which it is played, such as a limit to playing time. Thus, even though a particular game does not change, the specifics of a single completion of game play—which, following Zagal et al. (Zagal et al., 1999), we take as defining a game instance—do.

Game Session

We define game session as the activity undertaken in a game instance by the game's players. The actual time a game session lasts varies greatly from game to game. In Paper-Rock-Scissors, it is only a few seconds, in most board games, it is a few hours, while in massively multiplayer online games, game sessions only end when one or more players lose interest in playing the game.

Play Session

The completion of a game session can be divided into several distinct periods of game play activity, play sessions, that are typically much shorter than the periods of time between them. For example, complex tabletop board games can require many hours to complete; to find the required time, players usually divide this time into play sessions lasting a few hours that are played over a period of several weeks. Play sessions, though tightly coupled to players, do not have to be tied to all players. Play-by-mail games, for example, have separate play sessions for each player that are only related by the requirement to synchronize game play. Massively multiplayer online games have a multitude of play sessions ongoing simultaneously that start, merge, separate, and disappear, depending on players' activities.

Set-up and Set-down Sessions

Each of the previous components can have specific phases, where the activities that take place do not constitute game play directly but are required nevertheless. These include preparing for playing by placing tokens, deciding what variants of setups to use, and noting game states for later game play. These set-up and set-down sessions allow the players to customize the game play experience in various ways and to undertake additional administrative or planning activities.

Extra-Game Activities

Activities done because a game (or game instance) exists and not directly related to playing the game itself, not even at the level of arranging or storing the game state as in the setup and setdown sessions, we define as extra-game activities. The boundary between game and extra-game activities can vary, of course, depending on one's perspective. For example, it is possible (and may be interesting in some cases) to argue

that buying a new pair of tennis shoes is, in fact, part of the preparatory phase of playing a game of Tennis. Likewise, it can also be argued that bragging that your name is on a highscore list is sometimes a more important aspect of the game than playing it. The extra-game activities component of the framework contains all the activities related to the game that do not have a direct impact on the game (or the metagame) state or players' strategies for a single game instance. Although the amount of extra-game activities is, of course, only limited by the players' time, interest, and imagination, the designers can provide mechanics within the game to support extra-game activities, which can have an impact on the overall game play experience.

3.3.2 *Bounding Components*

While holistic components describe how the activity of game play relates to other activities, bounding components define the purposes for playing the game and what activities are allowed when playing the game.

Rules

Rules dictate the flow of the game and have been a central aspect of most definitions of games. Although rules have a distinct place in the framework, they are also embedded in every other component: there are rules that govern what the game elements are, how they behave, what actions players can perform, and so on. Rules can be endogenous, explicitly stated as part of the game, or exogenous, implicitly understood but neither formally inscribed nor enforceable within the game. Typical exogenous rules are so-called house rules regarding the end conditions for a game.

Rules are in the boundary part of the framework: breaking rules openly ends game activities, or at least requires their reformulation to exclude the rule breaker. Because a player cheats only by breaking the rules, to expose cheating the other players must detect the faulty behavior. As noted by Huizinga (Huizinga, 1955), the person who cheats is not the one who makes the activity of playing impossible; it is the person who openly refuses to follow the rules.

Modes of Play

Games are typically structured to have different sections, phases or turns where the interface, available actions, information for the players—and thus also the activities—changes dramatically. We define modes of play to be these different activities within the larger activity of playing a particular game. Typical changes in mode of play are switching from a map view to an inventory screen in a computer role-playing game and turn-taking in Chess.

How many modes of play a game has depends on the level of detail used to define its possible states. Chess can be said to have either two modes (one player's turn and the other's) or as many modes as there are possible combinations of its piece locations.

Goals and Subgoals

The aim of players' plans and actions in a game are usually described as trying to complete goals. Since many games either make players compete against each other or let players decide for themselves what goals they wish to pursue, goals can vary from player to player. Furthermore, one player can have several goals that do not have to be related to each other. Many games give players several goals, where progress in completing one goal makes it difficult to complete the other; some games, such as Space Invaders or Pac-Man, which do not have a winning condition, deny players the goal of being the winner.

Goals in more complex games are often split into smaller subgoals, either to structure the game play (into levels or narrative structures) or to make the completion of the goal easier to achieve (acquiring new powers or tools, reducing opposition, etc.). Subgoals can be either predefined by the game or created implicitly by the players, in which case, creating subgoals that facilitate completion of the main goal can be seen as an indication of a player's skill.

3.3.3 *Temporal Components*

Used to record the activity of playing a game, temporal components either divide the larger game play activity into temporally separated activities or define the boundaries between those activities.

Actions

Although players can only change the game state by performing actions, the relation between actions and game state is usually one in which they can influence one another: actions available for a player typically change according to the current game state and mode of play.

Depending on the game, an action can be either continuous or discrete, that is, temporally defined by either its relation to real time or its relation to other actions. For example, Chess has discrete actions: the outcome does not change between two games played with exactly the same moves even when they take different amounts of time to play. A computer racing game, by contrast, has continuous actions: a difference in the time to complete the game changes its outcome. Generally, games that allow players to perform actions at all times have continuous actions.

A special case of actions are those which are handled by the game system as "other actions" even though they do not update the game state (they can be compared to the "no operation" command in computer assembly languages). A typical use of these is messaging between players in online games, where actions that do not affect the game state allow players to spread information.

Events

Discrete points in game play where the game state changes, events are most typically triggered by the completion of players' actions, which, if

discrete, are integrally connected to the events. On the other hand, they can also be triggered without player intervention, most commonly in computer games but also by mechanical means, such as a sandglass.

The definition of an event does not specifically have to state how the game state changes. Rolling the dice in Monopoly triggers the state change in which a player moves his or her piece to a new place, but the event of rolling dice does not itself specify which place. Determining this, as similar events where the change is not known a priori, is controlled by evaluation functions (described below).

Closures

The completion of a goal or a subgoal results in a closure, a change of game state that is clearly perceived as a semantically meaningful transition by players (typically, by a change in the mode of play). Closures also occur when players openly recognize that a goal is no longer achievable or when certain deterministic game events occur (e.g., emptying a drawing stack in a card game or completing a bidding round in poker).

End Conditions

Usually accompanied by an evaluation function, end conditions specify the game states when closures occur and, most importantly, when the game instance ends. As in the case of role-playing games or online first-person shooter games, they need not isomorphically map onto the goals in a game.

Evaluation Functions

The outcome of an event, such as the winner at the end of a game instance, is determined by an evaluation function. When it both determines the winner and causes the end of the game instance, the evaluation function is also known as the "winning condition." Thus closures can cause evaluation functions to be determined, which can in turn cause new closures. Scoring mechanisms in games are also examples of the use of evaluation functions.

3.3.4 *Structural Components*

Perhaps the most concrete category in the framework, structural components are the basic parts of the game manipulated by the players and the system. They can be either physical tokens representing real-world or imaginary objects, people or creatures, or abstract phenomena representing values or attributes. Structural components are key when one is fine-tuning the game balance or when one is focusing on the fundamental components that the players interact with.

Game Facilitator

The activity of playing a game requires that there be a means to ensure that the rules are observed. Players are responsible for making sure

the rules of the game are followed and for updating the game state in traditional games, such as ordinary board, card, and children's games,. In most computer games, these tasks may be handled partly or completely by the system. By contrast, role-playing games and gambling games make use of a game master or an umpire, respectively, to ensure that the game progresses satisfactorily. It can be argued whether such a dedicated individual is also a player, but in any case he or she also serves the role of a game facilitator.

Game facilitators are responsible for keeping the game state synchronized, making the necessary changes created by player actions, taking care of the game events, and informing the players about the officially approved methods of playing the game. Game facilitators are also the ultimate arbitrators of possible disputes.

Players

By choosing and performing actions, players are the entities that strive toward the goals in a game by choosing and performing actions. As the logical components that perform actions, can be interpreted as having strategies and goals, and can enter and leave the game, they need not be human beings. For example, in a singleplayer strategy game, the opponents controlled by the computer can be viewed as other players. Although normally the player is manifested in the game by a specific game element, an avatar, such as Lara Croft in the Tomb Raider series, in online board game lounges, beyond the actions they perform, players may be nothing more than names.

Interface

Players have access to a game through an interface, where game elements are represented as tokens, which come in different types and forms and can be manipulated in a wide variety of different ways, depending on the game type. Board games have counters, pieces and boards; card games, obviously, have cards as tokens; digital games have digital and audiovisual representations of similar tokens and are manipulated by keyboard, mouse, or other accessories. In other words, the look and feel of the game is specified by the interface.

Game Elements

The physical and logical attributes that help maintain and inform players about the current game state, game elements are normally also related to one another, thus creating game element configurations. These relations can be game elements themselves. The state of the game is the totality of the game element configuration at any given time. Changing a game element means that at least one of its attributes changes. For example, game elements can

- represent players (i.e. avatars);
- define the actions available to players (e.g., avatars, units, or cards);
- enable evaluation functions (e.g., rolled dice, shuffled cards), by themselves or together with other elements;

- represent entities that can perform actions (e.g., the ghosts in Pac-Man or NPCs in RPGs);
- spatially describe the game space (e.g., Chess squares, cards and emergent city walls, rivers, and roads in Carcassone);
- represent specific values of the overall game state (e.g., time left in Counter-Strike or in a time-limited Chess game);
- convey intra-game information (e.g., signs in Zelda);
- convey extra-game information (e.g., the rules of the game).

Element functions in this incomplete list can overlap; for example, the dice in Monopoly both define the action available (roll them) and determine the number of spaces to move.

Game Time

Because games have actions that affect the game state and thus also affect subsequent actions, the actions in a game session can be ordered sequentially on a timeline to describe what happens during the game time, the period of time the game is played. Because, however, not all games depend on the exact time an action is completed so long as it is completed in its position in the sequence, the timeline of actions does not always have to be measured in real time. Thus game time can be independent of the real time used to play the game, although, in some cases, it is directly linked, for example, in real-time games or races. The distinction between game time and real time helps explain why, from a game state perspective, it can be meaningless to note the passing of time in some games, for example, turn-based games, while the passing of time can strongly influence the players' experience of the same games. The distinction can also help explain both differences in real time and game time due to breaks and time-outs in synchronous games and differences in time use in asynchronous games.

3.4 DESIGN PATTERNS FOR GAMES

Although the game component framework set forth in section 3 describes individual aspects of a game design, it does not explicitly address how the components interact with one another during the playing of the game to create a game play experience. This aspect is addressed by game design patterns. In the following section 4, we describe both the theoretical and the empirical basis for our approach.

3.4.1 *Theoretical Foundation*

As mentioned in the introduction, the research fields that have studied games as designed artifacts—rather than as players playing games—have primarily been narrative fields such as literature, theater, and film. The focus on narrativity naturally tends to minimize the role of game play, which may explain the limited success of academic results adopted by the game industry.

This does not mean that narrativity and game play cannot coexist but, rather, that a focus on narrativity loses the perspective of games as activities. Typically the study of activities is confined to the fields of ethnography and anthropology. As a rule-based activity, however, games have explicit requirements and more clear-cut boundaries than other activities; their explicit formality makes it possible to study gaming activity in a detailed way without having to observe the people who play games, making it easier to focus on the activity itself instead of the people. This distinction is important. Unlike many other activities, gaming activity is designed. As such, it can be treated as an objective material to be shaped by the designer. Since the actual interaction cannot be designed, but rather the artifacts and rules that encourage or discourage the interaction, this view of game design has been called "second-order design" (Salen and Zimmerman, 2003). Further, it opens up the possibility of treating game design as a part of interaction design (e.g., Fullerton et al. 2004), which looks at both analyzing and designing systems with the focus on how they are used, although for historical reasons, that field currently focuses on the human-computer interface (see Preece et al. 2002).

Even though we early identified game mechanics as a promising starting point to describe interaction elements in games, to use game mechanics more effectively, we needed a structure to describe how they influence one another. Supporting this aspect of relations was the design patterns model (Alexander et al. 1977, Borchers 2001, Gamma et al. 1995), which codifies design knowledge in separate but interrelated parts, and which has been used to describe game elements related to interaction Kreimeier 2002. Further, because they can easily be converted into design patterns, game mechanics seemed to be an ideal candidate for our framework, although design patterns are less than ideally suited as analytical tools owing to their introduction as problem-solving tools:

> Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice. (Alexander et al., 1977, p. x)

Thus, even though design patterns might be made to serve our purposes, not all aspects of design can or should be seen as solving problems, especially in a creative activity such as game design which requires not only engineering skills but also art and design competences. To identify design patterns that supported these activities, we needed a suitable pattern template.

3.4.2 *Empirical Development*

To develop a suitable pattern template, individual game design patterns, and an overarching game component framework, we gathered data by three methods: (1) we converted game mechanics into game design patterns; (2) we harvested game design patterns through game analysis; and (3) we interviewed game designers to validate ideas and concepts.

Given the initial concept of game design patterns, we first set about examining game mechanics and converting them into patterns.

This included discarding a number of mechanics, merging some mechanics into one pattern, and especially identifying more abstract or more detailed patterns. The mechanics we started with were those in popular usage, as assumed from their presence on websites such as <www.Boardgamegeek.com>. Board games are the games most explicitly categorized by game mechanics; their mechanics can, in many cases, be applied to computer games and other game mediums.

Our second method was the "brute force" analysis of existing games, concepts, and design methods of other fields (such as architecture, software engineering, evolutionary biology, mathematics, and interaction design); from the fields of sociology, social psychology, psychology and cognitive science, we extrapolated possible person-to-person and person-to-environment interactions. Using a five-step iterative process (recognize, analyze, describe, test, and evaluate), we harvested more than 200 pattern candidates, together with unexplored but promising areas of interaction.

Finally, using our third method, we collected information about how game concepts are used in game development by interviewing nine professional game designers, who together represented the full spectrum of game media. This also allowed us to confirm the validity not only of our approach, but also of certain specific concepts and pattern candidates. All interviewed designers used terms such as genre, theme and mechanisms casually and were obviously very familiar with the concepts behind them, although they seldom mentioned mechanics by name (typical exceptions were board and card game developers use of *Bluff*, *Tension*, *Action Cards*, *Storytelling*, *Trading*, *Action Point*s, and *Cooperation*). Some of the designers were themselves interested in creating structured frameworks for games; several of them were also aware of design pattern methodologies, although they had not tried to apply them. The interviews provided confirmation that our proposed solution was compatible with the way developers worked and provided many concepts that could be developed into patterns.

3.5 GAME DESIGN PATTERNS DEFINED

Unlike most design pattern researchers, we do not define patterns as pure problem-solution pairs. We do not for two reasons. First, defining patterns from problems runs the risk of viewing them only as problem-solving tools for removing unwanted effects of a design, not as tools to support creative design work. Second, many of the patterns we have identified describe a characteristic that more or less automatically guarantees other characteristics in a game. That is, the problem described in a pattern might easily be solved by applying a more specific, related pattern. We believe that game design patterns offer a good framework for how to structure knowledge about game play that could be used both for design and for analysis of games. Accordingly, and based on the findings described above, we again offer our alterative definition: game design patterns are semi-formalized interdependent descriptions of commonly reoccurring parts of the design of a game that concern game play.

3.5.1 *Game Design Patterns as Semi-Formalized Descriptions*

Due to the nature of the design process, game design patterns rely on general descriptions of particular areas of game play without using quantitative measures. Indeed, neither the presence nor the effect of game design patterns can be measured accurately, and automating their use is practically impossible. Thus any specification of game play that relied on measures would be too precise to be of practical use for solving the ill-defined problems of design. On the other hand, game design patterns do have a structure, they can be distinguished from one another, and relationships between them can be identified in a game design. This makes game design patterns semi-formalized concepts that have to be understood and applied differently in the different contexts of their intended use.

3.5.2 *Game Design Patterns as Interrelated Descriptions*

Although all patterns in any given game are related to one another in some form, some types of relations are more common and can more easily be identified and constructed. We have identified three pattern relations—two asymmetric and one symmetric—that are both common and useful for analytic and design purposes.

Instantiating: When one pattern has an instantiating relation to another pattern, the presence of the first pattern causes the second pattern to also be present. This is due to the fact that the design possibilities described by the first pattern limit the freedom of the designer in such a way that the design possibilities of another pattern follow automatically. (A variation of this relation is when the combined effect of two or more patterns together limits the game play space in such a way that another pattern emerges automatically.) A second pattern induced by a first in this asymmetric relation is instantiated by that first pattern.

Modulating: When one pattern has a modulating relation to another pattern, it can be used to change aspects of the other pattern in a way that influences game play. The modulating pattern works within a limited design space that is bounded by other restrictions regarding game play. Modulating relations are not instantiating relations since the design possibilities they describe do not limit the game designer to have to use the modulating pattern, rather the modulating pattern offers possibilities for fine tuning another pattern. This also means that the first pattern has to exist before it is possible to use the modulating pattern. A second pattern affected by a first in this asymmetric relation is modulated by that first pattern.

Potentially Conflicting: When one pattern has a potentially conflicting relation to another pattern, it can, in certain configurations, make the presence of the other pattern impossible and vice versa. This incompatibility affects a particular area or level of game play: patterns that are potentially conflicting can often be found in the same game but on different levels. A pattern having this symmetric relation to another potentially conflicts with the other, and vice versa.

3.5.3 *Game Design Pattern Template*

Based on the characteristics of game design patterns, we developed a template for describing the patterns. The template contains seven sections: (1) name; (2) core definition; (3) general description; (4) using the pattern; (5) consequences; (6) relations; and (7) references.

Name

Although not explicitly stating this in the template, we have tried to give the game design patterns short, specific, and idiomatic names, mainly to provide mnemonic support for remembering the pattern description. Where a pattern was adapted from a concept in another research field, we have retained the name of that concept to provide a link to that field. To minimize the number of names that need to be remembered, we have deliberately not included aliases; instead we take an approach similar to that of a dictionary by providing synonym-analogues in the form of references to similar concepts in other models and fields of study.

Core Definition

A brief sentence in italics immediately following the name, and describing the core idea of the pattern, the "core definition" section is intended to provide an overview for first-time readers browsing through a pattern collection and to remind returning readers of the contents of the pattern.

General Description

Following the core definition, the "general description" section, which often notes in which game the pattern was first identified and whether it has been identified in previous game design models, explains how the pattern affects the structural framework (especially if the pattern can be instantiated on different scales in the game) and cites examples of games where the pattern is typically found.

Using the Pattern

Even though the application of a particular pattern to any given situation requires a number of design choices specific to that situation, high-level choices can often be divided into categories. The "using the pattern" section mentions common high-level choices that face a designer wishing to apply the pattern, often citing a specific game component from published games.

Consequences

Each pattern has its own trade-offs: in solving one problem, it can cause or amplify other problems. To make a design decision for or against a given solution, a game designer must understand its costs

and benefits and compare them with those of alternative solutions. The "consequences" section describes the likely or possible consequences of applying the solution suggested by the pattern.

Relations

This section lists the relations between the described pattern and other patterns by the five identified categories of relations: instantiating, modulating, instantiated by, modulated by, and potentially conflicting.

References

This section lists previous works that have either directly inspired the pattern or describe its main aspects.

3.6 EXAMPLES OF GAME DESIGN PATTERNS

The following two pattern examples, Resources and Producer-Consumer are from the "Resources and Resource Management" chapter of the book Patterns in Game Design (Björk and Holopanien, 2005).These and other design patterns mentioned in the examples are capitalized and in italics.

Resources

Resources are game elements used by players to enable actions in a game.

Resources are the representations of commodities that may be used to fund actions in the game or that may be is depleted by other players' actions. A commodity may exist as a physical game element or as a purely virtual one, or may alternate between both. Common *Resources* in computer games include health and ammunition in first-person shooters, money and units in real-time strategy games, hit points and mana points in role-playing games, action points in turn-based games, and players and money in sports management games.

Example: The board game Space Hulk gives each unit a number of action points at the beginning of a turn. These points are a form of *Resources* that pay for the actions of the units.

Example: The computer game Victoria makes complex use of resource refinement. Thus producing a Tank unit in the game requires producing the Tank commodity, which in turn requires *Resources* refined from other *Resources*, and so on.

Using the Pattern

The primary question regarding *Resources* is what they are used for. Generalizing, *Resources* are used to win comparisons with other players in evaluation functions; they can sometimes be converted into actions (possibly providing *Privileged Abilities*) or other more valuable *Resources*. Typically, *Resources* are used or consumed by paying for actions through *Budgeted Action Points*, becoming part of objects built through *Construction* actions, or being destroyed due to *Damage*. Other actions that require the use of *Resources* are *Aim & Shoot* and *Betting*.

Resources can be used for several different purposes; for example, as *Budgeted Action Points*, they can be used both to modulate the *Right Level of Complexity* and to force players to make *Trade-Offs*. Games using one *Resource* for multiple purposes include the board game Carolus Magnus, where markers can be used to strengthen a fraction's control over an area or the player's control over the fraction, and the card game San Juan where each card represents a good, a colonist, money, and a building.

After determining what *Resources* are used for, the next question is how players gain access to them. Players may start with *Nonrenewable Resources* to promote *Stimulated Planning* for the whole game session, they may be required to collect the *Resources* from the *Game World*, *Resource Generators*, or *Chargers*, or they may receive *Resources* as *Rewards* for completing certain goals. Regardless of how players obtain the *Resources*, the game may be set up to promote either *Symmetric Resource Distribution* or *Asymmetric Resource Distribution* to enforce different strategies and *Varied Gameplay*. Unless used in a controlled fashion to provide *Handicaps*, however, *Asymmetric Resource Distribution* may negatively affect *Player Balance*. Goals that give *Resources* as *Rewards* are, in most cases, *Supporting Goals*. In addition to completing goals and *Collecting* them, players may be able to redistribute *Resources* among themselves through actions such as *Trading* and *Bidding*.

The *Resources* available at the beginning of game play may be the only *Resources* that exist, or they may be *Renewable Resources*, in which case, they may be produced from *Resource Generators*, handed out at regular time intervals, or given as *Rewards* for completing goals. All these options are examples of how *Producers* can create *Resources*, and together with how the *Resources* are consumed, they form *Producer-Consumer* patterns. When the *Resources* are collected from the *Game World*, several additional design choices are required, including the location of the *Resources*, who can see them, and whether there are *Clues* to where they can be found. Are they *Secret Resources* that are hidden by *Fog of War* or can they only be detected by *Privileged Abilities*? Are they *Rewards* for finding *Easter Eggs*? Do they appear in different amounts or concentrations? How much time is required to collect them? What game elements can collect them? Does the possession of them affect game element characteristics? Are they physical entities in the game and, if so, can they be converted to virtual ones? Do players have influence over how *Resources* are divided between players through *Player-Decided Distribution of Rewards & Penalties*?

Once possession of a *Resource* is obtained, does it need to be stored in a *Container*, and is there a maximum limit to how much of it can be stored? Does the *Resource* need to be used before a certain *Time Limit* has expired? Can the *Resource* be lost as an effect of *Penalties*?

The next question is how control of *Resources* is decided. Are they *Shared Resources* whose use several players need to agree upon through *Negotiation*, or are they manipulated by all players through *Indirect Control*? Is ownership changeable, that is, can other players steal *Resources* by various actions that have *Transfer of Control* effects, or can the players change *Resources* through *Trading*? When *Resources* are contested but are also used to produce *Units*, the struggle for *Resources* can become a *Red Queen Dilemma*, where gaining control over

larger amounts of *Resources* can only be achieved by consuming larger amounts.

In games where several different types of *Resources* are used, knowing how and when to convert one form of *Resource* to another may be part of the *Strategic Knowledge* of the game. The conversion may have inefficient exchange rates (by use of *Diminishing Returns*), may require access to a *Converter*, or may only be possible through *Trading* with other players.

Resources usually have to fit within the *Consistent Reality Logic* of the game, except when *Time Limits* prevent *Analysis Paralysis* or when *Resources* are primarily used to determine winning conditions. In this light, the concept of *Score* can be seen as a *Resource*, which is used to determine the winner of a game.

Units are common *Resources* in god games. The games Lemmings and Pikmin both make use of different types of *Units* that players have to direct to achieve goals while making *Trade-Offs* between various actions and what *Units* to use. The equivalent to these *Resources* in games using *Avatars* is *Lives*.

The introduction of *Time Limits* or *The Show Must Go On* in games makes time a *Resource* that has to be used efficiently. The computer game Space Hulk uses two modes of play: a strategic mode, where nothing happens but time is limited, and a real-time mode, where the *Time Limit* is replenished but commands cannot be given to *Units*, to force players to promote *Tension* together with *Stimulated Planning*.

Consequences

By providing players with quantifiable measures to judge their progress and plan possible future actions, *Resources* are one way for players to have *Emotional Immersion* in games. The *Resources* can either exist from the beginning of game play or be created through *Producers*, and are either destroyed by *Consumers*, transformed through *Converters*, or belong to *Closed Economies*. Games whose goal consists of *Collecting* various types of *Resources* can use the number of owned *Resources* as a *Score*; games having a separate *Score* system often use *Resources* as a second-order *Score* system to function as *Tiebreakers*. The presence of *Resources* in *Game Worlds* can motivate *Area Control* goals or, in the case of *Secret Resources*, *Exploration* goals. *Resources* are often also used to give *Characters* acting as *Consumers* or *Converters* the ability to perform actions. In some games, the distribution of *Resources* among players decides the order of *Turn-Taking*.

Relations

Instantiating: *Collecting, Score, Stimulated Planning, Varied Game Play, Strategic Knowledge, Trade-Offs, Easter Eggs, Rewards, Penalties, Red Queen Dilemmas.*

Modulating: *Player-Decided Distribution of Rewards & Penalties, Player Balance, Tiebreakers, Construction, Area Control, Turn-Taking, Characters, Emotional Immersion, Exploration, Game World, Supporting Goals.*

Instantiated by: *Score, Units, Clues, The Show Must Go On, Time Limits, Lives, Budgeted Action Points, Indirect Control.*

Modulated by: *Symmetric Resource Distribution, Asymmetric Resource Distribution, Converter, Container, Secret Resources, Nonrenewable*

Resources, Shared Resources, Renewable Resources, Limited Resources, Ownership, Transfer of Control, Resource Generators, Handicaps, Secret Resources, Time Limits, Trading, Diminishing Returns, Damage, Aim & Shoot, Betting, Producers, Consumers, Closed Economies, Chargers, Trading, Bidding, Producer-Consumer, Investments.

Potentially Conflicting: None.

Producer-Consumer

Producer-Consumer determines the lifetime of game elements, usually Resources, and thus governs the flow of game play.

Games usually have several overlapping and interconnected *Producer-Consumers* governing the flow of available game elements, especially resources. As *Resources* are used to determine the possible player actions, these *Producer-Consumer* networks also determine the actual flow of the game play. *Producer-Consumers* can operate recursively, that is, one *Producer-Consumer* might determine the lifetime of another. *Producer-Consumers* are often chained together to form more complex networks of *Resource* flows.

Example: In Civilization, the units are produced in cities and consumed in battles against enemy units and cities. This kind of *Producer-Consumer* is also used in almost all real-time strategy games.

Example: In Asteroids, the rocks are produced at the start of each level and are consumed by the player shooting at them. The same principle applies to many other games where the level of progression is based on eliminating, that is, consuming, other game elements: the pills in Pac-Man, free space in Qix, and the aliens in Space Invaders.

Using the Pattern

As the name implies, *Producer-Consumer* is a compound pattern of *Producer* and *Consumer*; as such, this pattern governs how both are instantiated. Because the produced game element can be consumed in many different ways, the effect of producing and consuming *Resources* or *Units* often turns out to be several different pairs of *Producer-Consumers*. For example, the *Units* in a real-time strategy game such as the Age of Empires series can be eliminated in direct combat with enemy *Units*, when bombarded by indirect fire, and finally when their supply points are exhausted. The *Producer-Consumer* in this case consists of the *Producer* of the *Units* with three different *Consumers*.

Producer-Consumers are often, especially in *Resource Management* games, chained together with *Converters* and sometimes with *Containers*. These chains can in turn be used to create more complex networks. The *Converter* is used as the *Consumer* in the first *Producer-Consumer* and as the *Producer* in the second. In other words, the *Converter* takes the *Resources* produced by the first *Producer* and converts them to the *Resources* produced by the second *Producer*.

This kind of *Producer-Consumer* chain sometimes has a *Container* attached to the *Converter* to stockpile produced *Resources*. For example, in the real-time strategy game StarCraft, something is produced and taken to the converter and then converted to something else and stockpiled. *Investments* can be seen as *Converters* that are used to convert *Resources* into other forms of *Resources*, possibly abstract ones.

Consequences

As is the case with its main subpatterns *Producer* and *Consumer*, the *Producer-Consumer* pattern is quite abstract, although effects on the flow of the game are very concrete. Simply put, *Producer-Consumers* govern the whole flow of the games that have them, from games with a single *Producer-Consumer* to those with complex and many layered networks of *Producer-Consumers*.

The feeling of player control is increased when players are able to manipulate the *Producer*, the *Consumer*, or both; adding new *Producer-Consumers* over which the players have control gives them opportunities for more *Varied Game Play*. In more complex *Producer-Consumer* chains, however, where the effects of individual actions can become almost impossible to discern and the process no longer has *Predictable Consequences*, players can lose the *Illusion of Influence*. *Producer-Consumer* networks with *Converters* and *Containers* are used in *Resource Management* games to accomplish the *Right Level of Complexity*; the games usually start with simple *Producer-Consumers* and add new *Producer-Consumers* to the network to increase the complexity as they progress.

Relations

Instantiating: *Varied Gameplay, Resource Management.*

Modulating: *Resources, Right Level of Complexity, Investments, Units.*

Instantiated by: *Producers, Consumers, Converters.*

Modulated by: *Container.*

Potentially Conflicting: *Illusions of Influence, Predictable Consequences.*

3.7 USES

Unlike earlier users of design patterns in architecture or software engineering, we do not propose a single use (problem-solving) for design patterns. Instead, we see the patterns and the structural framework as tools that, like a pen, can be applied in several different ways for several different purposes by several different user groups having inherently different working methods. On the other hand, we have identified a number of promising uses for patterns within both academia and the game industry, although we have yet to collect substantial amounts of data regarding the relative feasibility and merit of these proposed uses.

Because the use to which any given game design pattern is put very much depends on the specific use context and how rigorously its use is structured, we see no reason to limit potential users. Thus a pattern used by academics categorizing games and genres could also be used by critics writing reviews or by gamers making decisions about purchases. But we do wish to stress that game design patterns, with their neutral, jargon-free definitions based on the interaction in games, can greatly benefit multidisciplinary groups by facilitating communication between disciplines.

3.7.1 *Generating Ideas*

Game developers can use the patterns to give inspiration by simply randomly choosing a set and trying to imagine a game using them. A more structured approach is to study an individual game design pattern and try to implement it in a novel way.

3.7.2 *Developing Game Concepts*

Once an initial game concept exists, it can be developed using patterns. By describing the concept as a small set of patterns, developers can then flesh it out and make more specific design choices, deciding how to instantiate those patterns through related patterns, and studying how the different design patterns interact. The process can be iteratively refined, by examining the chosen pattern until the preferred level of detail is achieved.

3.7.3 *Designing Games*

Having a game described using patterns offers advantages when marketing the game design. Patterns allow one to present a structured description of the design as well as motivations for particular design choices by showing how replacing a pattern with another pattern would change the design, or more advantageously, by relating that game's use to other games' uses of the same patterns.

3.7.4 *Identifying Competition and Intellectual Property Issues*

As a side-benefit of having identified the patterns in a game design, one can identify competition, in the form of what the game will be compared to, by the examples given in the patterns. Further, references in game design patterns may point to patents that can influence the development of commercial game products.

3.7.5 *Problem-Solving during Development*

Similar to the rationale for FADTs and the 400 Rules, game design patterns are a way to collect the knowledge and experience of game developers. As such, they contain descriptions and motivations for how one can modify game designs to solve issues relating to game play.

3.7.6 *Analyzing Games*

The availability of a pattern collection can provide a simple way to start analyzing an existing game. Having iteratively gone through the collection to determine whether a pattern exists in a game and, if so, to what degree, one can then gain further information about the game by studying whether previously identified related patterns have been

used to create a pattern or whether novel game components have been introduced.

3.7.7 *Categorizing Games and Genres*

Assuming that a patterns-based analysis has been performed on a collection of games, these can then be categorized according to their similarities and differences. Besides offering a multitude of ways to measure how games compare to one another, collections of patterns found in games belonging to a particular genre can be used to describe that genre in greater detail.

3.7.8 *Exploring New Platforms and Media*

The commercial success of sequels and branding has led the game industry to become conservative not only in thematic and game play styles, but also in platforms and media. We believe that the use of game design patterns can help the industry explore new types of game platforms and media by providing a structured way to compare how game play changes with a changed environment. This is especially true for novel game media, such as pervasive gaming, which is a development of computer games but needs also to function in social environments similar to those of more traditional games.

3.8 DISCUSSION

One might object that the use of game design patterns takes the creativity out of game design or makes the designers "mere pattern-cranking machines" that automatically churn out games. Another common objection is that the use of patterns will lead to games falling into stereotypes, where nothing new is or can be created. Both these objections stem from confusing the everyday meaning of pattern as something repetitive with the basic philosophy of design patterns as introduced by Alexander. Although, for this reason alone, the choice of the term pattern might be regarded as a mistake, because it has a clear and firmly established meaning in several professional fields, we see no need to invent a new term, something that, indeed would lessen the usefulness of the pattern concept as a tool to overcome communication differences between various professions. The use of game design patterns might more appropriately be compared to the artistic endeavor in general: artists have a much better chance of creating something novel when they are familiar, if only unconsciously, with the basic elements of their craft, be it painting, composing, or scriptwriting, then when they are not.

Because the framework we have presented here, while incorporating components from as many types of games as possible, has tried to keep the number of these components within manageable bounds, it is restricted to a certain level of abstractness. Nevertheless, we have identified areas, such as classifying game elements more fully, that can be developed further on a general level without having to focus on specific games or on specific physical representations of game elements.

We believe that, for many practical uses, our two main concepts can be used independently of each other. That is, design patterns can be used without reference to the component framework and vice versa. One can, for example, in early concept development use the patterns alone, or in creating an object-oriented model for computer implementation of a game, make use of the component framework alone.

The loose coupling between our main concepts actually allows either to be replaced by another simpler, more complex, or functionally different concept, depending on the intended use. The prime methods for developing game design patterns and the component framework were structural and functional analysis of existing games, taxonomical categorization of the components identified, and experimental design, which we believe are reflected in the two concepts.

On the other hand, we also believe that in most cases, the component framework and game design patterns can be used together when analyzing and designing games, and in a style similar to that of the core concepts identified in Rules of Play (Salen and Zimmerman, 2004), which can be applied in a number of different ways (or "game design schemas" as they are called in that book).

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4

TEACHING GAMEPLAY DESIGN PATTERNS

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The *gameplay design patterns* approach to designing games is introduced and three main challenges (romantic vision of game design, transferring explicit knowledge to tacit knowledge and vice versa) in teaching the approach are identified and described. The use of gameplay design patterns in teaching game design is illustrated with examples from game design courses, workshops, and a description of a design tool called CAGE. The problems encountered in the examples are discussed in the light of the identified challenges. Strengths and weaknesses of the teaching methods and the approach itself are discussed and some improvements are suggested.

Keywords: gameplay design, design patterns

4.1 INTRODUCTION

Design patterns (Alexander et al., 1977) were introduced within the discipline of architecture for easy knowledge transferral between professionals and non-specialists. These patterns encode design practices as problem-solution pairs with accompanying information and are interrelated with each other to form hierarchies or nets. From their origins within architecture the ideas of design patterns have been spread to several other areas, e.g. programming (Gamma et al., 2001) and interaction design (Erickson, 2000, Borchers, 2001).

The idea to use design patterns for game design was introduced by (Kreimeier, 2002) in the context of computer games and has since then been generalized to all types of games (Björk et al., 2003), resulting in a pattern collection of nearly 300 gameplay design patterns (Björk and Holopainen, 2005a). These patterns differ from the original structure by replacing the problem-solution pair with a with causes-consequences pair describing how the pattern can occur in a game design and how it can affect the gameplay and player experiences. The reason for this change is twofold: to support both design and analysis of games and to allow designers to use the presence or absence of a gameplay design pattern as a design goal. The patterns also have a more detailed relationship structure, having five types of relations in contrast to the original parent and child relations.

Design patterns are an example of explicitly creating a design language (Rheinfrank and Evenson, 1996), which is a way of understanding a design discipline through what elements (materials) are

relevant, how these elements can be structured, and situations when specific elements and choices of structures are appropriate. Specifically, they let those involved in the design process consciously embed meaning into that which is designed and let people, if they are fluent in the design language, understand that meaning and thus support how, or if, they wish to assimilate that design into their lives. An additional purpose with having a design language is due to the problem of requirements of large-scale design projects, which are becoming more and more common in many areas but especially in the design of commercial computer games. Jones (1992) states that these modern design problems require the knowledge of many disciplines and that explicitly described design methods are needed to facilitate collaboration between the representatives of those disciplines and to let all participants understand the needs and possible outcome of all steps of a design process. These design methods should not be seen as complete design languages in themselves; rather they are tools that are applicable to specific elements of the design language depending on localized goals. Similarly, design patterns are not complete design languages in themselves since they do describe the basic elements nor describe the steps of a design process. Another motivation for design languages comes from the idea of the Reflective Practitioner (Schön, 1983), which stresses the importance of designers to be able to step back from practical work and objectively reflect on the current situation. Just as sketching can support the exploration of a design space for a visual form, design languages can support the exploration of the design space of more abstract design fields, e.g. interaction design or gameplay design.

The above mentioned collection of gameplay design patterns was developed with the goal of being a basis for a design language for gameplay design. Although based upon interviews from game designers and studies of existing games, it is in one sense an artificial language. This is because, like all other pattern collections and most other descriptions of design languages, it is constructed by a small group of people and does not have a "natural" base of native speakers. This paper describes our experience with spreading the gameplay pattern collection, both to support people in understanding gameplay design but also, like any language in use, to study how people want to expand and refine the language for their own uses. We limit our discussion to how we have taught gameplay design patterns to students at bachelor or master level education. Thus we specifically do not look at how PhD students or more merited people have used or are using gameplay design patterns, nor do we discuss their use in master theses since these vary significantly in form and process due to chosen area of each thesis project, e.g. patents (Davidsson, 2004), Items in MMORPGs (Söderqvist and Larsson, 2006), and rehabilitation games (Goude, 2007).

4.2 CHALLENGES WITH SPREADING THE WORD

After creating the pattern collection we have used these in several different cases for teaching design and analysis of gameplay. Based upon initial discussions with game design professionals and from the theories of design mentioned above, we have identified the following challenges in teaching the design patterns approach to gameplay.

4.2.1 *Challenge 1: the romantic vision of design*

The first challenge lies with the public view of design and other creative activities as being done by people with a born talent for creativity. This is in opposition to the views of Jones regarding modern design problems and to Alexander's goal of enabling non-specialists to participate in design processes, which both stress the importance of allowing co-operation between all stakeholders of a design process. This is a challenge to all design educations but one specific reason why this persists for game design is that the game industry is relatively young and the most well-known designers within it are self-taught. Also, many regard game design as being an art form of its own and that explicit and structured design methods are incompatible with the goal of producing something unique.

4.2.2 *Challenge 2: transferring tacit knowledge to explicit knowledge*

An argument why the romantic vision of design is not suitable for gameplay design education is that many representatives from the industry have stressed the importance of making the knowledge within the industry explicit (Costikyan, 2002, Spector, 1999, Koster, 2004). However, that doing so is a non-trivial activity can be deduced from the fact that progress within the industry itself has been very slow since the issue was recognized, with the 400 project being the most developed.

One of the problems with explicitly developing design languages is that the need for an explicit language only becomes apparent when there are breakdowns in a design process, and then the effort typically has to be focused on the practical problem at hand rather than the development of a design language. Another may be that the more tacit knowledge one has, the more work is required to document this as a form accessible to non-specialists. These two reasons may be the cause why there has so far not been a strong effort from the industry; the people who are most skilled at gameplay design are assumingly those that have least breakdowns in their design processes, and they also realize the amount of work required to document their knowledge. Even if presented with a documented body of knowledge these experts would have to spend considerable energy to make their knowledge explicit and contrast it to the documented version. Students that are hobby designers or avid players of games have tacit knowledge similar to professional designers and this typically means that students having the most knowledge of gameplay design have the biggest difficulties aligning themselves to any explicit knowledge description.

4.2.3 *Challenge 3: transferring explicit knowledge to tacit knowledge*

The above challenge is not problematic for a student with less or no practical knowledge of gameplay design. However, although these students may easily see the usefulness of explicit design knowledge documentation they have the challenge of turning that knowledge into practice. One particular reason for this is that without knowledge of previous work it is difficult to visualize the possibility space of any given design problem and to judge the novelty of any given design.

Like many pattern collections, the design pattern collection for gameplay has the additional challenge that the collection consists of many patterns. This poses both a psychological threshold to beginning to use the collection and a cognitive problem of having an overview of which patterns exist.

4.3 COURSE EXERCISES

The smallest and also most controlled use of gameplay design patterns has been as the basis for hand-ins and exercises in a game design course and the following game development project course for computer science students. During the three years the courses have been given (with approximately 55 and 30 students each year for the two courses respectively) several types of exercises have been tested and refined based upon the experience.

The first year the students were given the whole pattern collection as background material for two assignments in the game design course. In the first, the task was to analyze two games from different genres to identify similarities and differences, and had the hidden agenda of familiarizing the students with the pattern collection. The second exercise was to create a game design where the students were free to choose the method for creating a concept but were required to use gameplay design patterns to document the concept. Two issues with this use of patterns were identified. First, the collection was so large that students had problems having an overview of them and this led them to mechanically go through the collection and mark the presence or absence of patterns without making any deeper analysis. This mechanical process did not make use of the students' own knowledge to a large degree, indicating a problem regarding mapping between tacit and explicit knowledge. This was probably due to the task being too general and could probably be solved by requiring students to specify their own hypothesis before beginning the analysis. Second, when given the freedom of choosing their own methods for the second exercise the students fell back upon what is usually wrongly called brainstorming, i.e. undirected discussions. This meant that they came up with an idea which was then refined in various ways and the presence of gameplay design patterns in the design was checked after the design document was finished, reflecting the presence of both challenges 2 and 3 regarding transferral between explicit and tacit design knowledge. In practice this meant that the students analyzed their own games after they had finished the design to find patterns rather than use patterns to create the design.

Several changes were made for the second year in order to address the identified problems. Exercises replaced hand-ins so that teachers could provide guidance and the exercises focused upon design rather than analysis. Further, students were only given parts of selected patterns and these were described as game mechanics. The first exercise consisted of remaking one of three games by removing a specified pattern and adding one from one of the other games. The second consisted of choosing three patterns from a collection of five and creating a core gameplay from those. These exercises worked better than the hand-ins from the first year in that students could quickly

make use of the explicit design choices the patterns described and could put them to use in a design process. However, since the students were not given the complete patterns they did sometimes interpret the patterns differently than their extended descriptions and they did not make use of the interrelationship between them.

To address the issue of using the complete patterns and their relationships to each other two additional exercises were added to the game project course, where the pattern collection book was used as a text book. In the first exercise students had to make an analysis of what design patterns existed in a game chosen from a set of eight games, and in the second exercise they created a game design by choosing a set of three patterns that described an initial game idea and then iteratively expanded this by exploring one pattern and choosing one of its related patterns to add to the idea until a complete concept had been developed. A requirement for students to find a new pattern was part of the first exercise to avoid mechanical searches of the collection. These new exercises worked much as intended, especially to make students realize that they could expand the collection themselves or create their own collection, and the open question currently is how to integrate the exercises with the work in the large project itself.

4.4 WORKSHOPS

During the last couple of years we have used the gameplay design pattern approach in several workshops, ranging from three days to a full week, in various European universities and institutions offering game design courses. The students participating in these workshops have ranged from architecture and industrial design (Hochschule für Gestaltung und Kunst Zürich, ETH Zürich) to students attending full-blown game development programs (University of Gotland, Sweden; Berlin Games Academy, Germany).

The structure of the workshops has remained fairly consistent. After introductory lectures into game design and design methods, the gameplay design pattern approach is introduced by lectures, examples, and a pattern creation exercise. After these lectures the pattern collection is gradually introduced to the students by analysis and design exercises. The students then build game prototypes using the existing pattern collection and patterns created by the students themselves during the workshop.

In the prototype design the students are first asked to select from three to five existing patterns as starting points or design requirements for their game. The students are also provided with higher level design constraints mainly addressing the type of the game and the available prototyping material. For example, in one of the workshops we asked the students to design a game for two to eight people, with playing time of less than 20 minute, and that only cardboard, paper, strings, dice, coins, and various board game counters is allowed in the prototype. The students were also asked to keep notes of the design process: what new patterns were introduced to the design and in what ways the new patterns change the gameplay properties. This way the students have to both make their design choices explicit and also to think about how to use the gameplay design patterns in real design situations, potentially

overcoming challenges 2 and 3. In the end most of the students have been able to construct playable prototypes and to describe the effect of gameplay design patterns in the final prototype.

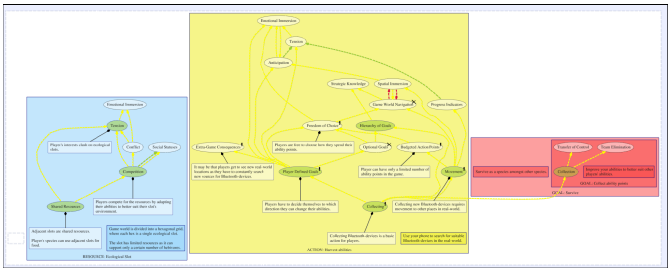
The concept and prototype creation in the workshops use the iterative game design process (Fullerton et al., 2004). After coming up with the high concept describing the main gameplay features such as the role of the players, high level goals, and basic actions the students start to make the prototype in a highly iterative fashion. First, the core gameplay mechanics (Fullerton et al., 2004) based on the required patterns are decided upon and the first somewhat playable prototype is created using the available material. The prototype is then playtested, refined, and the patterns used are gradually added, deleted, and modified after each playtesting round. It is common that during the first couple of iterations the design of the game is changed even dramatically. When the core mechanics have been stable the students fine-tune and balance game mechanics in order to make the final prototype more playable and in most cases enjoyable.

It has been evident during the workshops that the gameplay design pattern approach is not necessarily suitable for all kinds of game designer styles. Some students seem to have difficulties in making their own design thinking and process explicit even for themselves and, probably for the same reason, are more inclined to base their design ideas and decisions more on the intuition than on explicit statement of design situations and choices. Although we have not collected data on their background, a likely cause for this is that they belong to the group of people discussed under challenge 2 that already have significant tacit design knowledge or those that have a romantic view of design. On the other hand, some of the students adopt the patterns approach fairly fast during the exercises. One of the students expressed this eloquently: "I first thought that the patterns were a load of crap, but right when I started using them in my own design I realised that they are useful, they reflect to a certain extent how I have always been thinking about game design". Many students have made similar comments, reflecting challenge 1 either through an objection to the pattern concept in particular or the use of explicit codification of design knowledge in general. Based upon this feedback, we have come to the conclusion that even though the introductory lectures are good for providing the intellectual background for the patterns approach the student cannot judge the usefulness of patterns without trying to use them in practice, reflecting the challenge 3 of transferring explicit design knowledge into tacit knowledge.

Another issue that students have mentioned is that the current pattern collection, due to its size, is difficult to grasp and navigate and that it is far from easy to understand the relations of the patterns in a specific game design. We have encountered the same issue also in our own design work. The pattern visualization tool CAGE described below could alleviate the problem but, unfortunately, we have not yet had the opportunity to use CAGE in the workshops.

4.5 CAGE – A GAMEPLAY DESIGN PATTERN TOOL

CAGE (Kuittinen, 2008)is a visualization tool that allows designers to build structural drawings of game designs in terms of the various elements, including gameplay design patterns, within the games. The drawing is not a process model of a game or a model of the system interaction but a conceptual model of the description of a game i.e. it is a visualization of the description (see Figure 1). In many ways CAGE is similar to a group of software tools known as CASE-tools (Computer-Aided Software Engineering; Chikofksy, 1993) which are used in software development for conceptual modelling of software. CAGE follows a top-down -approach to game design where the architecture is laid out first and incrementally defined in more detail, thus supporting iterative approach to design.



At the higher level, game design is understood as consisting of a group of meaning-producing elements and their interrelations. As such, these elements can be used to specify a skeleton, or architecture, for the design. The elements can be connected to other elements and they can also be inside other elements. The lower level complements and describes the higher level more thoroughly consisting of more detailed aspects for each element and stricter rules for describing the elements and their inter-relations. This layer is defined with game design patterns. The visualisation of these two layers is the key idea of CAGE. In game design, it is especially important to see how complex one's design is and what any consequences are of modifying it. In CAGE, these two requirements are featured in the lower abstraction level.

CAGE is not a designing tool for game mechanics or a testing tool, but a tool for understanding and refining a broad view on a particular game design. Typical ways of communicating the design to other members of the development group are game design documents and, as previously mentioned, prototyping. Although both are essential in a game development process, they are not perfectly suited for easy comprehension. Game design document is a specification of the game defining much specific information that may not necessary support a holistic understanding of the gameplay and at the same time, it usually does not describe reason for the decisions made during design. Prototyping as a testing and refinement tool, on the other hand, is more useful in describing individual game mechanics than the whole game. Therefore, CAGE attempts to improve game design comprehension by providing a description model between these two with the goal of also providing the reasons for various design decisions - not focusing purely on what the design is but also why it is.

As intended CAGE has proven to be at least somewhat useful tool for both gameplay analysis and gameplay design (Goude, 2007).

We have not yet assessed the full impact of using CAGE in a larger game development project but intend to do so in our pervasive and mobile phone game prototyping projects.

4.6 CONCLUDING DISCUSSION

We conclude the paper by summarizing our suggestions for how to most efficiently teach gameplay design patterns.

4.6.1 *Design patterns is one tool in a set of tools*

The first observation regarding gameplay design patterns is that it is not a complete solution for either designing or analyzing games. This became obvious when students either applied them mechanically, as in one of the exercises, or, as for some participants of the workshops, did not see the purpose of patterns. We believe this is at least probably due to the students perceiving patterns as a proposed universal solution, and for the workshop participants rightly rejecting that view. To avoid both these cases it is important to clarify that a design pattern collection is only one part of any given design language, and should be seen as one tool that is most efficiently used together when equipped with other such tools, such as the design methods suggested by Jones, 1992. This has proved to be a way of mitigating fears and objections from students that have the romantic view of design since the design process is not (necessarily) mechanized through using design patterns.

The latter exercises used showed how a relatively simple method of either analyzing or design a game can be used in conjunction with design patterns and worked well. Similarly, when workshop participants began using patterns as part of an exercise they could see how they could be used and noticed that they can be combined with their own way of working. Seen in this light, gameplay design patterns are an ephemeral form of tool since they can be combined with many types of design methods, an a strength of the design pattern concept is the same pattern can be used in many different methods, acting as a knowledge bridge between the methods.

4.6.2 *Taking the existing knowledge into account*

The current pattern collection is perceived by students new to design patterns as being daunting to work with. Assimilating that knowledge and incorporating it with already present tacit knowledge is something that many students regard as requiring more effort than it is worth. This is why we are now modifying the workshop format to get rid of most of the explicit lectures and try to incorporate the main issues (e.g. the history of patterns approach, the why and how of design methods in general) in the concrete exercises themselves. In particular, only parts of the collection are presented and students are required to identify new patterns. In line with Schön's (1983) concept of reflective practitioners, this lets the students see how their, in most cases tacit, knowledge can be described explicitly as design patterns and then be put to practical use.

Thus, the challenges of transferring knowledge between explicit and tacit can be addressed. However, this requires that students do have extensive experience of playing games or even better of creating and modifying games. It also points to the fact that it might be a requirement for game educations to give their students a basic level of experience of playing games before moving on to more advanced levels of designing and analyzing games.

4.6.3 *Differentiate between the pattern collection and the use of the patterns*

As a corollary of the two first points, it is important to separate the current pattern collection from how one can make use of design patterns. Students have been able to begin using design patterns well when only using part of the collection, and can more easily see benefits of the approach when making their own additions or collections. This is something we stress in all presentations, but our experience is that people need to concretely create patterns to understand the difference between the approach itself and the collection.

4.6.4 *Need of tools*

The previous point does not suggest that a large canonical collection is irrelevant, rather that using a large collection is not the best way to familiarize oneself with design patterns. Even so, beginning to use the complete collection can be simplified through visualization tools such as CAGE. Wiki-based systems, such as the one used by the Game Ontology Project (www.gameontologyproject.org), is also interesting to explore different ways of allowing the general public to create collections. Our experiences with students using patterns suggests that they are most receptive to using patterns when they see them as a malleable tool which supports rather than directs their work, and both CAGE and hypothetical collection editors support this. Although this might lead to a proliferation of collections it would show how collections are created to support different needs and would make the design pattern approach to gameplay design be a living language.

5

GAMEPLAY DESIGN PATTERNS FOR MOTIVATION

Jussi Holopainen and Staffan Björk

Published 2008 in *ISAGA 2008: GAMES: Virtual Worlds and Reality*, Kaunas Lithuania.

This paper presents a limited exploration of how games provide motivation, using gameplay design patterns to codify the results. Based upon analysis of four games the patterns Progress Indicators, Player-Designed Characters, Planned Character Development, Social Status, and Player Defined Goals are expanded. In addition, the new design patterns Overlapping Closure Arcs and Memorabilia are introduced.

Keywords: gameplay, design patterns, motivation

5.1 INTRODUCTION

It is commonly perceived that games evoke strong emotions of motivation in players, and games have been compared favorably against classroom environments in how they promote good learning environments (Gee, 2003). Although documenting these reactions verifies their existence and the consequences they generate, they are of limited use to designers unless they also contain information about how to reproduce them. This requires a shift in focus from studying existing games or players engaging in gameplay to the more abstract area of game design, or more specifically gameplay design if focusing on the distinguishing features of games.

Unfortunately, much of game design can be still be categorized as performing a craft skill rather than doing design. This difference between design and craft work has been described as the latter having an explicit language to express intentions and motivations while the former relies on tacit knowledge and making small changes to existing designs (Jones, 1992). This is confirmed by professional game developers when writing about self-identified problems with design processes (Costikyan, 2002). The area of gameplay design is young in comparison to other design disciplines but several suggestions for parts of what could be design language have already been suggested both from industry (Church, 1999, Falstein, 2002) and academia (Zagal et al., 2005, Björk and Holopainen, 2005b).

5.2 APPROACH

In this paper we explore design possibilities to encourage motivation within games. These possibilities are described as gameplay design patterns (Björk and Holopainen, 2005b), although space restrictions make

full documentation impossible. The choice for this way of documenting results is the twin benefits of continuing the development of a design element collection as well as tying the derived knowledge to an existing knowledge source. Björk and Holopainen (2005b) have defined gameplay as "the structures of player interaction with the game system and with the other players in the game" and thus a natural starting point for this paper is identifying what gameplay support player motivation from the gameplay point of view.

To identify patterns we analyzed four well-known and commercially successful games: Civilization IV, Elder Scrolls IV: Oblivion, The Sims, and World of Warcraft. The choice of games was based upon meeting the requirements that players in these games need to consciously make plans or define their own goals. This was done to ensure that the game design has a strong component of encouraging motivation encapsulated within the gameplay and not depending on other aspects of the game experience, such as theme, narration, and representation. Even though the games were designed for entertainment purposes we feel that they are suitable for this analysis since their popularity in number of players and part of successful series indicate that they have features supporting motivation, probably in many areas but importantly for this paper in gameplay. Although the games are all computer-based we argue that this medium or platform (depending on your point of view) are only weakly, if at all, connected to the core of the gameplay and that they thereby can represent games in general.

5.3 CASE STUDIES

Civilization IV (Civ4) is the fourth installation in a series of turn-based strategy games where players compete in developing civilizations. The normal setup starts at the Stone Age and allows players to develop their civilizations up until they are ready to reach the stars. The core mechanics (Salen & Zimmerman, 2003) of the game include building units in cities, exploring and conquering new territories, and developing new technologies which then allow building of new types of units.

The Sims is a digital equivalent to doll houses, and one of the best selling entertainment software titles ever (as is its sequel and spin-offs). The players create and control the lives of sims, the characters in the game, by building their homes and guiding their social relationships and work-life, all which can be preserved after the game through a photo book format. The game is open-ended, having no explicit goals, and players are free to create their own focusing on what goals specific sims are given, exploring the system, or using the system to create stories.

Elder Scrolls IV: Oblivion (Oblivion) is a single-player fantasy role-playing game. In the game manual the developers explicitly state that Oblivion should be "a game where you could be whoever you wanted to and do whatever you wanted." This intention shows in that players of Oblivion, as in its predecessors, have a large selection of options for how to create their characters and that a variety of side quests supporting a wide range of character types. Although the actual game can be argued to not be completely unbiased regarding character types and gameplay styles, several design choices point towards

such a vision. Specifically, rewards for quest are completely within the diegetic construct (money, equipment, and social status) and character improvement depend solely on skill use, which minimizes the pressure of players to play a certain way to follow a scripted experience. That being said, the game does contain a main story arc but players can choose when they want to follow that and can continue playing after finishing it.

World of Warcraft (WoW) is a massively multiplayer online roleplaying game (MMORPG) which has millions of players worldwide and is widely regarded as a "time-sink" even by its players. The gameplay and social structures in the game motivate, and even pressure, players to play the game as much as possible. The game has a fantasy roleplaying setting where the players can create their own characters and then gain experience points by completing different kinds of quests, exploring the vast game world, and, of course, killing monsters. These experience points, or rather experience levels based on the points, determine how powerful the player's character is in the game. In addition to experience levels there are different kinds of game items such as mounts for travelling and powerful epic weapons for making the combat more effective.

5.4 A BRIEF STUDY OF MOTIVATION

A natural starting point for finding causes for motivation in games is the goals they provide. Games contain designed goals that provide players opportunities to commit to striving toward a certain game state. However, this is a case of players submitting to the intentions of the designer and can fail because the offered goal is, for some reason, not appealing. The Sims is an interesting case in this context since it does not provide any precisely defined goals, and so automatically fails to make players' submit to a designed goal. Given the theme of the game, it is however quite easy to find goals by relating to everyday life, even if the goals can be contradictory to what is socially approved. The player can decide, for example, to first develop a happy and satisfied family and then bring them to the ruin or to try to create as ascetic family as possible. Thus, The Sims allows players to become the designers of their own goals which they can tailor to be as engaging as possible. This possibility has been described as a gameplay design pattern Player Defined Goals – "[g]oals and subgoals that players can create or customize within the game itself" (Björk and Holopainen, 2005b). It is worth noting that in this context the players need to discern themselves if they have reached their own goals as the game system has no way of knowing the end conditions for this type of player defined goals. In WoW goals can be created together with others, and if all players pursue these together this can result in extra motivation from the feeling of solidarity. Striving together towards a goal is in itself motivating as described in the Mutual Goals pattern in Björk and Holopainen (2005b).

Player Defined Goals can be induced through the use of the pattern Player-Designed Characters, i.e. letting players create the characters they control in the game. The Sims only provides this in the sense of letting player set the strength of a few character traits on a limit scale while Oblivion and WoW provide a detailed character creation

process. However, by making these choices and knowing something of how the characters can develop during gameplay the game encouraged players to define goals for their characters (not to be confused with the characters' goals), which is the essence of the Planned Character Development gameplay pattern. Further, since a part of creating a believable character is to give it goals, all three of these games support Player Defined Goals through roleplaying, i.e. acting to reach characters' goals even though this may be counterproductive to the designers' stated or implied goal of the game.

Committing to achieving a goal automatically provides a certain level of motivation for the players. The motivation, however, can be lost if reaching the goal can take too long time, regardless if it is due to a long series of actions or if many attempts of short series of actions are required. In part this can be due to the lack of information about how close to completing a goal the player is. Civ4 avoids this problem by letting players know exactly how many turns they are from completing basic goals of construction and research (although the information when other civilizations will reach their goals is not initially present). WoW and Oblivion use similar methods to show how close players are to achieving the next experience and skill levels of their characters. This design choice of giving players a measure of how close they are to achieving their goals has previously been described as Progress Indicators pattern (Björk & Holopainen, 2005), and can used as a basic building block for motivation. In fact, since failing to achieve a goal can motivate one to try again with the additional knowledge and skills from the previous attempt, it may be more important to have a closure rather than succeeding with a goal.

However, relying on a single goal to provide motivation is a clear example of the idiom "putting all eggs in one basket." It is trivial to address this by having several parallel goals. The Sims does this by supporting goals for each sim and common goals regarding money and items, while Civ4 similarly provides different goals for each city and group of units under the players' control, augmented by research, trading, and diplomatic goals. WoW and Oblivion have overlapping goals of different quests, social standing in factions, and collecting equipment. Simply having many goals may still fail if they can be regarded as subgoals of a larger goal, and then may become part of Progress Indicators rather than goals in their own right. Civ4 solves this by having each type of goal take several turns to complete and that the amount varies between goals, meaning that as a player decides on a goal for a city or unit and take an appropriate first action, the completion of another goal typically awaits within the next few turns. This feature is a reason that the Civilization series is famous for invoking a "just one more turn" attitude. The Sims has a similar solution through having players keep track of many sims, each with skills and traits that can develop over time and potential individual goals. The formalized quests in Oblivion and WoW are typically independent of each other and thus are not likely to simultaneously motivate players, but character improvement and collection of equipment and items can play similar roles. We define this common design solution, having players have several goals to strive for in parallel, as a new gameplay design pattern Overlapping Closure Arcs.

So far the motivations have been assumed to be based upon being contained within the frame of playing the game, that is following the idea of games being autotelic, being their own motivation. However, it is easy to conclude that positive consequences of gameplay after the game has ended can also be strong motivation for playing the game. WoW happens in a social environment, with potentially thousands of other players around the player. This means that what achievements were reached and how one has worked together with others, can provide additional motivation since others can notice this. This is an example of the pattern Social Statuses (Björk and Holopainen, 2005b) which is also supported in Civ4 and Oblivion through letting players compare with each other outside the game on how the complete various aspects of the game, including those done with self-imposed restrictions. This can be done in The Sims through the creation of interesting stories but since these are told through photo books that exist outside the game itself, this solution is fundamentally different. The "photos" are venues for showing people not only the game situations but also player investment which we have defined as a new gameplay design pattern Memorabilia. Players can create similar artifacts in Oblivion, WoW, and Civ4, but this cannot be said to be part of the game design since this requires independent screen capturing software and the game themes do not encourage this. The built-in support for modding Oblivion and Civ4 can be seen as another way for players to receive recognition from others, but this activity is typically not performed by the majority of players.

5.5 CONCLUSION

In this paper we have expanded the gameplay design patterns collection through exploring how games support motivation. Two new patterns have been identified that show how having several simultaneous goals during play and how providing game effects that survive the ending of the game can make gaming more motivating. In addition, additional insights into gameplay design possibilities have been provided through exemplifying and thus expanding several existing patterns. Based upon this we argue that the collection of patterns can provide a basis for understanding how to create motivating gameplay.

6

NEUROPSYCHOLOGY AND GAME DESIGN

Jussi Holopainen and Stephen Meyers

Published 2000 in *Consciousness Reframed III*, Newport, Wales, UK.

This paper discusses the role of dramatic and predictive closure and temporal and somatic displacement in the design of games, especially computer games. Each of these elements is drawn on the physical characteristics of the human brain and corresponding mind structures. We further argue that enjoyment in game play is a product of these evolutionary features, and that the most successful game design presents the user with the opportunity to seek closure and to displace the sense of self.

Keywords: game design, computer games, dramatic closure, predictive closure, temporal displacement, somatic displacement

6.1 INTRODUCTION

This paper proposes a model for studying elements of game design rooted in neuropsychology. By examining these elements in a context of other forms of art and the biological functions of the intended audience, we hope to point the way for further aesthetic advancement in this most lively new form.

We argue that enjoyment in game play is a product of the evolution of the human mind, an increasingly common point of view in the field. In The Ambiguity of Play, Sutton-Smith (1997) indicates:

"Play [is] a reinforcement of potential synaptic variability through the performance of variable antics, and... as a fuller imitation of the evolutionary process itself, in which the organism models its own biological character"

It is important to make the distinction between pure, or "free" play and games with codified rules. The former is observed in virtually all mammals and some species of birds, while the latter appears to be exclusively confined to homo sapiens[1].

The most successful game designs present the user with the opportunity to seek closure and to displace the sense of self. These two features evolved in the brain to support survival and social stability.

1 Even though there have been some cases of apparent game play in young mammals (Fagen, 1981), such as "king of the hill," the rules may not be strictly codified from their point of view; we might be anthropomorphizing, imposing our own standards on spontaneously arising play behaviour.

6.2 CLOSURE

6.2.1 *Predictive Closure*

Predictive closure is the capacity of the mind to suggest consistent completion of a mental model, filling information gaps with a reasonable inference based on witsh learned information. The effects of this form of closure are familiar in many fields including vision, psychology and art, and simple closure is present in animals with far less developed neural systems than human beings.

If, for example, a predator is only partly visible, closure enables potential prey to assume that the rest of the predator exists. *"In an incomplete world, we must depend on closure for our very survival"* (McCloud, 1994).

The human mind extends the quest for closure from these early vision processes to higher levels of conscious thinking, in order to maximize the pleasure induced by successful closure (Ramachandran and Hirstein, 1999). Artists began to employ predictive closure en masse with the Op Art movement, incorporating gestalt closure and other optical illusions from the study of vision into their art. The player extends predictive closure towards a game, thus forming the first part of a feedback loop that is inherent to enjoyment. This urge for completion underlies our interest in hearing the end of a piece of music, or seeing the end of a movie - the loops of prediction have been opened in the mind of the audience, and we will not rest until we find out what happens.

6.2.2 *Dramatic Closure*

Dramatic closure is a feature common to many forms of art, including literature, music, and computer games. It appears to stem from the property of consciousness that requires formation of a story structure, or internal dialouge. This personal storytelling allows the mind to maintain a stable identity and a sense of self. (Dennett, 1992)

This form of closure has been adequately described in the cases of drama (Hiltunen, 1999) and music (Hofstadter, 1979), explaining how satisfaction arises from the resolution of tension. However, there has been little academic exploration of the aesthetic uses of tension and release in game design, although designers themselves are well aware of this structure (Falstein, 1999).

The simplest example of dramatic closure may be found in the popular game Tetris. While the drama of Tetris is simple, it is clear-cut - the player succeeds, or fails, a single row at a time, defeating an enemy that emerges from chaos. The individual quadrominoes begin to take on an archetypical character: the linear piece is the saviour; the s-shaped piece, the trickster in two forms. In some sense, each player's journey through the state space of the game is a tiny epic, overcoming obstacles to defeat a greater evil.

However, Tetris never permits the final, highest level of closure - the game only ends when the player has failed at a series of smaller

closures. This is the root of the addictiveness of the game - it causes a state of tension that can never be fulfilled, but can be temporarily sated by further small closures. The falling blocks which fill the minds of devoted players are much akin to the melody which rings in your ears after the song is gone, parodied in "Who Framed Roger Rabbit." Roger is drama incarnate, and is done in by the need for closure.

6.2.3 *Relationship between Dramatic and Predictive Closure*

These two forms of closure create a feedback loop between them, where the expectation of resolution drives the player to perform the actions needed to reach closure. Typically, these actions are repetitive, and in a well-structured game, there will be multiple hierarchical levels of sub-closures.

In Miyamoto's landmark The Legend of Zelda: Ocarina of Time, Link is driven to a final resolution, saving the land of faeries, through a series of subquests in which he rescues representatives of air, earth, fire, and water. Song structure is one element used to create this dramatic tension, as the player must learn and play melodies and different times in the game to drive the action.

Link begins the game as a young boy, around ten years of age, and he is introduced to a pony, Epona. Her keeper teaches Link "Epona's Song", and the horse bonds with Link. Learning the song is itself a small puzzle, with a minor closure of its own. Later in the game, Link has aged, and is now a young man. When he plays the same haunting melody, the fully-grown Epona, now running wild in a ruined land, remembers the song, and will thus serve as his loyal steed.

6.3 DISPLACEMENT

6.3.1 *Somatic*

Somatic displacement refers to the ability of a person to project the mental model of his or her own identity into another physical form, which represents the player in an alternate environment. There are some examples of somatic displacement in other human activities, such as driving a car - successful automotive navigation requires the driver to project their body image to the physical limits of a car. When one is involved in a car accident, one typically says "he hit me!" rather than "his car hit my car!"

Many games play upon this form of displacement of the self. For example, computer games set in the third person require a user to project their self-image into the character on the screen. First person games require the user to project their entire body image into a virtual environment, a phenomenon referred to commonly as immersion.

Krueger (2000) noted that users have little trouble projecting their body image into their representation naturally, even if this representation is highly distorted, such as by perspective. Indeed, it is difficult not to displace your representation into a physical form you control.

"The brain is wired to understand... faces and bodies... It is surprisingly easy to control your flat hand in a 3D space, even when mapped onto a curved plane."

This physical displacement of self is familiar to many game players, and accounts for some of the most appealing and popular games. The chart-topping Tomb Raider series, for example, projects the player into the pneumatic body of Lara Croft, a beautiful and athletic young woman. She is capable of running, jumping, and doing perfect backflips in pursuit of her many quests, this providing players with a the vicarious thrill of physical mastery.

In several of the Super Mario games, Mario acquires the gift of flight. Interestingly, his form of flight is that form familiar to from dreams - a temporary swooping release from the bonds of gravity. The fact that this skill is not innate, and can only be acquired as an aspect of a magic hat, the thrill of achievement at the point of first becoming airborne is tangible, typically leaving the player breathless.

Physical displacement does not seem to be required in games in general - abstract games such as Tetris and chess, for example, both have have very weak displacement, if any. However, in representational games, this displacement is required to insert the ego of the user into the closure loop, so that a reward will be perceived as coming "to" the user, rather than to make it an abstraction. This phenomenon is very similar to identification with a character in a movie, for example, except that there is rarely much physical engagement in cinema.

6.3.2 *Temporal*

Temporal Displacement is the prediction of hypothetical situations, including the predicted point of view of another person. In The Feeling of What Happens, Damasio (1999) explains the neural basis for the self and its displacement, which Damasio calls the "extended consciousness"

> "EXTENDED consciousness goes beyond the here and now of core consciousness, both backward and forward. The here and now is still there, but it is flanked by the past, as much past as you may need to illuminate the now effectively, and just as importantly, it is flanked by the anticipated future."

Survival endowed us with the ability to predict the future based on our mental models, which allowed us to survive and flourish beyond all other creatures. Any complex game play requires this. In The Man Who Mistook His Wife For A Hat, Sacks (1985) relates an anecdote about the Lost Mariner, a man who suffered from neurological damage that reduced his active memory to a span of roughly one minute. Locked in a perpetual now, he was able to play simple games and puzzles, such as tic-tac-toe, but unable to extend his working memory or conception of future event well enough to engage in more complex games such as chess.

It is possible that the Lost Mariner, an inexperienced chess player, merely lacked the attention span to maintain a mental model of a game long enough to select a suitable move. It seems more likely, however, that he lacked the ability to displace himself into the future and understand the effects of his moves.

6.3.3 *Relationship between Temporal and Dramatic Displacement*

While temporal displacement is a requirement for survival - even less intellectually advanced species than ourselves can make some predictions about the future - somatic displacement appears to be a modern phenomenon, linked to the use of technological advancements. Indeed, this capacity for projection of the ego is rather surprising, as related by Krueger (2000):

> "I realized that the image as a representation of the person is instinctive. It was as if the DNA didn't care if it was in this or that body. The image was an extension to the self, and what happens to the image seems to happen to the person... We had two cameras set up, one pointed at each of our computer screens, and the two images composited together. His hand was reaching up from the bottom; my hand could reach up from the top. At one moment, the image of my hand touched the image of his hand, and he suddenly jerked his hand away. He didn't want to hold hands with me! Well, my feelings were hurt but I thought this was a revelation."

What evolutionary advantage could this skill confer? A best guess might be that it it is a natural extension of the ability to displace ourselves temporally. The ability to imagine yourself in a different time is the same as the ability to imagine yourself in a different body.

6.4 CONCLUSIONS

Computer games are, in the authors' opinon, the most important form of art being made at the turn of the century. While they have many structural features in common with other media, there are a number of unique aspects that have not been deeply studied in this context. At least two of these, displacement and closure, can be discussed in terms of their neuropsychological basis, thus shedding light on factors that distinguish an aesthetically pleasing experience from one that is less successful.

7

PLAY, GAMES, AND FUN

Jussi Holopainen

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Play behaviour is present in all mammals and even fish seem to play in certain situations. The more developed the species is in evolutionary terms the more elaborate are the play patterns. Animals, however, do not play games as such, although there are some reports of "proto-games", such as king of the hill played by chimpanzees and simple racing by dolphins. Games and game playing is present in every human culture and there is some archeological evidence that games emerged at the same time as the first symbolic expressions such as cave art. Thus it can be claimed that playing games is fundamentally human. Games are also fun. A player can be so engrossed in playing a game that even the physiological needs are suppressed. The chapter traces the evolution of gameplay features from the animal play through ancient games to modern computer games by following the basic tenet, which states that games are caricatures of intentional activities. Findings from modern philosophy of mind and cognitive neuroscience are used to further support and elaborate the exploration of how games and play are fundamental features of being a human.

Keywords: gameplay, play, flow, neuroaesthetics

7.1 PLAY, GAMES, AND FUN

The basic claims of this chapter are 1) that games are caricatures of intentional activities; 2) that playing games is based on somatic and temporal displacements; and finally 3) that games consist of several layers of predictive and dramatic closures. These three basic concepts of engaging with games are used to trace the evolution from play to playing games and games in general. Note, however, that the principles presented here do not explain the whole basis of playing games; they are just a small subset of a large number of similar principles for guiding our understanding of why playing games can be so engaging or fun. It is important to make the distinction between pure, or "free" play, and games with codified rules. The former is observed in virtually all mammals, in some species of birds and even reptilians and fish, while the latter appears to be exclusively confined to us humans. For more thorough discussions on the distinction see, for example, Salen and Zimmerman (2003) and Juul (2005).

Games are caricatures on several different levels. The most basic levels are that of representation, actions available for players, and goal

structures that guide the players' intentions. The caricatures are, by definition, exaggerated and simplified forms and structures of everyday being in the world. The forms and structures found on the representation layer are similar to that found in other representational arts (Ramachandran and Hirstein, 1999), for example, painting and sculpture. The painting even on the most realistic end of the spectrum leaves out features of the lived world and exaggerates at least in some form the salient features the painting wants to address. Take as an example a landscape painting by John Constable. The pastoral landscape as a setting is "realistic" and familiar but the forms used to depict and express the landscape are both exaggerations (to a limited extent) and simplifications of what could really be seen if one was viewing the real landscape.

These features reflect well the characteristics what Ramachandran and Hirstein (1999) claim to be some of the central characteristics of understanding representational art as caricatures. These central characteristics are: the peak shift effect, that perceptual grouping and binding is directly reinforcing, and that contrast extraction is reinforcing.

The peak shift effect is a principle in animal learning. If an animal is taught to discriminate square from a rectangle, the animal's response to a rectangle which is longer and thinner than the original one is even stronger. This means that the animal is not learning a prototype but a rule, in this case the rule of discriminating rectangles from squares. Ramachandran and Hirstein claim that this is one of the principles of how human aesthetic experience is constructed.

Perceptual grouping and binding is essential to discover and delineate objects in the visual field and this relies on extracting correlations. The process of finding out these correlations in order to discover objects in the environment is essentially reinforcing for the organism, otherwise there would be no incentive for going through such a cumbersome and complicated process.

Contrast extraction is in itself necessary for achieving perceptual grouping. The contrasts or the edges are important clues to allocate attention to interesting features in the environment and this, at least in some cases according to Ramachandran and Hirstein, may imply that these features are also 'pleasurable'. The contrast principle not only applies to the basic visual perception such as colour and motion but can be extended to more abstract and conceptual features.

The visual arts have used and use these principles in composing engaging experiences and the representational layer of games follows the same principles. Consider the visual contrasts of black and white in chess board and also the pieces: the black and white squares provide enjoyable low level visual contrast while the more abstract contrast of black player against the white player is represented by the pieces themselves. The positions of the chess pieces on the squares and their shapes follow the caricature principles of peak shift effect.

The actions available for the player in any given game are simplified, exaggerated and transformed structures, i.e. caricatures, of possible actions in the real world. Continuing with the chess example the actions and their consequences are rigid, crisp, and codified. The player moves the chess pieces from one square to another and

the exact position on the square or the manner how which the piece is moved is of no consequence for how the game unfolds. The same applies to evaluating the consequences of players' actions. The chess piece entering the square captures the opponent's piece on the square. The consequence is clear cut: the captured piece is removed from play and again the exact manner of how the piece is taken out from the board does not have an effect on the outcome of the action from the perspective of the game.

The goal structures of the game give the players the incentive to play the game and also guide their actions during playing. The caricature principle is in effect also for the goals. The game, in principle, brackets of the real world goals of the players and formulate caricatures of real world goals within the game environment or system. The goals in the game are simplified and exaggerated of the certain goals found in our everyday experience. The goal of overcoming the opponent in chess is a highly conceptual caricature of overcoming an opponent or obstacle in the real world using the power of discrete and mobile units with differing strengths.

Tetris is a good example of how the caricature principle guides the whole design of the game from representational features to possible actions and finally to the goal structures. The representational layer of Tetris consists of discrete blocks with clear and crisp boundaries. Even though the colour of the blocks does not effect how the game unfolds but in most versions they are used on the representational layer to enhance to overall experience. The way how the blocks stack up create opportunities and especially missed opportunities for perceptual grouping. The gaps in lines invite the players to fill them in and the closure (see the closure discussion also below) of filling the row is both a pleasing visual experience (the perceptual grouping of the whole line is accomplished) but it is also at the same time one of the basic level goals of the game. The actions and events of Tetris are caricatures in themselves. The blocks are falling down (in most of the versions of Tetris) simulating in a crude manner the way how gravitation effects objects without support. When the block touches another block it is stacked up, again in a similar fashion what would happen if objects fall upon each other in real world. The actions available for the player are caricatures of basic spatial object manipulation. The player can move the block left or right in discrete steps and the player can rotate the block in 90 degree steps. Tetris is, indeed, a prime example of how the different layers of caricatures are tied together to provide a compelling and engaging experience.

Holopainen and Meyers (2000)suggest that many games, especially modern electronic games, exploit the psychological capability of projecting the mental self-image into another physical form. Holopainen & Meyers call this capability somatic displacement. There are two different ways of looking at somatic displacement: first, where the displacement is more or less extension of the body as in tool use; and second, where the displacement is the transferal of the somatic model into an object in the environment. In both cases the potential for controlling the focus of displacement heightens the experience. For example, while playing a third-person action game such as Tomb Raider the experience of somatic displacement focusing on the avatar, Lara Croft, is stronger than when just watching other people play the same game. In a similar

fashion the sense of car as an extension of your body is stronger if you are driving it. It can be argued that the somatic displacement is weak in abstract games such as chess or Tetris but many players have claimed (the author included) that in these cases the chess or Tetris pieces feel like extensions of your self, in other words they are regarded as tools for manipulating the environment in a similar fashion as a spade is an extension of the hand for digging holes in the ground.

The second type of displacement Holopainen and Meyers (2000)discuss in their paper is temporal displacement: the ability to project oneself into hypothetical situations, including the point of view of some one else, i.e. "theory of mind" (Damasio, 1999). The temporal displacement is crucial for playing games, especially those which require strategic thinking. The phenomenon is easy to recognize in chess where the players have to think ahead of their own moves and also the opponent's moves. Temporal displacement seems to be closely connected to imagination. Persons coming up with hypothetical situations must use imagination at least in some sense. The projection of self into an imagined situation is, then, the function of temporal displacement. The game rules, current game state, the props, the previous "moves" the players have made etc. are features of playing the game which guide the imagination of the players to construct the hypothetical situations needed for temporal displacement.

Although it can be argued that both somatic and temporal displacements are present in every game, it is evident that different game types use the displacements in different ways. As already stated above the temporal displacement component is strongly present in games requiring strategic thinking at least as compared to, for example, quick-paced arcade fighting games such as Tekken series. It also seems to be the case that the stronger the somatic displacement the weaker the temporal displacement is in the game. This may be due to the fact that the somatic displacement has a higher priority for the use of the same cognitive structures as the temporal displacement (Banich, 2004). Note, however, that the same game can contain different modes of play where the displacements are used differently. For example, the main mode of play in a side-scroller shooter Forgotten Worlds relies heavily on the somatic displacement as the player has to steer the ship through a hostile environment dodging obstacles and shooting down enemies. Between levels the player can use in-game currency gained during the play to upgrade the ship. Choosing between different upgrades requires strategic thinking and thus temporal displacement.

It is claimed that the sense of closure is one of the most important characteristics of the aesthetic experience of art forms as divergent as painting and drama (Ramachandran and Hirstein, 1999, Grodal, 1999). It is no surprise then that the experience of playing a game is based upon or modulated by the various closure structures within the game itself. Holopainen and Meyers (2000) distinguish between predictive and dramatic closures, although they seem to be somewhat overlapping. Predictive closure as opposed to dramatic closure can be described as lower level and based solely on sensory experience. McCloud (1994) talking about closures in general states: "The phenomenon of observing the parts but perceiving the whole has a name. It's called closure." The predictive closure is evident also in other sensory modalities than just visual. For example, musical tunes, especially if they are familiar,

provoke the sense of predictive closure (if the tune is not finished the listener is left in a state of unfulfilment). Visual predictive closures are, however, are more prevalent in games and is closely related to the above mentioned perceptional grouping and binding. The visual predictive closures of Tetris are, as mentioned, strong low level incentives for filling in the gaps.

The dramatic closure is often described as the satisfaction arising from the resolution of tension. As the term itself implies this type of closure is found in art and entertainment forms with dramatic elements from stage plays to action movies. In the context of this chapter it is better to mention that dramatic closure is associated with a completion of a task, which is reinforcing in itself (Reeve, 2004, Grodal, 1999, p. 51). The interplay of dramatic closure and temporal displacement is one of the sources of enjoyment when watching, for example, movies. The hero who finally succeeds in revenging the death of her family completes a task and by temporal displacement we can identify with the enjoyment associated with the completion of the task. Of course, there are many other sources and factors present affecting the final movie experience but it seems that the dramatic closure as a completion of a task is one of the most important factors in enjoyment of games. Dramatic closures occur also when the completion of a task fails or there is a setback, e.g. the player loses a life in Pac-Man. The temporal sequencing of the achievement and failure dramatic closures creates the "dramatic experience" in games. As stated above games always have goal structures, which in essence define the tasks the player has to complete in order to progress in the game. In this way the goal structures define the possible structures for dramatic closures. Note here, that even games such as SimCity, which do not have a big explicit overarching goal, have a hierarchy of smaller subgoals and the players almost always construct their own bigger goals within the game environment, e.g. build a big city without law enforcement.

Virtually every game consists of several layers of dramatic closures (Falstein, 1999). In Tetris, for example, the lowest achievement and failure closures are related to putting the block in a proper place. The next achievement closure is, of course, filling in a full row of blocks thus removing the line from the screen and increasing the player's score. It is intriguing to note that there is no final achievement closure in the game; the player is always overwhelmed by the falling blocks in the end. This might be one of the reasons for the addictiveness of Tetris as you can never complete the task of winning Tetris. It is also a well known fact from psychology that it is easier to remember unfinished tasks than finished ones (Reeve, 2004). This means that the task of "finishing" Tetris lingers in the player's memory and can be an unconscious motivation for playing Tetris again.

7.2 ABOUT PLAY AND GAMES

Play has been, and still is even after a more than a century of studies, an elusive concept with a multitude of diverging (and sometimes converging) theories, definitions and approaches. Sutton-Smith (1997) in his Ambiguity of Play tries "to bring some coherence to the ambiguous field of play theory by suggesting that some of the chaos to be found

there is due to the lack of clarity about the popular cultural rhetorics that underlie the various play theories and play terms." The seven rhetorics proposed by Sutton-Smith are:

1 The rhetoric of play as progress, which states that animals and children adapt and develop during play in order to prepare for the adult life.

2 The rhetoric of play as fate where the choices and outcomes of our actions are dictated by destiny, luck or what ever.

3 The rhetoric of play as power which sees play as a representation of conflict and as a way to establish and enforce the power status of the winning players.

4 The rhetoric of play as identity as "a means of confirming, maintaining, or advancing the power and identity of the community of players" (Sutton-Smith, 1997, p. 10).

5 The rhetoric of play as the imaginary as applied to creativity and "playful improvisation" in arts and other aspects of life.

6 The rhetoric of self where the focus is on the enjoyment or fun aspect of the participating players themselves.

7 The rhetoric of play as frivolous as in cases where play is regarded as something unnecessary, even foolish.

The current discussion is focusing on the rhetorics of self as we are trying to tackle the issue of fun in games, although the rhetorics of progress, power, and imaginary are also relevant when discussing the possible biological functions of play, sports, and roleplaying games.

Sutton-Smith's seven rhetorics give us an overview of how one can approach games but leave us unable to define play. Burghardt (2005) has proposed five criteria to distinguish play from other kinds of activities. Burghardt claims that "all five criteria must be met in at least one respect before the play label can be confidentially attached to any specific instance of behaviour" (Burghardt, p. 79). Burghardt's criteria are:

1 "[. . .] the performance of the behavior is not fully functional in the form or context in which it is expressed; that is, it includes elements, or is directed towards stimuli, that do not contribute to current survival."

2 "[. . .] that the behavior is spontaneous, voluntary, intentional, pleasurable, rewarding, reinforcing, or autotelic."

3 "[. . .] that it differs from the 'serious' performance of ethotypic behavior structurally or temporally in at least one respect: it is incomplete (generally through inhibited or dropped final elements), exaggerated, awkward, or precocious; or it involves behavior patterns with modified form, sequencing or targeting."

4 "[. . .] the behavior is performed repeatedly in a similar, but not rigidly stereotyped, form during at least a portion of animal's ontogeny."

5 "[. . .] the behavior is initiated when an animal is adequately fed, healthy, and free from stress (e.g. predator threat, harsh microclimate, social instability) or intense competing systems

(e.g., feeding, mating, predator avoidance). In other words, the animal is in a 'relaxed field'."

The second, third, and fourth criteria are important for the current discussion. The second and third criteria, that the behaviour is pleasurable, rewarding or reinforcing and that the behaviour is exaggerated, can be met with the above mentioned principle of peak shift effect concerning both the action itself and the goals of the game. The fourth criterion is evident in games as the main mode of play is usually characterized by repeated similar, but not stereotypical, actions performed by the player in order to reach the different levels of goals of the game. In Tetris, for example, the player repeatedly places the blocks by moving them left to right and rotating them in order to fill in horizontal lines. The first and the fifth criteria are at the same time obvious and problematic in the case of games. Playing games is something, which does not contribute to the immediate survival although gambling and professional sports contradict this. Game playing happens normally outside the normal pressures of everyday life but at the same time playing a quick game of Minesweeper during work hours can be used for alleviating the stress of the workplace; the player brackets off the stressful environment by playing the game.

Free play is still too amorphous to be fully caught in the caricature analysis. The exaggerated and "useless" movements, awkward positions, and modified action sequences can be explained as caricatures of the actions themselves, but as according to the definition of free play the clear goal structures are still missing. More game-like play behaviour such as playfighting (rat pups) and chasing (dogs) have implicit goals of overcome and contact and it is clear from the behaviour of the animals that there are winners in these protogames. In both cases of playfighing and chasing the "losing" animal clearly indicates that the winning condition has been met, i.e. there has been an failure or losing closure. Here we can see the seeds for explicit and codified games we humans play. The goal structures even in these protogames can be analysed according to analytical tools, such as game design patterns of Björk and Holopainen (2005b) used for describing human games. The section in Björk and Holopainen describing goals and goal structures include such patterns as Overcome, Exploration, and Contact which appear in many cases of animal play behaviour.

7.2.1 *Sports*

Playful physical competition between people has occurred for as long as we have recorded history, and the play of young animals and the formalized combat in mating rituals can be seen as closely related natural play activities. Sports use the physical abilities of the participants to determine the outcome of the activity, and many sports are based on the definition of how to use a specific ability, e.g. 100 meter dash, the long jump, or wrestling. Indeed, the aim of sports can be described as a way to judge which player is better than the others in that specific ability. The sports are, as play behaviour in general, caricatures of intentional activities. The 100 meter dash simplifies and exaggerates the everyday behaviour of running. The track is exactly 100 meters long and straight, the competitors start at the same place and the same

time, and the goal is to cross the finishing line as fast as possibly. The same principles apply wrestling, which seems to be a direct descendant from rough-and-tumble or playfighting. Burghardt's third criterion, that the action is incomplete, is codified (and caricaturized) as a winning condition. The player forcing the opponent to fall wins the game and the seemingly aggressive behaviour of overcoming the opponent ceases. The activity and behaviour of the wrestlers is remarkably similar to playfighting in young canids (dogs, wolves, foxes) or rats (Fagen, 1981). It can be argued that the wrestler's are not playing any more and that according to the rhetorics of power the contest has lost the innocent spontaneity of play behaviour. This does not undermine the interpretation of wrestling as an evolved form of playfighting, on the contrary, it illuminates one of the mechanics of transforming play into games: valorizing the outcome of the play activity over the activity itself. Team sports from tug-of-war to cricket follow the same principle. Only certain types of actions are allowed (according to the rules) and the lower level goals in more complex team sports are rigidly codified. For example, the low level goal of the soccer is to get the ball into the goal area of the opposing team. Similar goals of Traversal or Delivery (Björk and Holopainen, 2005a) are widespread in other team sports involving a focal goal object, such as the ball in soccer.

7.2.2 *Games of Chance & Dice Games*

Games using the random outcome produced by a game element share the possibility of being the oldest form of games with sports. Derived from the objects used in divination (e.g. the I Ching) the elements started to be used for more earthly matters. Since games using dice or binary lots have few other game elements, most noticeable the absence of written rules, little is know about the earliest dice-only games. Knizia states that dice games were played since the origin of civilization but does not provide examples (Knizia, 1999)Parlett provides no examples of pure dice games but does provide some examples of randomizers in early games: five staves constructed to function as randomizes were found in Tutankhamen's tomb (from ca 1323 BC) together with a gameboard; three similar staves were found in the royal tombs at Ur together with another gameboard; and the Rig Veda from approximately 1500 BC confirmed the use of randomizers to "cause delight" in ancient India (Parlett, 1999, p. 21-22).

The first game elements used for these types of games are called binary lots, simply objects that can be shaken, thrown or otherwise have their physical location changed in an unpredictable way. Binary lots are still used in the practice of flipping a coin to generate a heads or tails result. According to Herodotus the "normal" dice, the six-sided cubical die omnipresent in non-computerized games today, were invented by the Lydians of Asia (Parlett, 1999, p. 27). Predecessors to these, Astragals, produce one of four numbers (typically not 1,2,3,4) have been depicted 800 BC, and their use has been confirmed by classical writers and finding in royal graves in Palestine (Parlett, 1999, p. 25).

The use of dice and other randomizers in games introduce several aspects to gameplay. Instead of relying on physical abilities, players rely on chance, making the actions of the game impartial to what player

performed the action (following the rhetorics of fate it is still common for players to see destiny or the will of gods in the results).

These early games indicate the point in the evolution from play to games where the physical activity itself is on the background and the focus is on the outcome of the codified and caricaturized action. In the case of dice games the action is simple: throw the dice and the outcome of the action is more important than the action itself. The caricature principle is evident in dice games on many levels. The action is simplified and abstracted, the player can, according to the rules, do only one type of action; the possible outcomes are discrete; players take explicit turns to perform their actions; the final outcome is explicitly calculated from the outcomes of each individual player; and as the outcomes are discrete the sense of closure is heightened accordingly. The dice games are also the first examples of how the natural play behaviour is changed into symbolic behaviour. The dice and the possible outcomes stand for something else than they are requiring symbolic thought and are the seed for games requiring somatic and temporal displacements.

7.2.3 *Board Games*

Although difficult to prove, the beginning of board games can be traced to the need of having a way to keep track of player's scores in dice games (Parlett, 1999, p. 35-36). From using a board with game pieces that were moved as player gained score points, the change to making the movement of the pieces important gameplay activity was small. By offering players choices of how to do movement, typically having more than one piece and being able to choose which piece to move, tactic choice became possible, and game skill could become a success factor together with luck (Parlett, 1999, p. 36).

Race games can be seen as an evolution from dice games toward board games. Parlett gives no exact date for the earliest race games but writes "all cultures that have games at all have race games, and [...] of extremely ancient date" (Parlett, 1999, p. 35). Race games, especially games where there is only one piece moving, are examples of first games with strong somatic displacement component.

Pachisi (Parlett, 1999, p. 42), the Indian game from which Ludo originated is one of the oldest racing games. Although the exact date for the appearance of the game is unknown, there is partial evidence from carvings from the 6th or 7th century and references to possible variations of the game claim to have reached China in the third century AD.

Bilateral racing games, with Backgammon as the principal example, are a form of games where players start in opposite ends of the race track and race towards the others end. The probable forerunners to modern day Backgammon can be traced to the city-state of Ur, and although probably much older, tablets dated to 177/176 BC gives the rules to the ancestor game. The existence of a game with a similar board, the Game of Twenty (Parlett, 1999, p. 65), has been confirmed to the middle of the second millennium BC. Yet another similar game, Senet, (Parlett, 1999, p. 89) is shown in a picture in an Egyptian tomb from 2650 BC. Race games introduced several pieces controlled by one

player, in one sense making a player play several games at once, and opened up for player-to-player interaction as the pieces could easier be used for tactical purposes such as blocking or capturing other pieces.

The games have now become symbolic activities but they still retain some of the old structure of play behaviour. The race in Pachisi is a symbolic transformation of moving your own body as fast as possible from one point to another. The additional gameplay features of blocking and capturing have similarly evolved from earlier physical play behaviour.

7.2.4 *Electronic Games*

Electronic games are those that make use of electronic hardware to store the game state and handle game actions. The history of electronic games starts around 1950's with electronic versions of Tic-Tac-Toe and Tennis for Two and the games available now have, on the surface, little or no resemblance of the older games. However, new games tend to get build upon the features of the older games and even natural play behaviour and it can be argued that when the slick graphics and awesome sounds are removed the core features of even the most complex current games can be found in the murky past of the evolution of play and games.

7.2.5 *Fighting Games*

Having a possible origin in boxing simulations, fighting games soon evolved to being duels between characters with various fantastic abilities which challenged players' ability of timing and learning button combinations. As the games progressed from early variants such as Karate Champ, International Karate, and Street Fighter to the later variants such as Mortal Kombat, Soul Calibur, Dead or Alive, and Tekken the games have grown more complex in number of maneuvers and characters as well as in graphical detail.

Fighting games introduced the concept of combos, long sequences of actions that triggered special effects. Some of these combos where described to players in manuals but some of them had to be discovered by experience and experimentation. Another specialty of fighting games was to reward gameplay but unlocking new characters that could be played, a form of meta-reward that was only useable in subsequent games. The main goal of all fighting games still continues to be to overcome the opponent by skillful timing and maneuvering of the character, that is, they rely heavily on the somatic displacement.

7.2.6 *Racing Games*

Racing games have had a long history in video games. Games such as Sega Rally, Pole Position and Outrun have all been popular and driven the evolution of the industry. The development of racing games genre is represented by two different approaches: the simulations that try to model racing as realistically as possible (Gran Turismo series, Colin McRae Rally series, Need for Speed series) and those that use fantastic settings (F-Zero GX, Wipeout, Crazy Taxi, Mariokart Double Dash!!).

Racing games (together with BattleZone) were the first to have continuous game worlds that were larger than the player could see at once. Besides providing a feeling of spatial immersion, this feature required the introduction of overview maps to show the positions of all participants in the race.

7.2.7 *Real-Time Strategy Games*

Although the video game Herzog Zwei by Sega Enterprises Ltd in 1989 can be seen as the first real-time strategy (RTS) game, the genre became well-known through Westwood's Dune II in 1992. The genre continued with successes such as the Command & Conquer series from Westwood, Warcraft series from Blizzard, and Age of Empires by Ensemble Studios.

RTS games provided players with games that were more complex than other real-time games and did not force players to wait for other players to complete their turns as in other strategy games. The genre forces players to not only divided their attention between all the units they command but also forces players to divide their attention between giving the units commands and planning providing an interesting (and sometimes frustrating) interplay of somatic and temporal displacements.

7.2.8 *First-Person Shooters*

Although preceded by games such as Ultima Underworld and Wolfenstein 3D that had first-person views, Doom from Id Software established the first-person shooter (FPS) as a genre (Kent, 2001). In these games the player experienced a dark and hostile world filled with monster through a first-person perspective. Providing players with a new level of spatial immersion combined with tension and violence proven to be extremely popular and soon other FPS games such as Duke Nukem 3D, Quake, and Unreal. Later FPSs such as Thief and Deux Ex showed how the genre could be used for games that were closer to adventure or roleplaying games than simple shooters.

As gameplay is concerned, they provided players with spatial immersion to a level where players could get lost, and made moving an avatar in a virtual game world a skill that had to be learned to an instinctive level in order to master the game. The first-person shooters allow for immersive somatic displacement where the player can really feel that his or her body is moving inside the virtual game world.

7.3 WHAT ABOUT FUN?

The fun aspect of play, the second criterion in Burghardt's list of five, is generally accepted as one of the main motivations of playing games. Unfortunately "fun" is an ill-defined and elusive concept. Usually fun is associated with freedom from stress, leisure, and positive experiences but games cause anxiety, worry, and even stress and the enjoyment mainly comes from the dynamics of suspense and relief. Thus fun might not be the right concept for describing the experience of playing

games. The popular concept of flow might be a better alternative. Flow experience is "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous" (Csikszentmihalyi, 1990). Flow experiences consist of eight elements:

1 a task that can be completed;

2 the ability to concentrate on the task;

3 that concentration is possible because the task has clear goals;

4 that concentration is possible because the task provides immediate feedback;

5 the ability to exercise a sense of control over actions;

6 a deep but effortless involvement that removes awareness of the frustrations of everyday life;

7 concern for self disappears, but sense of self emerges stronger afterwards; and

8 the sense of the duration of time is altered.

The first five elements are structurally more interesting for the sake of discussion than the last three which are, more or less, the result of the first five elements. Games as caricatures of intentional activities fit well to the first five elements: 1) they almost always have an end condition; 2) starting to play the game requires that the players concentrate on playing the game and the games, at least the current computer and video games, provide various stimuli the keep the players interested in the game; 3) games have clear and discrete goals which can be described as caricatures of possible real tasks; 4) the feedback is given in simplified and often symbolic way, for example, by keeping score; and 5) the range of potential actions is limited and discrete and usually easily available for the players. Anyway, we can call the experiences the games provide as fun, flow, engrossment or involvement but the psychological basis for the experiences stays the same. As suggested in this chapter, looking at games as caricatures of intentional activities with the associated somatic and temporal displacements and predictive and dramatic closures might give us better conceptual tools for dissecting the elusive fun of playing games. The more intricate details of how these concepts are related to the fun still remain inadequately explored but they seem to provide a starting point for a more thorough elaboration and empirical verification of the cognitive and neuroscientific foundations of fun in games.

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8

LUDOLOGY FOR GAME DEVELOPERS

Jussi Holopainen and Aki Järvinen

8.1 OVERVIEW

There has been a recent rise in academic studies of games, and the term *ludology* has been coined to characterize this new discipline. In truth, ludology is a term for a host of different methods with which to study, teach, and even design games. This chapter introduces various aspects of *ludology*, and suggests means to apply ludology for practical game development purposes. Numerous references and pointers to ludological resources encourage the reader to become familiar with ludology and make his or her own interpretation of the field.

The authors have experience from both industry and academic contexts, and have employed ludological methods in their own game design and concept evaluation tasks. The chapter concludes with a dialogue where various aspects and applications of ludology are discussed through concrete examples.

8.2 INTRODUCING LUDOLOGY

Game scholar and editor-in-chief of the online journal *Game Studies*, Espen Aarseth has named 2001 as the inaugural year of academic game studies (Aarseth, 2001). This academic approach has been referred to as ludology. The word is a neologism resulting from the combination of the Latin word *ludus*, meaning game, and Greek term *logos* referring to reason and science. In similar fashion as "narratology" refers to a set of theories on narratives and narration, ludology is a general term for studies and theories focusing on games (Frasca, 1999).

For a game developer interested in broadening his or her understanding of games across different media and technology, the general rise in interest toward games presents fresh opportunities to get familiar with both early and contemporary contributions to ludology and feed off their findings. Thus, the neologism that constitutes our topic is not just a buzzword to promote academic activities in the present, but also a tool to give new worth and usefulness to earlier theoretical discussions on games.

8.2.1 *Defining Ludology, Defining Game Studies*

The heart of the matter is in first asking, what kind of research is possible to do on games? Second, if games are the object of study, we must understand what distinguishes games from nongames.

8.2.2 *Descriptions of Games, Play, and Gameplay*

We all have an instinct that tells us if something is a game or not, but, as most probably have noticed, we do not seem to agree with everyone else about specific cases. Providing a definition to solve these differences is difficult for two reasons. First, games are a very diverse category of artifacts and activities where the challenge is to pinpoint characteristics that appear in all games. Second, people have different opinions of what a game is, so any possible definition would either have to be based on popular opinion or based on a narrower definition of some form of an expert group.

The meaning of the word *game* also has many, sometimes radically different meanings ranging from animals that are hunted to concepts of social manipulation ("game of love"), making it even more difficult to define. Some people, such as analytical philosopher Ludwig Wittgenstein, have even proposed that it is futile to try to define what a game is (Wittgenstein, 1958).

The word *play*, which is closely linked to the word game—for example, in the concepts of "to play a game" and "gameplay"—is likewise difficult to define (see Brian Sutton-Smith's *Ambiguity of Play* for further discussion on the meaning of *play* (Sutton-Smith, 1997)).

What does it mean to play a game? How is playing a game different from other activities such as watching television, participating in politics, or taking a stroll in the park? Games and play have been studied, and defined, in many different fields from economics to anthropology. The descriptions presented here range from definitions to models and have been selected from a myriad of other descriptions because they represent views from different fields of study and together show the complexity of games and the activity of gameplay. The fields of practice of these descriptions range from rigorous scientific fields to practical game design, which, of course, have an effect on their level of rigor. Some are based on ethnographical and anthropological studies, some on analytical examinations, some on personal design experiences, and some on a combination of different fields of expertise. The studies and methods presented here have different intended readers and therefore provide different views on the subject.

8.3 HISTORICAL AND CONTEMPORARY STUDIES OF GAMES

Early landmarks of academic game studies have been documented by Elliot M. Avedon and Brian Sutton-Smith (Avedon and Sutton-Smith, 1971, pp. 19 – 26). This work consists largely of anthropological and historical perspectives to games in a particular culture or period of time. These studies testify for the lasting presence of games as an everyday part of the various people and their cultures.

Probably the most well-known "early" study of games is Johan Huizinga's cultural critique *Homo Ludens: A Study of the Play-Element in Culture* originating from 1938. Huizinga sketches out a concept called "magic circle," which refers to the particular enchantment of games as something detached from everyday activities, and governed with make-believe rules. Magic circle is a powerful metaphor for games, and it has sustained its explanatory power to this day: it has been promoted in contemporary game studies and writings on game design, especially by Katie Salen and Eric Zimmerman in their influential book *Rules of Play* (Salen and Zimmerman, 2003).

However, Huizinga's book was preceded by a number of anthropological and/or historical approaches, such as Stewart Culin's studies on the games of Native Americans, Chinese, and so forth (Culin, 1993a,b, Avedon and Sutton-Smith, 1971). H.J.R. Murray was another prominent figure of game studies in the early twentieth century. He was a historian of board games, studying both chess and other forms (Murray, 1951). These studies can be recommended to those who want to learn about the origins of classic game genres.

A notable modern entry into ludology is Roger Caillois' *Les Jeux et les Hommes* from 1958 (translated into English as *Man, Play and Games* in 1961). Caillois looks into various sorts of games from a socio-anthropological viewpoint, and introduces the four categories of *agon, alea, mimicry*, and *ilinx*, which account for different game and play activities. Caillois also introduced an axis that describes the players' attitude to the game. According to him, it ranges from free-form *paidia* to rule-bound *ludus* (Callois, 1961). If we adapt Caillois' thinking to contemporary games, then *The Sims*, with its loose goals and winning conditions fosters a paidia type of attitude, whereas an *Unreal Tournament* death match clearly demands a ludus type of attitude. The *Grand Theft Auto* series, with its seemingly open mission structure, would reside somewhere in between these two extremes.

Game theory is another discipline that warrants attention when discussing the roots of ludology as we know it today. John von Neumann and Oskar Morgenstern wrote their *Theory of Games and Economic Behavior* (1944), which gained prominent status and was applied to various applications. Game theory mainly discusses so-called zero-sum games where the players are making rational and informed decisions. As such, a number of game design problems (e.g., balancing a game's resources evenly, etc.) are indebted to game theory and theories on mathematical probability.

It also needs to be noted that there is a rich field of play theory, of which especially the work of Brian Sutton-Smith and his colleagues is recommended reading for game developers (Avedon and Sutton-Smith, 1971). Studies on simulations present another field of relevance: there is a rich literature that discusses simulations in the form of games. The work of theorists and designers such as Cathy Stein Greenblat are of interest for contemporary ludology as well (Greenblat, 1988).

8.4 LUDOLOGY AS AN ATTITUDE

To be precise, we understand ludology as an *academic attitude* to games; in other words, a specific interest for knowledge concerning games. This is an inclusive definition, rather than an exclusive one.

There is evidence that the academic world tends to opt for exclusive definitions. A debate on a particular subject has shadowed the early steps of contemporary ludology: the so-called narrativist-ludologist debate has been going on in the field even though Gonzalo Frasca has argued that the "debate never took place" (Frasca, 2003). The supposed conflict was between scholars investigating games with an emphasis on their narrative aspects (i.e., the "narrativists") and ones dedicated to studying "games as games" (i.e., the "ludologists"). Essentially, this meant that the former were interested in games with strong narrative aspirations (e.g., *Myst* and many similar adventure games), whereas the latter liked to throw the "*Tetris* card" onto the table, promoting games with no narrative or characters.

The stance of *radical ludology* came to be known and articulated via Finnish game scholar and writer Markku Eskelinen who argued that even stories are unimportant features of games and putting effort into studying these would not be worthwhile.(Eskelinen, 2001)

This debate between stories and "pure" game mechanics is something that we've found to exist among discussions between game developers as well, whether or not with the same terms and concepts (see (Scholder and Zimmerman, 2003)). Regardless of the terms and contexts, the interest for knowledge is similar, we believe: to better understand what games are, how they work, why people play them, and how to design better, or at least more diverse, games.

This equals the inclusiveness that we argued for a couple of paragraphs earlier. Seeing ludology as an attitude with which to conduct detailed inquiries into games and their players allows us to regard many development-oriented activities as ludological. For instance, it is quite clear that the Game Tuning Workshops held at the Game Developer Conferences for a number of years have displayed a very evident ludological attitude, and yes, the "L" word has even been voiced aloud in this context.

Some counter-examples include market research, for instance. Seldom do you see market researchers, or the ones taking advantage of the figures produced, conducting their business with a ludological attitude; their interest for knowledge regarding games is quite different and very case-specific. We do not see background research focusing on a specific technological solution or, for example, finding out facts for a game concept that has a historical setting as particularly ludological activities. In conclusion, ludology as an attitude requires a more generic approach to games.

8.5 DESIGN RESEARCH: LUDOLOGY FOR GAME DEVELOPERS

Is there a form of "applied" ludology, especially geared toward practical applications for game design and development? Could or should there be? One answer to these questions would be to put ludology in context

with another discipline of research introduced and articulated recently: design research.

What is design research? In general, it is research that is particularly interested in methods and results of the different stages of the design process. Thus, we see design research as the means to apply ludology as an attitude to practical game development tasks.

In the preface to the anthology *Design Research* (Laurel, 2003), Peter Lunenfeld discusses the various attempts to define design research from Bauhaus to date. He cites Sir Christopher Frayling's threefold identification of key areas of design research:

1 Research *into* design

2 Research *through* design

3 Research *for* design.

These areas are described as follows:

Research into design covers aesthetics and history of art and design. Research through design is done for particular projects and includes, for example, research of materials. Finally, the goal of research for design, even though most difficult to formulate, is to come up with systems and models which show-case and validate the results of the research (Laurel, 2003).

The three approaches are useful also for situating ludological activities into the contexts of design research. The most traditional aspect is "research into design," which consists of ludological analyses of existing games (i.e., their designs) and how players engage with those designs (i.e., play the games). Research into creating methods for these kinds of endeavors is something that the ludological attitude is able to contribute as well. The representatives of "research into game design" mostly equal the academic papers found in the online journal Game Studies and conferences of Digital Games Research Association (DiGRA).

"Research through design" is characteristically research that builds prototypes of games or game-related products as its results. These kinds of tasks may be built on specific ludological findings or theories that thus constitute research for design, possibly even for highly specific design purposes. Moreover, the documentation of the prototyping process and reflecting its solutions and outcomes becomes part of ludological study.

8.5.1 *Research for Design*

For the purpose of this chapter, we feel that the ludological attitude as research for design is the most fruitful area to cover in more detail, even though generally research for design has to borrow heavily from assumed history of design processes for games.

Games can be said to have been around as long as tales, mythologies, and rituals have been, while play predates these since it does not require a language and can be found in many animal species (Sutton-Smith, 1997). It can be assumed that these early games were designed in a similar way as folk tales are authored: the game elements and rules

evolve over time by the effort of countless, and nameless, "designers." Physical games, including sports, contests, and children games have been around even longer than games based on the use of symbols.

The difference between the gameplay in these activities can be divided into four main groups:

- Somewhat codified game-like interaction spontaneously arising from normal play behavior.
- Physical contests and tests with codified rules to determine the conduct and the outcome.
- Evolved symbolic games such as dice games and early board games.
- Games that have been designed on purpose.

The focus of analyzing gameplay in games (i.e., research into their designs) covers all these four categories, while the discussion of the problem of designing games focuses on the last category. All these categories are somewhat overlapping and share the common ground of gameplay activity, but all games in all categories can also be seen as artifacts that are the result of conscious design choices. For the last categories, this can be obvious as there may be records of the intentions the game designers had before starting the design process. Activities in the first three categories do not have initial design goals, but have been changed by the participants themselves while performing the activity, so that the activity suits their current intentions. As the activity has been repeated, the rules for the activity have developed in an evolutionary way where every change has been the adjustment to a local context.

The similar distinction can be made in general between craft and design (Jones, 1992): the characteristics of a craft product can be understood as a combination of the methods and materials available as well as the situations in which the product has been used over a longer period of time; and the characteristics of a designed product can be understood as the result of trying to reach a design goal, which is often at least partly implicitly defined, by using methods and materials available. A product can, however, be the result of movement between the categories. For example, an initial design can be the starting point for how a product develops through craft practice, and an already crafted product can be the inspiration for a designer to create new designs.

This view of craft and design can be found in Herbert A. Simon's *Sciences of the Artificial* (Simon, 1996), where he states that any activity with an intention to devise a course of action to change the existing situations to preferred ones can be classified as design. In other phrasing, things created by people can be treated as if they were designed when analyzing them, even if the people who created the things did not perform the actions, specifically setting design goals, normally associated with design.

Some argue that designing games is an art, knack, or a mystical craft that cannot by analyzed, and that the attempt to create methods and models of game design is futile. We believe that there is some truth to this claim, at least that it is impossible to come up with a cookbook or a set of instructions that can automatically create beautiful

designs without any other insight, talent, or skill. However, we also feel that it is possible, even desirable, to find and describe the basic features, elements, and patterns that can assist, guide, and inspire design work. Visual artists have to know the methods and techniques of visual composition, novel writers benefit greatly from understanding the principles of drama such as foreshadowing and climax points, and architects have to know the basic elements of how to construct buildings. Making the principles of how to design explicit gives designers a conscious layer of self-evaluation, and makes it easier to consciously break the principles and to seek new forms of expression. These are all practical aspects of a ludological attitude that game developers can embrace.

8.6 TOOLS, METHODS, AND MODELS

As seen previously, many of these definitions and models with ludological attitude come from professional designers as well as researchers who do experimental designs as part of their method to explore the design space of games. It is no wonder that many of these researchers and practitioners also have developed methods and models to design games.

The following methods and models are all recently proposed with an intention of supporting design of games and, obviously, the ludological attitude is evident in each of them.

8.6.1 *Chris Crawford*

Chris Crawford's *The Art of Computer Game Design* (Crawford, 1984) may well be the first contemporary treatise with a strong ludological attitude. In the book, Crawford identifies representation, interaction, conflict, and safety as the four common factors in all games. Although he does not give a definition based on these factors, he elaborates the meaning of game through exploring the factors. According to Crawford, all games are constructed representations, since games are closed formal systems that represent parts of reality. (Crawford, 1984, p. 9) The terms *closed* and *formal* are used to signify that there is a clear distinction between what constitutes the game state, and what does not, and that the system is mechanically deterministic respectively. Based on this perception of a game as representation of a selection of reality, Crawford then claims that the most fascinating thing about reality is the relationships of cause and effect, and that these are best explored through interaction as he states that interactive representations are the most complete kinds of representations and that interactivity is the most important aspect of games as such. (Crawford, 1984, p. 10). Crawford has also written numerous articles on this area and his newest book on game design (Crawford, 2003) is also worth noting because of his distinctive attitude toward games.

8.6.2 *Greg Costikyan*

Greg Costikyan in his "I Have No Words & I Must Design" article (Costikyan, 1994) identifies design choices that have to be made when games are designed. He lists decision making, goals, opposition, managing resources, game tokens, and information as the main features that are necessary for games and that should be taken into account by game designers when making games. After identifying these categories, he continues to describe them and explain why each is necessary, but does not provide specific details on how the features can be created.

Decision making is, according to Costikyan, the most integral feature of games. The players have a choice between different courses of action in the game and have to weigh the pros and cons of these alternatives. Regarding goals, Costikyan argues that they are what make players stay interested in playing the game. If there are no goals, no objectives in the game, the players eventually lose interest, as there is no purpose for their actions. Opposition is something that the players have to overcome to reach their goals. Opposition provides struggle, and Costikyan claims that a game without a struggle will fail as a game. Having the players manage resources in the game avoids the pitfall that the decisions are eventually trivial. If the player has to make trade-offs between using different resources, the choices are both more complex and interesting. The players have to have some methods to change the game state, and this is done through game tokens. The last feature, information, governs that the players should have enough, but not too much, information available about the factors that have an effect on decision making. The information itself can also be used as a resource, especially in games based on exploration. In the article, Costikyan also mentions some other features that strengthen games, from diplomacy between the players to narrative tension.

8.6.3 *MDA: Mechanics, Dynamics, and Aesthetics*

Robin Hunicke, Marc LeBlanc, and Robert Zubek have developed a formal approach to understanding games, which they call the Mechanics, Dynamics, and Aesthetics (MDA) framework. It has been employed in the Game Tuning Workshops held in Game Developers Conferences since 2001 (LeBlanc). The MDA framework consists of three main components: mechanics that describe particular components of the game, e.g. how data is represented and what kind of algorithms are used; dynamics that describe how player inputs affect the game system's behaviour over time; and aesthetics that describe players' emotional responses while interacting with the game system. The goal of MDA is to provide a framework for bridging the gap between game studies, game design and game development.(Hunicke et al., 2004).

These three components can be thought as three separate, but causally linked aspects of the game. The design of mechanics gives rise to the dynamic behavior of the system, which finally creates the aesthetic responses for the player. The aesthetics can be broken up into more distinct components; what the authors call *Eight Forms of Fun*:

- Sensation, game as sensory pleasure

- Fantasy, game as make-believe
- Narrative, game as drama
- Challenge, game as obstacle course
- Fellowship, game as social framework
- Discovery, game as uncharted territory
- Expression, game as self-discovery
- Submission, game as pastime.

The framework supports designers by showing how the one design goal regarding one part of the framework can be achieved by making specific design choices in other parts of the framework. They do not provide a detailed model for the possible ways the different parts can affect each other, but do offer some examples. For example, the authors argue that *Fellowship* can be encouraged in a game's design by goals that require co-operation or information that becomes more valuable when shared among players.

That is, different dynamics create different aesthetic experiences, and it is the designer's task to determine the aesthetic forms he wants and develop dynamics that create these forms. Finally, the actions, behaviors, and control mechanisms available to the players create and support these dynamics.

8.6.4 *Formal Abstract Design Tools*

Doug Church in his "Formal Abstract Design Tools" article (Church, 1999) argues that in current computer game development, the lack common design vocabulary has slowed down the evolution of game design in a considerable way. He then proposes a framework to overcome this problem, the Formal Abstract Design Tools (FADT), stressing abilities to communicate design ideas and shifting the focus on underlying ideas rather than specific implementations. This would lead the way for a common vocabulary.

One of his ways to approach the problem is to look at current good games and first identify and collect some key elements and aspects that make those games work. These concrete elements are then abstracted and formalized into a FADT. For example, his analysis of *Super Mario 64* led to two FADTs: *Intention* (forming a plan in response to one's understanding of the gameplay options and the current situation), and *Perceivable Consequence* (a clear reaction from the game as a result of the player's action).

FADTs give designers concepts to use when describing ideas and choices, and different collections of FADTs can be identified and created independent of each other, allowing them to be tailored for specific use. However, they do not have relationships to other FADTs as part of their definition, so designers are not helped in understanding the effect of using a FADT to change a game design where other FADTs have already been used.

8.6.5 *The 400 Project*

The 400 Project is an attempt to formalize what Falstein perceived as the basic rules of game design in an accessible way (Falstein, 2002). The rules consist of five parts:

- An imperative statement of the rule.
- A description of the domain of the rule.
- Rules that take precedence over the rule.
- Rules over which the rule takes precedence.
- A description of examples and counter-examples.

The rules are meant to be tools, which can be used in different phases of the design process, from problem solving during the design to fine-tuning an existing design. The target of the project is to come up with, as the name implies, 400 such rules.

The rules in the 400 Project differ from FADTs in that they are more structured and contain relationships to each other. However, they are not concepts that designers can use in their designs, but rather instructions on how the design process should be done. That is, they are imperative, and can be seen as a way of codifying best practice.

8.6.6 *Ernest Adams and Andrew Rollings*

In their book, *Ernest Adams and Andrew Rollings on Game Design*, the authors divide game design into three different areas: core mechanics, interactivity, and storytelling and narrative (Rollings and Adams, 2003). Adams and Rollings continue to separate other elements of games, such as setting, interaction model, perspective, the player's role, and define gameplay as series of challenges that are causally linked and take place in a simulated environment (Rollings and Adams, 2003, p. 201).

Adams and Rollings support design by showing how gameplay can be constructed from what they call "pure challenges," or combinations of these pure challenges, which they call "applied challenges." Their pure challenges are based on physical, mental, or social challenges with the following categories: logic and inference, lateral thinking, memory, intelligence based, knowledge based, pattern recognition, moral, spatial awareness, coordination, reflex/reaction time, and physical. Examples of the applied challenges that are based on the pure challenges include races, puzzles, exploration, conflict, economies, and conceptual challenges. The authors further provide descriptions of game design elements specific to different genres that can be used when creating the pure or applied challenges.

8.6.7 *Game Design Workshop*

Tracy Fullerton, Christopher Swain, and Steven Hoffman in *Game Design Workshop: Designing, Prototyping, and Playtesting Games* (Fullerton et al., 2004) discuss the structure of games and identify eight basic formal elements: players, objective, procedures, rules, resources, conflicts,

boundaries, and outcomes. These formal elements are the basis for their further elaboration and refinement of the method and structure to design games. The main theme in their design methods is to use the formal elements, and specific instances of them, to describe the current design and make sure that all aspects of a game design are taken into consideration. By doing this, an initial game idea can be described in a format that maintains the key elements as the idea is transformed into a concept, paper prototype, alpha release, and so on.

8.6.8 *Steffen P. Walz*

Steffen P. Walz has proposed and elaborated an approach to game design based on applying the classic rhetoric models and rhetorical figures of, for example, Aristotle, Quintilianus, and Burke (Walz, 2003). The main thrust of Walz's approach is to explore how rhetoric, defined as the science of persuasion, can be applied to the design and analysis of games. Walz takes the triadic relationship between game designer, game, and players as the starting point for his further analysis of digital game rhetoric. This relationship is similar to the classic rhetoric relationship between the communicator (or orator); the performance and the message to be conveyed; and the receiving audience. Further, Walz argues that identification, a concept adopted from Kenneth Burke's work on rhetoric, is the key for the use of rhetoric in game design. The three dimensions of identification—systemic, symbolic, and structural coupling—define the processes and strategies of how the game designer persuades the players to play the game. The most interesting dimension for this discussion is the structural coupling, where the game designer can modulate the player's expectations, motives, needs, and actions in the game by structuring the levels of offers and demands the game provides to the player. For example, Tetris contains several levels of these offer-demand pairs. The basic level is that of the demand of the block moving down and the offer of rotating and moving it left and right. The highest level is the demand of keeping the screen as clear as possible and the offer of removing several rows at one time. The interplay of these offer-demand pairs then creates the flow of the gameplay experience.

8.6.9 *Game Design Patterns*

The first article about game design patterns was Bernd Kreimeier's "Case for Game Design Patterns" (Kreimeier, 2002), in which he formulates the four basic aims of game design methods: they should relate to game design, have utility as a tool, be abstract, and be formalized. Inspired by Christopher Alexander's pattern approach to architecture, Kreimeier (Kreimeier, 2003) developed an approach to game design based on the concept of game design patterns. Parallel and inspired by Kreimeier's work, Björk and Holopainen started their ambitious Game Design Patterns Project (GDPP). Björk and Holopainen have a slightly different approach than Kreimeier. They follow the basic principles of Alexander to describe invariant and recurrent characteristics of game design. These are expressed as interdependent semiformal pattern de-

scriptions. Their collection of almost 300 patterns can be found in the book Patterns in Game Design (Björk and Holopainen, 2005b).

8.6.10 *Katie Salen and Eric Zimmerman*

Salen and Zimmerman's book *Rules of Play* (Salen and Zimmerman, 2003) introduces a formidable set of theories and schemas for game design and studies: theoretical groundings run from psychology to game theory, information theory, systems theory, semiotics, mathematics, and so forth. The book testifies to the wide number of different backgrounds on which game design and game studies can potentially draw. The authors' goal is to see the actual conceptual tools that are relevant regarding games, and thus better understand the uniqueness of game design as design practice.

Salen and Zimmerman promote "meaningful play," which refers to actions and outcomes within a "magic circle" (see Johan Huizinga previously) that add to the emotional and psychological experience of playing the game. Creating meaningful play is a complex process, and Salen and Zimmerman address different aspects of analyzing and designing systems that facilitate the emergence of meaningful play. They articulate a number of game design schemas that are intended to provide frameworks for understanding formal, experiential, and cultural aspects of games.

8.6.11 *Discussion*

The use of what we call ludological methods and models is also dependent on the different intuitive approaches the designers already have. Some designers prefer the structured, sometimes even rigorous approach to game design, while some are more comfortable with the feeling of playful freedom of the design process. The methods and models, however, are developed to assist the design process, not to straightjacket it into following step-by-step cookbook instructions. According to both anecdotal evidence from designers and personal experiences of the authors, the use of a method is not always conscious. During the design process, there are phases when the design falls into place intuitively, without conscious reflection on the choices. The methods and models are then used consciously and with rigor to evaluate and sometimes validate these intuitive design choices. The explicit and structured models of games are also good for understanding the role of games in larger cultural context and analyzing games in general.

8.7 TWO LUDOLOGISTS: A DIALOGUE

To close the discussion, the authors engage in a dialogue to highlight some aspect of ludology and its uses in their own design and research tasks.

AJ: By naming our contribution "Ludology for Game Developers," we offer a particular interpretation of what ludology is and, more or less, what it should be, right?

JH: That is correct, although I am a bit hesitant to offer interpretations, as they tend to be regarded as definitions and this can lead to much confusion later. So, I stress here that what we offer is just our interpretation of what ludology means in this particular context; i.e., "Ludology of Game Developers." The focus is on shedding light on the ludological issues that are, in our opinion, the most important ones for those who are in the trenches of game development. Ludology itself is still a slightly vague and sometimes far too encompassing discipline. For example, one definition presented previously, "the study of games, particularly computer games" (Frasca, 1999), is not really useful in this context, as it could also include specific technical topics such as rendering techniques, which, again in my opinion, are not part of ludology as I understand it. Following the discussion in the first part of the chapter and also my own research interests, I would like to make the area of ludology focusing on the structures of gameplay as the most important one for game developers.

AJ: In your experience, how do people working in the industry find ludology? Do they embrace or resist it? To put the question in context, I've had a couple of opportunities to witness how people react to your and Staffan Björk's ideas and methods about using game design patterns, and there seems to always be someone from the "not invented here, or by me" camp. Any thoughts on this?

JH: This depends quite a lot on what kinds of developers there are in the audience. Some of them are obviously interested in all kinds of things related to games, and they usually carefully listen to our argumentation and take bits and pieces which fit in their work and choose to ignore or criticize the rest. The resistance, however, is widespread, and we have heard many, many times that the models we have presented are useless because 1) they are too complex, 2) they do not reflect the actual work done by the designers, and last but not least, 3) we are not working in the games industry (as it is).

AJ: I believe this has to do with a more general perception of theory. For theorists, theory is a means to produce order from chaos and thus reduce complexity, but theorists (myself included) often fail in communicating this intent with their complex figures, concepts, etc. Do you agree?

JH: Yes, pretty much. The first issue, the models being too complex, is something we are trying to address in our future work by somehow making it easier to access the complex models. This issue, however, has two sides: on the one hand, we do not believe that it is possible to have a simple model of game design without sacrificing way too much, and on the other, there might be flaws in the model if it is impossible to use it in a practical way. This issue is, I feel, ubiquitous in every theoretical approach to creative work. Just looking at, for example, the models of narrative and drama by French semioticians: the models are complex and beautiful, but it is almost impossible to use them in a fruitful way without revising the presentation heavily. The second issue, that the models do not reflect how real designers do real designs, is a slightly more subtle problem to tackle. However, after discussing this in more detail with those people, it usually turns out to be that the model does not fit their intuitive view on their work process, and by making the mappings between their implicit conceptual models and our model more explicit there are surprising similarities. The last issue with us

being outsiders to the games industry often turns out to be a case of "Not Invented Here" syndrome, which in one sense is understandable. The last two complaints are also based on mutual misunderstanding about the reason for presenting the model. Developers sometimes take these theoretical models as outright and blunt criticism of their own work, and I have to admit that sometimes our style of presentation fits this view quite well ("here we are presenting a model which describes the design process in a structured and clear way. . . "). These models, however, should not be taken as facts or normative guidelines, but rather as tools which can be modified and added to the developers' toolboxes based on their needs.

AJ: So what about this idea of ludology as an attitude rather than some clearly distinguishable design or research method?

JH: I feel that this is a beneficial approach for both the people working in game development and the ludologists themselves, especially for helping them understand each other better. The ludologist (well, I might be a good example) storming into a development studio to present these fancy new research results as the design method is going to be ignored or, in the worst case, smeared in tar and rolled in feathers. The key issue is first to create a mutual understanding of the approach, in this case ludology as an attitude, and then start to investigate what is useful and what is not. Somehow, I have this feeling that we as academics have a tendency to "preach," and I fully understand the developers who resist these kinds of approaches. What about your experiences? You are working in the Finnish National Lottery company as a games researcher. What kinds of experiences have you had with ludology as an attitude there?

AJ: Well, I have tried to pursue it within the company, with varying results. There is definitely the challenge of incorporating formal methods with the "silent knowledge" and routinized practices of experienced designers. But I've had some successful steps in introducing board game workshops, systematic analysis methods, etc., into the design process. Overall, my own work divides into two branches: One, I am working on my academic thesis on game analysis and design methods, and two, I am trying to adapt those methods to the practical design and evaluation tasks that I am responsible for. The thing is that I am working within an industry that has long traditions (gambling in all its forms) and this presents quite specific and rather ruthless requirements for new games, such as luck being a near-absolute deciding factor regarding outcomes, and so on. I believe the formalistic approach has helped enormously to better see the formal structures and their configurations—rules, draws, game mechanics—that one has to have in a game in order for it to be operated as a lottery or a betting game. After distinguishing those, it is easier to focus your attention to how the game appears and how you "thematize" the game, to use a theoretical term from my own theory. Also, it has enabled us to experiment with completely new forms of lottery and gambling games and focus on the player's experience. To emphasize this point, I've found game design patterns very useful and tried to adapt them for games of chance in particular. In the context of my academic pursuits, I've taken the MDA approach as a starting point and tried to reformulate it by giving its ad hoc nature a more detailed groundings in psychological theories on emotions, moods, and cognition.

JH: That is quite similar to my work at Nokia Research Center. I also feel that the ludological view we are pursuing is quite different from research done on games, for example, in media culture and philosophy just because we both have to apply the research to our daily work.

AJ: Exactly. It doesn't mean that research that remains on a descriptive level is useless, but rather that it has to be filtered or remodeled into tools that one needs in everyday work. In practice, though, there has to be someone who has the means and the time to do it. For this, having one foot—or at least a couple of toes—in the academia helps a lot, as one can use general knowledge of research methods in seeing what kind of research and theory is applicable for design and product development. This is definitely a benefit of general interest in ludological matters, I believe! Let's move on to discuss more examples of ludological attitude or ludological method. I find many kinds of self-reflective approaches to design processes or fundamentals of game design (Game Tuning Workshops, Rules of Play, etc.) quite lucid examples of ludological attitude. But how about less formalistic approaches, such as studies of player behavior, do you see them representing ludology? How do you see "culturalist" ludology and the questions it would be interested at?

JH: As I previously mentioned, for this particular context I feel that the formalist ludology focusing on structures of gameplay and design processes is more appropriate than cultural issues. Even though this is the case, I really, really do not want to say that the cultural issues are irrelevant for game developers, far from it. I just feel that the issues of "culturalist" ludology might be more difficult to use in the day-to-day work in game development. Of course, it would be beneficial if at least the producers, designers, and marketing people would be familiar with issues such as the cultural history of representation in games and game advertisements.

AJ: We both were involved in a study where psycho-physiological player responses (heart rate, skin conductance, etc.) were measured in relation to specific events in games such as Tetris and Super Monkey Ball [Ravaja04]. I believe ludology played a part in that study in the sense that we tried to analyze and distinguish those particular events as general patterns that exist in a wide array of games...you agree?

JH: Sure. I guess that this study was an excellent example of ludology as an attitude approach within the research itself. Both parties (we as ludologists and the other researchers as media psychologists) had the "ludological attitude" and the first results were cautiously optimistic about the relevance of this research to playtesting methods in general, even though the conclusions were not done with proper ludological rigor. However, in the later phases of the study we are starting to look at how this attitude can be expanded to making the method available and accessible also to the developers by automating the now cumbersome testing methods. I strongly believe that the results of this kind of research can, in the end, validate and guide otherwise intuitive design choices by making explicit the patterns of player responses to different gameplay structures. In conclusion, the study confirmed, to certain extent, our initial hypothesis that a ludological approach can produce results that are useful to game developers, and I think that

is, or at least should be, one of the drivers for ludology: to provide research results to be able to make better games!

AJ: True! In general, I believe ludology as an attitude tries to question the tug-of-war between theory and practice by trying to show that the ends of the rope, so to speak, are not necessarily clearly demarcated in the first place. Also, why won't we ask, "How does practice inform theory" for a change? This is where ludology and design research are able to provide examples and answers, and compete on both ends of the rope!

8.8 SUMMARY

Ludology is an attitude toward game design and development that is driven by a need to understand games in general terms. Ludology finds practical applications both in academic studies of games, and in developing formal methods for game design. The generic nature of ludological attitude means that it is interested in learning and developing interdisciplinary methods for making better games: ludologists want to learn from psychology, architecture, play theory, design theory, information theory, semiotics, rhetoric, and so forth, and adapt them for the purposes of game analysis and development. Ludological attitude can also point the way for finding common vocabularies and practices for game scholars and developers, even though there doesn't need to be a division between "thinkers" and "doers." Rather, it is the ludological attitude that builds bridges between the two, with methods such as Formal Abstract Design Tools, Game Design Patterns, and Meaningful Play presenting concrete ways of how to build them.

8.9 EXERCISES

1 What is ludological attitude? Describe at least four different dimensions of ludology as an attitude.

2 Select one of the approaches listed in the Tools, Methods, and Models section and describe how it could be used in real-life game development project. It is recommended that you go through the source material in more detail than is done in the chapter itself.

3 What are the perceived benefits of ludology for game development? What issues would hinder using ludological approaches in game development? Make a short pros and cons analysis of ludology for game developers.

4 Give concrete examples of the three key areas of design research as applied to game development.

9

USING PROTOTYPES IN EARLY PERVASIVE GAME DEVELOPMENT

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In this article we discuss various prototyping methods in early pervasive game development. The focus is on pervasive games that are played with mobile phones. Choosing the right prototyping method is crucial in achieving results that can be used for validating or developing further design ideas. In this article we give guidelines that help the selection process and give ideas on methods that can be used in different situations. We have play-tested pervasive game prototypes using agile software prototype development methods, forum prototypes, and guided paper prototyping methods. We give examples of five pervasive games where these kinds of prototyping methods are used. In concluding, we compare the results and discuss their benefits and disadvantages in the game development process, that is, when the methods should be used and what should be considered when using them.

Categories and Subject Descriptors: K.8.0 [**Computing Milieux**]: Personal Computing – *General, games*

General Terms: Design, Experimentation, Human Factors.

Additional Key Words and Phrases: Mobile, game design, paper

9.1 INTRODUCTION

Prototyping is a commonly used design method in game development (e.g., Fullerton et al. (2004)). Prototyping pervasive games is often more difficult than prototyping traditional digital games that are played with a computer or console. In this article we focus on prototyping methods that can be used for testing and improving game concepts in the preproduction phase of the game development process (e.g., Koivisto and Palm (2005)).

Various definitions for pervasive games have been presented in the literature. For instance, in her dissertation Mcgonigal (2006) defines pervasive games as disruptive, highly visible, and often artistic events. She argues that ubiquitous games are often used as a synonym for pervasive games. Walther (2005) claims that ubiquitous games are a subgenre of pervasive games (which is closer to our view as well).

According to Montola (2005) pervasiveness in games can be defined as those that break the temporal, spatial, or social boundaries[1]

1 The boundaries here refer to the Magic Circle, a term coined by Johan Huizinga (1955).

of games. Spatial pervasiveness means that the game can be played in different places and the location can affect the game-play. It also means that games can be found in places where they are not expected[2]. Temporal pervasiveness means that the gamecan be played during everyday activities. Games can contact players when they are not actively playing. The social pervasiveness means that players can change their roles flexibly from being a nonplayer or an audience to being an active player, and vice versa. It can also mean that nonplayers are used as game resources; not all of these boundaries need to be broken for the game to be pervasive.

For the purpose of this article we chose to use Montola's definition. The prototyping methods that are discussed in this article can be used for any game, and are particularly recommended for pervasive (as defined earlier) games, or if the game is very innovative.

Considering the three aspects of pervasiveness (spatial, temporal, and social), it is easy to understand that prototyping pervasive games can be challenging. Pervasive games are often completely new kinds of games. When designing a first person shooter game with slightly different elements than implemented in other earlier games, the designers already have a rather good idea of what the game-play would be like. In the case of pervasive games, the designers have often never played games similar to those they are designing, and it is difficult to understand the game-play before trying it out in practice.

The more inexperienced the game designers are, the more difficult it is to imagine what kind of game-play will emerge when the players, and potentially the environment, interacts with it. However, even the most experienced game designers, such as Will Wright[3] (2004), say that they benefit from experimenting with physical prototypes when designing (nonpervasive) games.

In the iterative design process, play-testing games with prototypes is typically done for three reasons: to test game design ideas or concepts, to generate new design ideas, and to probe the attitudes, opinions, and behavioral patterns of potential players. When prototypes are tested, typically all these kinds of observations are made. In addition, prototypes are used to demonstrate ideas.

To enhance game design we have developed pervasive game prototypes during the early phases of game development projects. This article discusses using agile software development, readymade software components such as forums, and physical or paper prototypes in pervasive game development; we also give guidelines for choosing the right methods.

The term "physical prototype" in this article covers all prototypes that are constructed with paper, miniatures, or actors – components that do not focus on using software. This method is sometimes also called paper prototyping, even if the prototypes contain objects other than paper.Agustin et al. (2007) call the method for developing very rapid prototypes that are thrown away in game development game sketching. They argue that prototyping is used to both prove that the team can build the game and to test whether the game ideas work. It is important to make a clear distinction between them; this is why

2 For instance, an advertisement could lead the player into a game.
3 Designer of the Sims

Agustin et al. (2007) prefer to call the very early prototypes sketches rather than prototypes.

The article is organized as follows: First we discuss related work on prototyping games; we then describe agile software prototyping, software-component prototyping, and physical prototyping methods we used in this study, and give examples of prototypes that we developed using these methods. Before concluding, we give guidelines for selecting the right prototyping methods in pervasive game projects.

9.2 RELATED WORK

We studied related work to learn what kinds of prototyping methods were used in the early development of game and play applications. Paper prototyping is a commonly used game design method among game researchers and designers (see e.g., Fullerton et al. (2004) and Sigman (2005)). Often, physical prototyping and testing are not conducted with the actual users, but with project members and other colleagues; it is also commonly used in usability testing of nongame applications. At times such testing is conducted with potential end users of the application. Variants of paper or physical prototyping of applications and services have been presented earlier. Ehn and Kyng (1992) demonstrated how combining prototyping and games can be used to improve communication of the concepts to end users. Iacucci et al. (2000) developed the method further by using a similar approach to that of Ehn and Kygn for testing mobile applications and services. Iacucci et al. (2000) found that playing the prototype as a game enhanced the user's understanding of contextual changes and the contexts of other users.

Testing pervasive games with physical prototypes is not straightforward, since the games can last for a long period of time and involve real-life activities. Höysniemi (2006) describes in her dissertation using the Wizard-of-Oz[4] method to play-test physical games. She found that Wizardof- Oz prototyping was useful because it was flexible enough for demonstrating behavior patterns that the designers did not expect beforehand. For instance, when the players used swimming motions that the designers did not expect, the Wizard could change the prototype to support that kind of interaction on the fly. On the other hand, she noticed that the Wizard's conceptual and motor skills set limitations on what could be done with the prototype.

Ballagas and Walz (2007) used several prototyping methods in their location-aware cityexploration game, REXplorer. They used a board game prototype to successfully demonstrate the game, and noted that it was particularly useful for getting a feel for travel times, expressing spatiality, judging proximity of sights, and ensuring that the game was fun to play. Like Iacucci et al. (2000), they used event cards for simulating a more realistic environment. To test game interaction, Ballagas and Walz also prototyped the game at the locations where the game was supposed to take place. They used a GPS signal detector for designing the "hotspots" (i.e., the areas where something new was to happen in the game), and tested how the game worked in the hotspots

4 In Wizard-of-Oz prototyping, a prototype is controlled by a human. The human involvement is not usually visible to the test user.

with the Wizard-of-Oz method, whereby the wizard shadowed the players and input their locations.

Focus group discussions[5] and interviews were used to discover the attitudes and opinions of actual users, often when there was no implementation of the concept available. However, there has been criticism of this method, since it may be difficult for users to evaluate something that they have not seen or tried out in practice. (our previous study also supports this statement (Koivisto and Wenninger, 2005)). Such focus group discussions are better at finding out the opinions, attitudes, and behavior of the players. The players should not be asked directly if they liked certain concepts (Ermi and Mäyrä, 2005). To make concepts more concrete in focus groups, scenarios (e.g., comic strips, Lankoski et al. (2004)) or acting (Strömberg et al., 2004) should be used instead. Ethnographical studies were found useful in designing mobile leisure applications. Esbjörnsson et al. (2004) used an ethnographical study when designing Hocman, a social networking application for motorcyclists on the road. They called their method associative design; its key idea is that ethnographers and designers work in very close collaboration, instead of just delivering reports on paper.

Pervasive games can greatly benefit from rapid software prototyping. Agile methods (Cockburn 2002; Beck 1999; Agile Alliance: http://www.agilealliance.com), which in recent years have become widespread in the software development industry, have helped in the design of pervasive games (Koskinen and Suomela, 2006). To minimize the risks in the development process, agile software focuses on making software in short iterations. Every iteration contains all parts of the software development process, including design, coding, and testing. Agile software development emphasizes working software, which allows the team to constantly measure the quality of the software. Such an approach has a great advantage in correcting design.

Agile methodologies can be applied to games as they are, but there are well-known problems in doing so. A typical game project consists of large teams, but agile methodologies apply best to small teams. However, actual game software development does not differ that much from traditional software development, and agile development has been successfully applied in game development as well. We found agile methods useful for game prototyping because they make it possible to change the functionality of the prototype quickly when needed. A sequential software development model like the waterfall model (Royce, 1987) does not allow the flexibility necessary for the early development of prototypes.

Ready-made software components were also used for game prototyping. Manninen (2002) published two studies in which a mobile game console and a card game were prototyped in a virtual environment. He found that using game engines like Unreal for game prototyping was a promising approach, particularly when the interaction with the physical environment did not need to be very complex. According to Manninen (2002), developing the prototypes was fast and made work in distributed locations possible.

5 Here, we are *not* referring to product-interactive focus groups Lee et al. (2004), where the attendees try out prototypes or existing products.

9.3 PROTOTYPING STUDIES

In this section we present research done on rapid game development: one study was conducted with a ready-made software component, and in the other study two games were tested with physical prototypes. Later, we will compare the results and give guidelines for selecting the right kind of prototyping method.

9.3.1 *Rapid Game Development*

We conducted some experiments on rapid development of context- and location-aware games. Such games should react to the users' immediate environment via location or some other input. They are pervasive in nature, and since they deal with the real world, it is not feasible to first create the games and then test the final product. The real world is something that cannot be controlled in the digital domain, and the design process should take this into account by observing how the game prototypes actually react to the environment.

In our experiments we created location-aware games in 24 hours (Suomela et al., 2004) and context-aware games in one week (Koskinen and Suomela, 2006). Our focus was to design and implement a game in the given timeframe, which each group managed to do. The aim was not to create finished products, but to create working prototypes that the other participants could play at the end of the sessions.

The sessions focused on the very first phases of the game design process. The participants came up with the idea and immediately proceeded to make the first running prototype. We focused on working software, not on game design – as a consequence the games were fairly simple, and only the selected game features were highlighted. However, these sessions were very successful in communicating the game design. At the end, every participant was able to test the game and immediately give feedback to the developers.

The prototyping sessions were hectic. Learning, design, and implementation followed each other very rapidly, and the time left was used for testing. This kind of a setup is useful for testing one or a few features in a game, but since the testing phase is reduced to a few hours, it is not useful for testing a game that takes a long time to play. Still, this approach gives valuable information on the feasibility of the concepts and on some of their features.

In yet another session (Koivisto and Suomela, 2007), two experts developed three game prototypes in a single day, based on ideas given by visitors to an event. Out of the three games, one seemed to be good, one had problems in the design, and the last was nice but not interesting. In the context of this article, the game (called Hot Potato) with the design problems was the most enlightening. It involved a variable number of players and was persistent, so that it could, for instance, be played during a work day, among other activities.

The idea in Hot Potato is that one player at a time has a hot potato that he or she must hold on to for a certain period of time. A player cannot hold the potato forever because it becomes too hot and must be handed on to another player nearby before it burns one's hands.

Figure 1: Play-testing PhotoQuiz; an observer's point of view.

The initial analysis of the game design pointed out a few strong points. The game is very social, since the players are directly interacting with each other via a game object, and it would be easy to add multimedia content to the potato, making it aware of its history and past owners.

Problems began to appear after the prototype of the game was put on mobile phones. First, players who did not have the potato had nothing to do; second, if there were no other players in the proximate range of the sensors (Bluetooth), the potato could not be passed on; third, if the potato was on a device owned by a player who was leaving, the game stopped (the potato was out of the game).

There are many ways to counter these problems, like adding several potatoes to the game or sending potatoes over a distance, and so on; but they would all radically change the game concept.

These features could have been spotted at design time, but they were much easier to spot with a functioning prototype that was built in two hours by two developers.

Feedback is very important in pervasive context-aware games, since the games can act very differently in the real world than they were initially designed to do. If the game requires a certain real-world condition in order for content to trigger, the condition might never occur in the actual game.

Another software prototype, called PhotoQuizz, was play-tested in 2006 in two focus groups at the Technology Research Centre of Finland (VTT). A typical view of the test setting appears in Fig. 1. The players sat around one table, with two facilitators in the same room; other observers were behind a transparent mirror. Seven players participated the sessions and played two games, one was PhotoQuizz.

The game was developed at the Helsinki Institute of Information Technology by the MoMUPE project. In this game, the players took pictures of objects and other players tried to guess the words that the pictures represent. We organized two test sessions with researchers at VTT that lasted for two hours each.

We received feedback from the test sessions and made observations on the attitudes and opinions of the players and on game-play and usability issues. We received some data on ergonomic and technical issues as well. The game-play did not need much explanation and was easy for the players to understand since they got to try the game out.

9.3.2 *Prototyping with Ready-Made Software*

In the IPerG project (IPERG) we prototyped a pervasive game called Mythical: The Mobile Awakening[6], which is played with mobile phones. The game was tested with both a physical prototype and a prototype consisting of a ready-made software component: a web forum. The target of the prototyping sessions was to design and test one of the main modes of play in the game. The main design requirements for the entire game were to support blending activity and interrupt-ability (i.e., so that the game could be played meaningfully even when the player's main focus was on other tasks, e.g., attending a lecture). These requirements were fulfilled by making the mode of play a slow-update one, where the player did not have to pay attention to the game all the time. The problem from the prototyping perspective was that a slow-update game could take days or even months to finish. The development team decided to use physical prototyping to test the core game mechanics and web-based forum prototyping to quickly test whether the core mechanics worked in a slow-update version before nailing down the game-play features for the next version of the game. The team designed and tested several versions of physical and web-based forum prototypes before deciding on the core game mechanics for the final forum prototype (Fig. 2). In each version, the core game mechanics were first tested and modified with a physical prototype before testing with the web-based forum prototype. The development team conducted the tests, as it was considered too early to bring in external testers since the game-play features were still mainly undecided.

The game-play features changed considerably between each version as new gameplay problems and opportunities were identified. The main design conflict was between making the game complex enough to be interesting while keeping actions and representations simple enough to make it playable on a mobile phone. For the last prototypes, the team's graphic designer made mock-ups of the mobile phone user interface to test whether it was possible to display the required game state information on a small screen.

During the whole process it was necessary to use physical prototyping to test whether the core game mechanics worked at all and then use the forum prototype to test if the game-play was interesting enough even in the slow-update mode. In hindsight, more attention should have been paid to representational complexity in some of the intermediate versions. Even though some features were interesting, they had to be rejected because they would have been too difficult to display on a mobile phone screen. It would have been good to make quick UI mock-ups before every forum test to see if the design was at all feasible on a mobile phone.

6 http:// www.mythicalmobile.com

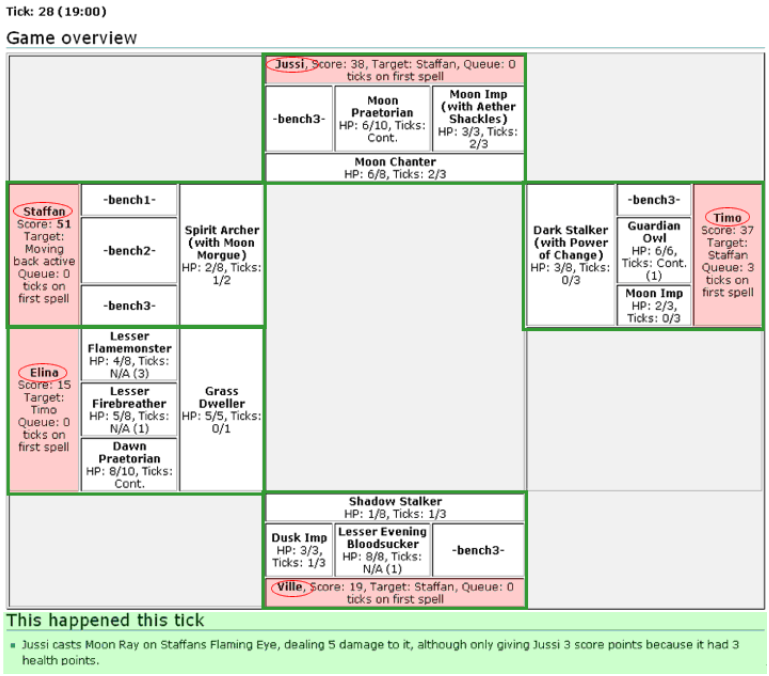

Figure 2: Screenshot of the final forum prototype (color added to make the table more readable). The table shows the game situation in one tick; it shows all the players (the names are circled), the game situation (each player's score, current target, spell queue, and minions' status), and actions (here a player has attacked another player).

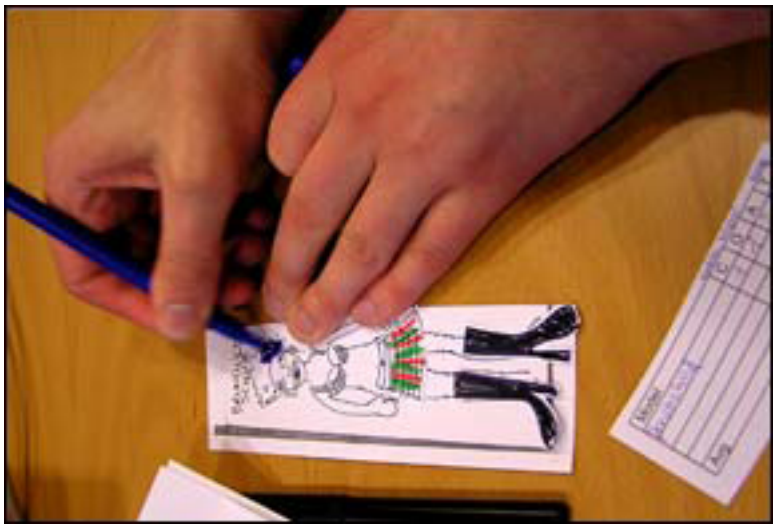

Figure 3: A player customizing his model in game 1.

Figure 4: Play-testing game 2: A player, storyteller, and "computer."

9.3.3 *Physical Prototyping and Guided Physical Prototyping*

In the first physical prototyping study we play-tested (with six colleagues) a physical prototype of a multiplayer online mobile game. The game was pervasive in the temporal sense, and could be played over a long period of time; the in-game communication continued over the course of the day during which the player performed other real-life activities. The game was targeted towards female players, as the theme was managing fashion models.

Play-testing was conducted in 2005 in Finland, and took two hours. The physical prototype was constructed of paper, pens, and an Excel sheet for calculating the results of the players' actions. Fig. 3 shows how a player customized one of the game characters he controlled.

The second study involved three researchers and eight potential players. The game was a pervasive massively multiplayer online game (MMOG) called GED (for Garden of Earthly Delights) (Koivisto and Eladhari, 2006). The game was designed to be played on a mobile phone and a stationary computer. Each play-testing session (conducted in Sweden in 2005) lasted 1.5 hours on average; most of the test subjects were university students.

The prototype was constructed of paper, and the researchers had three roles: one was a "computer" who changed the screens that the player would see, one was a storyteller who set the player up in different kinds of situations, and one was an observer. A picture of a typical session can be seen in Figure 4.

Both physical prototyping studies were very fruitful in finding ideas for improvement and problems in the game design. The Fashion game prototype did not demonstrate the user interface in detail and there were no comments related to usability. The second prototype concentrated on evaluating the game user interface as well.

Observations from the play-testing session of the Fashion game concentrated mostly on game-play issues (which was the purpose of the testing session, as testing was conducted very early in the design

process while the team was still working on the game design). The test results were used to validate the playability of the game concept and to develop it further. This was done, and the game concept was "sold" to a third party to for further development. Unfortunately, it was never made into a real product.

The pervasive MMOG prototype provided a lot of feedback on the game-play and user interface issues, but there were also plenty of observations on the attitudes and opinions of the real players. For example, the game was designed to be collaborative, but there was feedback that at times the players wanted to play the game alone as well.

Play-testing the Fashion game brought out 51 problems, opinions, and ideas; playtesting GED turned up 81 findings (however, considerably more time was spent on organizing the testing sessions). There are two reasons for this. First, in usability studies, the number of new findings gets rather small after testing the application with five test users (Nielsen, 1993)]. In play-testing mobile games, we noticed that often it is enough to test the game with six players to find most of the issues related to playability and usability. However, in this case we wanted to involve more players to get a better understanding of their opinions and attitudes as well. Second, most of the findings in the case of the Fashion game were ideas for its improvement. Experts are often used to playtest the physical prototype in order to create new ideas as well as to evaluate existing ones.

9.3.4 *Comparing Test Results*

The physical prototypes that were used to test the Fashion game and the very early versions of the Mythical game were very effective in testing and generating ideas. Several fixes were done based on the feedback. Because we managed to recruit a colleague who had previous experience as a fashion model to test the Fashion game, we received expert feedback on potential users and on the theme of the game. But we could not gather reliable data on the culture of the players or their attitudes and opinions. When playtesting GED (pervasive MMOG) with potential players, however, we received a lot of data on their opinions and attitudes.

The physical prototype of GED was not very good at revealing potential problems related to environment and movement in the real world. The results could have been improved by using a real- world map, miniatures, and event cards, as in related studies mentioned earlier. However, even then the findings would have been somewhat limited by the researcher's imagination (e.g., the kinds of events that could happen). Also, in the case of GED, the virtual game world was overlaid on the real one and the interaction between them was very difficult to test with a physical prototype and real players.

The forum prototype was very effective in play-testing slow-update prototypes with a distributed team. It did not require any specific software for the test players to participate. When some of the players forgot (frequently) to update their actions, the facilitator backed them up and simulated them.

We found that it is a lot easier to see the technical problems and those related to the context in which the game is to be used if it is tested with a software prototype. For instance, in the case of Hot Potato, the problem was lack of other players in the environment, which could have been difficult to see via the physical prototyping method. Physical prototyping is often organized for a fixed number of participants for a fixed period of time. Since pervasive games can include one or more of three specific features– temporal, spatial, and social–these variables should also be changed in the test setting. Some simulation can be done when using the guided physical prototyping method; but the scenarios are designed by the test organizers, who cannot always predict the problems or situations that may arise.

9.3.5 *Comparing Resource Intensity*

The purpose of creating game prototypes is to provide a tool so that game mechanics can be tried out in practice before there is a real implementation of the game. In the early phases of a project, the aim is to get something working fast so that the design ideas can be tested either by the team or by potential players. This leads to an important question: How fast is fast, and how many resources are needed to create something that is usually thrown away after it is tried out?

When using rapid software prototyping platforms or tools to create game prototypes such as MUPE (Suomela et al., 2004), simple software prototypes can be developed within a couple of hours, as shown in our example of the Hot Potato game earlier. However, before they can be used efficiently for prototypes, software frameworks must always be learned first.

Provided that developers work with tools that are familiar to them, a game prototype can be created quickly; but "quickly" can refer to weeks, days, or hours, depending on the complexity of the task. MUPE is a platform that is tailored for pervasive games, and it is possible for an experienced developer to create a working prototype in hours.

Developing simple physical prototypes of the core game-play can be rather fast; developing the materials for testing the Fashion game took approximately one day. The work included drawing pictures of the characters' clothes, creating character and team sheets for the players, creating a spread sheet to calculate results of rounds of the game, recruiting colleagues to test the game, and copying material. The test session itself lasted two hours; five test players and the organizer participated. The approximate amount of working time to create and test the prototype took 20 hours.

Developing and testing the prototype of the pervasive MMOG required more effort (play-testing the game consumed 120 hours, and the overhead, e.g., sending emails before testing, was not counted by Koivisto and Wenninger (2005)). One reason for taking such a long time was due to involving "real users" to play-test the game, and testing it one player at a time; another is that this prototype was more complete than the first, since it demonstrated how the user interface in the game would work. The pervasive MMOG concept was also slightly more complex than that of the Fashion game.

In the case of the Mythical game, testing each of the early physical prototype versions took three persons between one and two hours. The forum prototypes took from one to three days to play through, with one person as facilitator and two to five players. The forum prototypes required that the players spend a minute or two every couple of hours checking the game situation and playing the game, while it took the facilitator ten to twenty minutes every two hours, excluding night time, to synchronize the game state.

9.4 CHOOSING THE RIGHT PROTOTYPING METHOD

Prototypes should be created as early as possible in the game project. Inventiveness, new technologies, use of physical and social context, all increase the need for prototyping, since there are more unknowns in the design. The more inexperienced the game designers the more important the prototyping. However, even the most experienced game designers use and benefit from early prototyping.

We presented several prototyping techniques in this article, some used in our own studies and some by other researchers. Based on our own studies and related research, we recommend the following guidelines for choosing prototyping methods for pervasive games. To some extent the guidelines can be applied to nonpervasive games as well.

9.4.1 *The Purpose of the Prototype*

The desired results. The early prototypes are typically used in the iterative game process for validating ideas, creating new ones, or probing attitudes, opinions, and behaviors. As stated earlier, every test session with a prototype usually generates all of this data. However, the choice of prototyping method and test subjects will affect the results.

Obviously, the prototype, whatever it is, will provide more reliable data on the attitudes, opinions, and behaviors of the end users if it is tested with the potential players of the game. Hence particular attention needs to be paid in the recruitment process to make sure that the test subjects match the target group of the game. Some data can be gathered when using colleagues as well, and some of it may be reliable if the target group is similar to the test subjects. But it should always be remembered that game designers are typically very experienced gamers and represent only a very small specific group of players.

The less polished prototypes are useful for generating ideas. When the prototype does not look like a finished product, it is easier not to comment on its looks (Snyder, 2003) but to concentrate on its design instead. If the prototype can be changed on-the-fly, like the one by Höysniemi (2006), the test session can even be adapted to the new and unexpected behavior of the players. Our experience in testing prototypes with colleagues is that they are enthusiastic in presenting new ideas which could be used to design better games.

The prototype's target audience. In addition to testing games with potential players, prototypes are often used to demonstrate the game to

Purpose of the prototype	*Test subjects*	*Required prototype completeness*
Probe attitudes, attitudes, and culture of users	Real players	Medium; complete enough for players to understand; focus groups and ethnography are useful too.
Generate ideas	Experts, players in focus groups, and ethnography	Low; sketchy prototypes encourage idea generation; good if change on-the-fly is possible.
Test ideas	Experts and real players	Medium; good if change on-the-fly is possible.

Table 1: Choosing the Prototyping Method by the Desired Result (any prototyping method can be used)

stakeholders, such as clients, in the project. These kinds of prototypes should be instantly playable and the players should be able to complete something within a few minutes. If this is not possible, it may be a good idea to demonstrate the game-play with a video. Agustin et al. (2007) highly recommend that prototypes used to demonstrate the game to third parties and those used to generate ideas or to test them (game sketching) not be confused.

9.4.2 *The Game Type*

The game type has a huge effect on choosing the right prototyping method. Earlier, we said that pervasive games break the boundaries of "traditional" games in three ways: temporally, spatially, and socially. The prototypes that need to be built depend on these aspects, as shown in Table II.

Social games are played with multiple players, and sometimes the other players can be simulated (as in our GED example); however, real players will provide more realistic data. Some pervasive games that break the social boundaries of game-play involve a fixed number of players, but more often these games involve a varying number of players.

Persistent games can be played over a long period of time, typically with varying numbers of players, and possibly in various locations. The forum prototype that we presented earlier worked well in such circumstances. Due to the extended playing time, physical prototypes can be difficult to use for persistent games; but the basic game mechanics are easy to test in a "blitz mode" (i.e., quick mode; the physical prototype for the forum prototype was tested in "blitz mode" before it was built).

It should be possible to play location-based games at various locations, which can be simulated as well (as in the GED example). However, it may be difficult for the test players to completely understand what the game-play should be if the game does not require actual movement. If the game breaks the spatial boundaries of game-play with context-aware game-play, then sensors are needed, which can be

Game feature	*Prototyping requires*
Social/multiplayer	Multiple players
Social/varying number of players	0-N players, changing over time
Temporal/persistent	Playing the game over a longer period of time; involves a varying number of players.
Spatial/location-based	Varying locations
Spatial/context-aware	Varying use conditions based on selected sensors.

Table 2: Requirements for Prototyping.

simulated as well; but using rapid software prototypes will provide more reliable data.

In the following, we list the game features that affect the choice of prototyping method.

Context-awareness. If the game-play relies much on context-sensor input (e.g., location or temperature), it is often more feasible to create a software prototype. Such changes are difficult to simulate with a physical prototype, and the test organizers cannot always think of all the relevant cases that could occur. If real sensors cannot be used, the Wizard of Oz method can be useful.

Discreteness. If the game is very discrete, that is, if events happen in an easily predictable manner and do not depend on mathematical functions, it is easy to test the game with physical prototypes. However, if the game events depend on continuous functions, (e.g., with respect to location), it is better to test the game with software, since the outcome of these functions would be difficult to predict. An example of a discrete game could be a location-based game where the events happen in hot spots; an example of a continuous game could be a location-based game where the power of a spell depends on the player's location; $f(x, y, z)$.

The level of technical novelty. Using new technologies is always a risk and adds uncertainty to a project. The way technology will work in certain kinds of situations cannot always be anticipated. In the development of the GED game, one of the major obstacles to testing its software prototype was the network operator's unwillingness to provide the location technology that the game was going to use. In their study, Ballagas and Walz (2007) assessed the problem of technical uncertainty by using a specific GPS scanner to find the feasible places for hotspots in their game.

Social or behavioral novelty. If the game puts the players in new kinds of social situations or requires them to change their behavior, some feedback from the players can be gathered in focus group discussions or ethnographical studies. Scenarios, acting, comics or videos can be used to make focus group discussions more concrete (e.g., Ermi and Mäyrä (2005); Strömberg et al. (2004)). Physical prototypes can be played, and may help us to better understanding how game-play situations could develop. For instance, when play-testing the GED game,

many of the players said that they would not like to do "borderline" gaming all the time.

It can sometimes be difficult to imagine or consider new kinds of situations, hence it is more effective to actually put the players in the actual situation. Ballagas and Walz (2007) used Wizard of Oz prototyping for the REXplorer game, In play-testing they found that some of the older players felt awkward gesturing with the magic wand in public spaces and decided to provide an alternative way of casting the spells from a menu.

Abowd et al. (2005)tested a pervasive application that was not a game but a shortterm memory aid used for recording conversations. They tested its social acceptability by acting out potential situations with real users. After the conversations, the users were asked how they would have felt had the conversation been recorded to help the other person remember it. Abowd et al. called this method paratyping, as it is a prototyping method that does not involve a functional prototype. They found that the method helped the test subjects relate to the questions. Such paratypes could also be useful in probing the attitudes and opinions of players of pervasive games.

Complex interactions between various gaming platforms. When testing the GED game with a guided physical prototype, we noticed that prototyping complex interactions between physical and virtual game worlds could be difficult. In GED, the virtual game world was mapped on the physical one, and during the test session the players could move in both worlds (Koivisto and Eladhari, 2006). When play-testing GED, it was particularly difficult to understand how players using different platforms to play the game could interact. Complex interactions between the virtual and physical worlds can be difficult to demonstrate with physical prototypes.

Persistence. As stated earlier, it can be difficult to realistically test persistent games that run over long periods of time with physical prototypes only. However, some results can be obtained by playing the games in a faster mode; this can be particularly useful when testing the core game mechanics. Physical prototyping of the game in blitz mode was done successfully for testing the first versions of the Mythic game. Later, the forum prototype worked very well in predicting what gameplay would be like when mixed with the players' everyday activities. Persistence can be also simulated, as in testing the GED game.

Player-to-game interaction. Player-to-game interaction is generally easy to test with physical prototypes since it often involves testing the core mechanics of the game and because parts of it can be tested separately with simple prototypes. If the focus of the game is manipulating the game objects physically, as in dexterity-based games or moving in the game world, it would be difficult to imagine what gameplay would be like with only a physical prototype. Fullerton et al. (2006) play-tested the Clouds game with a software prototype very early in the project. Physically manipulating the clouds on a computer screen is a central part of game-play, and would have been difficult to experience with a physical prototype. Testing arcade games like Tetris with physical prototypes could be challenging, but rather easy to prototype with software. In Table III we summarize the selection criteria for prototyping methods on the basis of the game type.

Game type	*Prototyping method*
Context-aware (sensor input needed)	Often easier to implement as a software prototype; Wizard of Oz prototyping is a good alternative-
Discrete (events occur in predictable manner)	Physical prototypes as well as software prototypes.
Continuous (e.g., events are functions of location and other sensor input)	Software prototype is useful.
Technically innovative	Software and/or hardware should be used early to test technical aspects.
Social novelty	Real users should be involved in realistic situations. Both software and physical prototypes can be used, e.g., Wizardof- Oz prototyping or paratyping. Can also be a supported with interviews, focus group discussions, and ethnographic studies.
Complex interaction between various gaming platforms	Can be difficult to demonstrate with physical prototypes.
Persistent, long-term	Software prototypes or prototypes with software components are good. Testing with physical prototypes is difficult but can be useful in testing core mechanics.
Player-to-game interaction: dexteritybased games	If manipulating game objects physically is central in the game, as in dexterity-based games like Tetris, software prototype is needed.

Table 3: Selecting Prototyping Methods Based on Game Type

9.4.3 *The Project Type*

Skills of the project group. The skills of the project group will affect the kinds of prototypes that can be created. The developers' skills will affect the quality of the prototypes dramatically, particularly for rapid software prototyping. Skill is also required for building and testing physical prototypes. When the team is lacking some competences that would be necessary to build a suitable prototype, it can be necessary to hire outside people to implement them. For instance, in the study by Strömberg et al. (2004), the research group decided to use actors in their prototype and hired them from a local theater.

Structure of the project group. When a project team works in one location, it is easy to create prototypes quickly. In the case of a distributed team, it is more difficult. The forum prototype of the Mythical game demonstrates how very early prototypes can be implemented online. Virtual worlds can offer new possibilities as well, as demonstrated byManninen (2002). In our earlier study Koivisto and Wenninger (2005), we experimented with conducting focus group discussions in virtual worlds, with promising results. For the guided physical prototyping of the GED game, a lot of the time needed for testing was used by the three facilitators in traveling to Stockholm (travel time and other overhead were not included in the 120 hours needed for the actual testing).

9.4.4 *The Phase of the Project*

It is very useful to try out ideas quickly in the early phases of the project. The prototypes can be very simple, either physical or software, and it is often more fruitful to test them with colleagues, since the prototypes may be difficult for outsiders to understand. Recruiting people who match the game's target group takes time, and when the game concept is not yet clear, it is a good idea to quickly run a few experiments before recruiting outsiders for the test sessions. However, the real users should be involved in the process as soon as possible.

Ethnographical studies and focus group discussions with potential players can be also very useful early in the project, even before any design is done. Such methods can be used to see what direction the game design should take and to understand the culture, opinions, and attitudes of the game's target group.

Software prototypes can be created and are useful in any phase of the project, even right after the development of the game concept itself, assuming that the project team has the skill or external resources needed for creating a simple prototype. The guidelines related to the project are summarized in Table IV.

9.5 DISCUSSION

In the future, we expect to see more pervasive games and pervasive game research. Additionally, we predict that mainstream games will have more pervasive features. People who play them do not necessarily consider them pervasive games. For instance, once GPS (General

The project	*Impact on prototyping*
Skills of the project group	Skills limit what can be done but if it seems crucial to create a certain prototype hiring resources is recommended.
Structure of the project group	Distributed projects can benefit from using software prototypes over the Internet. Virtual worlds can be used to both demonstrate products or conduct user research (e.g., focus groups).
Phase	All kinds of prototypes can be used once the idea of the game concept has been created. Prototypes should be created as early as possible, preferably along with the concept .

Table 4: Project-Related Guidelines for Selecting a Prototyping Method

Position System) becomes more common in mobile phones, it is also probable that more mobile games and applications that use location features will be created. As games like Alternate Reality gain more publicity, it may be that attitudes towards gaming will also change, and more people will actively seek games in places where they are not supposed to be found. A large part of the world's population has been playing digital games since they learned to walk, which also changes attitudes towards playing digital games in general.

All of this means that pervasive games – or rather games with pervasive features - will be a significant research topic. We would like to see more research on experimenting with prototyping methods for pervasive games and features.

9.6 CONCLUSIONS

We presented examples of physical prototyping, rapid software development, and use of ready-made software to build pervasive game prototypes in the very early phases of a game project. The focus was on testing simple game ideas or complete game concepts, rather than on generating ides in the early phases of the game development project when the final game design is still very much undecided.

Based on these studies and earlier research, we presented guidelines on selecting the right prototyping method. We found that choosing the right method depends on the following considerations: the purpose of the prototype, the game type, the project type, and the phase of the project. Guidelines for selecting prototypes were given on the basis of these considerations.

Both physical and software prototyping can be very useful. In our experiments we saw the value of early prototyping (which was also cited in earlier research). We also noticed that particularly in the case

of pervasive games, where interacting with the player's environment is often prevalent, software prototyping was valuable in the conceptual or early design phases of the project. When testing the Hot Potato game (software prototype) and GED (guided physical prototype), we noticed that real-life events and interactions were often easier to understand with software prototypes. Even when guided physical prototyping is used and the facilitators present scenarios to the users, the test does not often reveal other problems that the test situation is not designed to (e.g., if the test situation does not take into account that there might not be always other player's around, the problems that can arise in that kind of situation would not be revealed by the test setup).

Both physical and software prototyping can be very time-consuming when the whole game is prototyped and is complex. The physical prototype-testing of the GED required approximately 120 working hours, and overhead (traveling time, coffee beaks) was not counted. It may sometimes be appropriate to just quickly create a software or physical prototype of part of a game (e.g., concentrating on the core game-play). Physical and software prototyping methods can often be combined.

We also discussed using "real" players and professional test players. Players who belong to the target group of the game usually provide more relevant data and are useful for understanding the players' attitudes, opinions, and behavior. Using professional test players (e.g., colleagues) for testing enables faster iteration, and is also beneficial when new ideas are needed. If the prototype is very incomplete, it can be difficult for outsiders to understand, so it is useful to have both kinds of test players in the same project.

There are software prototyping platforms available, such as MUPE, that enable a faster development phase. Such tools can enable prototype development that is as fast or even faster than physical prototyping. Testing with software can also be more efficient if the prototype is complex, since otherwise a lot of guidance would be needed for testing a physical prototype (e.g., GED). However, it must be noted that learning to use the tools takes time; fast development time is typically achieved after learning to use the platform – which may take a few hours or even weeks, depending on the developer's skill and the development tool.

In addition to software development platforms, complete software products such as forums or virtual environments can be used to test games and ideas. Our example of the Mythical: The Mobile Awakening forum prototype showed that this kind of approach enables quick testing of early game features in distributed teams.

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10

DESIGNING PERVASIVE GAMES FOR MOBILE PHONES

Jussi Holopainen and Annika Waern

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11

SOME NOTES ON THE NATURE OF GAME DESIGN

Jussi Kuittinen and Jussi Holopainen

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The focus of this paper is to have a critical look at the current game design literature through the analytical lenses of the current state of the art in design research. The aim is not to create yet another prescriptive framework for game design but rather an attempt to connect the game design studies to general design studies in a stimulating way.

We first discuss what has been said about design in general, including industrial and graphic design, engineering, architecture, and even software design. We will then continue discussing game design specifically compared to the design in general and point out similarities and especially differences. This leads us to a somewhat obvious claim that doing game design is an activity similar to any other design field but that the form and the content are specific to the game design context. Even though this claim might sound obvious it has some unexpected consequences: firstly, it grounds game design in the large body of existing design research and, secondly, it helps in identifying the crucial activities, forms, contents, and contexts that determine the nature of game design.

We look at six game design books alongside two distinct but mutually supporting models of design in general. Our focus is in understanding game design as a situated activity and to see how this notion is discussed in the game design literature.

Keywords: Game design research, design research, design situation, game design literature

11.1 INTRODUCTION

During the relatively short history of design research, there have been two influential theoretical approaches to explaining design as an activity. The view put forth by Herbert A. Simon (1996) describes design as being essentially a problem solving process where a rational problem-solver, the designer, searches the space of possible solutions for a satisfactory solution to the given design problem. Simon's theory emphasises the rationality of the design process and aims to reduce the complex nature of designing to a goal-oriented activity where the designer deals with the ill-structured design problems by decomposing them into smaller, better defined subproblems.

The second influential view is by Donald Schön (1983) who describes design as a reflective practice where the designer is constantly in conversation with the design situation. Schön (1992) characterises design as an act of "seeing-moving-seeing" where the designer uses representations of the design problem to identify elements in the design situation (seeing), experiment with possible solutions (moving) and evaluate the consequences of these moves (seeing). The central idea is the reflective and conversational nature of the process. Instead of starting out with a clear problem definition or goal for the design, the designer constructs the design gradually by experimenting with design moves and thereby gaining "a new understanding of the phenomenon and a change in the situation" (Schön, 1983).

Both views have explicit and implicit takes on what are the design situations and problems the designer encounters during designing. For the sake of this discussion we use the concept design situation to refer to the overall field of tasks, goals, ideas, representations, and what not the designer has at a specific point of doing design. The design situation thus describes the holistic state of a particular design at a particular time. For alternate views on design situation see, for example, Löwgren and Stolterman (2007) and Visser (2006). The design situation can, of course, never be comprehensively stated (Lawson, 2005). A design problem, on the other hand, is a designer's internal or external representation of a specific task within the design situation (here we are following Visser (2006)). A design solution is, then, a designer's internal or external representation that meets at least partly the requirements of a design problem. Often, if not always, a design solution will become a design problem until the design task is considered finished by the designer. This kind of co-evolution of problems and solutions (Dorst and Cross, 2001) at least partly explains why design cannot be considered as rigid problem solving. In one sense, the design situation can be also described as the state of the current design problems and solutions and the resources the designer has at his or her disposal to change the situation.

Describing design activity through the concept of design situation acknowledges the complex network of issues that affect design at any given moment. The design situation is in constant state of change due to a number of factors such as the acts of the designers, changes in the perspectives of the actors involved in the project, changes in the design context such as market state and so on. However, the overall design situation is a theoretical entity. It is virtually impossible for any designer to hold a mental representation of the whole design but instead he or she focuses only on the local design situation, the situation at hand as presented to the designer at a given moment (Dorst, 2006, 2004, Lawson, 2005). As the designer always works with the local design situation, we will use the term design situation to denote the local design situation and when applicable, use the term overall design situation to refer to the holistic view of the design situation.

A design problem is something that the designer is confronted with in a specific design situation. A design problem forces the designer to pay attention to certain issues while leaving the other issues in the periphery. This is mainly due the fact that our cognitive capabilities are limited. We humans just cannot properly comprehend complex networks of often even contradictory possibilities. Framing something

as a problem limits the possibilities that have to be taken into account, at least for a certain time (Dorst, 2004). After making a decision it is then again possible to consider what the more holistic implications are for the decision.

The design situation changes all the time during the design. The same thing happens even more drastically for the design problems and solutions. The problems are decomposed into subproblems, problems become solutions and vice versa, and they can be altogether abandoned, as is the case, for example, when the designer decides to scrap the current solution and start from scratch. The models for design as activity have to take this constant flux into account, otherwise they cannot capture the (sometimes) chaotic and (always) creative nature of design.

In most areas of design - also in game design - the designers often work in multi-disciplinary teams, where there are different kinds of stakeholders involved. In such cases, the subjective nature of design activity transforms the design process into a social process where individual interpretations of the design situation play an important role (see e.g. Cross and Clayburn-Cross (1996), Dong (2005), Badke-Schaub and Frankenberger (2004)). Similarly, a common understanding of the situation is important as well (Hey et al., 2007).

11.2 DESIGN AS A PROCESS AND AS AN ACTIVITY

We provide an overview of two models of design process or design activity: Löwgren and Stolterman's three layer abstraction model and Lawson's model of design activity. These two were chosen because, first, they are complementary to each other and, second, they are compact and convenient models based on thorough analysis of design activities in many different kinds of domains.

11.2.1 *Löwgren and Stolterman*

Löwgren and Stolterman (2007) first describe the scope of the design process from the initial idea, the vision, through more detailed specifications to the construction of the final artefact. Their model is focused on the intermediate artefacts the designer is working with, be they internal, vague ideas or more concrete sketches, and how the design itself emerges from a complex interplay between these different kinds of representations. They also elaborate on the nature of design thinking and the role of social activity. Here our main interest is on their view on how the design emerges from the vision, through the operative image, to the final specification.

Löwgren and Stolterman's model focuses on the early parts of the process. The process starts when the designer is "thrown into" the design situation and is confronted with the design task itself and the environment where the design takes place. This can happen in several ways from getting detailed requirements from the client to the designer, the designer starting from a vague idea, or even from scratch. In any way Löwgren and Stolterman (2007) stress that the design process starts earlier than most methodologies realize; the work starts before there

are any formal plans or even requirements for the design task at hand. The design of the design process itself, deciding how the design work is carried out by choosing the focus in the early phases, the amount of innovation and creative work and so on, might be the most important activity of the whole design project (Löwgren and Stolterman, 2007) .

One of the fundamental characteristics of design activity is the "recurrent leaping between details and the whole, or between the concrete and the abstract" (Löwgren and Stolterman, 2007). Often the designer has an abstract idea or a strong feeling on what the design is going to be like but is at the same time confronted with making practical and concrete decisions. Löwgren and Stolterman (2007) distinguish three different layers of abstraction in early design work: the vision, the operative image, and the specification.

The vision emerges when the designer is confronted with the initial design situation, often as something vague, elusive, and even contradictory in nature. In the case of experienced designers the vision can emerge very early in the process and it can be described as a first organizing principle for the whole design. The emergence of the vision should not be regarded as mostly analytical process, rather it most likely guided by intuition and tacit knowledge of the designer. Often, if not always, it is even impossible to explicitly state how the early vision came to be.

The vision at this stage can take many forms from vague and implicit ideas to rough sketches and ad hoc verbalizations. As the early formation of the vision is contradictory and chaotic in nature there will be several visions operative at the same time, fighting with each other. These conflicting visions are necessary for the designer to be able to assess the design situation at hand from several points of view. As the design thinking is characterized by constant leaping from one abstraction layer to another the vision can be guided by more detailed and concrete considerations, such as choosing the materials in the case of industrial design. Even though the vision at this stage is vague and even contradictory it will guide the rest of the design process. It is, however, important to note that even though the vision is the first guiding principle for the design thinking it will most likely be modified, shaped, and even replaced during the later stages of the design process.

The next abstraction layer, the operative image, consists of making the first explicit representation of the vision. As in the vision, there are many kinds of representations the designer can be working with from early overall sketches of the whole design situations, such as rough architecture models in software engineering, to detailed sketches of a specific design situation such as decorative details of a window sill in architecture. The main point in the operative image is that it has an explicit form allowing the designer (and other stakeholders if need be) to visualize, simulate, and manipulate a specific design situation. Through the operative image the vision, or parts of the vision, are made concrete allowing more detailed and thorough evaluation of the design situation. The process, however, is still far from straightforward. The sketches and other representations define an option, a possibility, for the design decisions. The operative image is thus a tool for making the vision and the design situation more concrete and understandable. It is again worth noting that the designer is in constant conversation

with the design situation and is constantly leaping between abstraction layers.

A sufficiently detailed operative image can act as the specification, which instructs how to construct the final artefact. Even at this stage the design work is not finished yet. During the construction process new kinds of design situations emerge, as there is no clear division between design and construction stages.

The abstraction layers are a way to think about the design as an activity. As Löwgren and Stolterman note several times, the design work does not follow a linear path from the vision through the operative image to the specification but all three abstraction layers form a constant, dynamic dialectical process. The vision shapes the operative image and the specification and is in turn shaped by them. The designer moves back and forth between the layers during the design activity.

11.3 LAWSON

Lawson's (2005) model of design activities offers a complementary view to the one described above. Lawson's model focuses on categorizing different kinds of activities which are inherent in design thinking. While Löwgren and Stolterman's (2007) abstraction layers describe the implicit and explicit ways of formulating the design thinking Lawson provides insights into what the designers are doing, what kinds of decisions they have to make, and what kinds of thinking they go through the design process.

11.3.1 *Formulating*

The group of activities that Lawson calls "formulating" essentially consists of the activities involved when a designer observes and assesses the design situation. Some prominent research theorists see the designer's ability to formulate the design situation as the elemental ability in terms of designer expertise (Cross, 2004, Dorst, 2008, Lawson, 2005). Lawson makes a distinction between identifying and framing.

Framing is a key concept in Schön's theory. As noted by a number of commentators (see for example Lawson (2005), Dorst (2004)) Schön himself never fully gave a clear definition of a frame, but the concept has caught on. He speaks of framing of the design situation as being "a setting of some problems to be solved" (Schön, 1983). The designer frames the situation in such a way that there is a problem which can be attempted to be solved with an experimental design move. Schön sees framing as a subjective act, governed by the designer's own "likings, preferences, values, norms, and meanings" (Schön, 1984).

What Lawson means by "identifying" is partly contained in Schön's act of framing. The designer needs to identify the elements within the design situation and be able to understand their qualities and how they relate to each other. Lawson does not mean the simple task of singling out the components within the design situation. Instead he speaks of the designer using specialised domain-knowledge and already making judgements on the composition of the elements. In fact,

Lawson Lawson (2004a) describes identifying as being kin to the way chess players recognize board situations allowing them to respond to the situation with a suitable gambit. Instead of analysing the situation, expert chess players perceive situations in the broad context of massive number of precedents and gambits used in the history of chess allowing them to quickly understand the future possibilities of the situation.

Lawson (2005) underlines the usefulness of framing as a tool for controlling the complexity of the design situation by allowing the designer to focus on a select number of issues while temporarily suspending others.

11.3.2 *Representing*

The designer works with and works through representations of the design situations. The representations can be on different abstraction layers (Löwgren and Stolterman, 2007), can take many different forms from almost illegible scribbles on a napkin to functional software prototypes, and they can even be as evanescent as thinking out aloud. Some claim that the representation does not even have to be external but that the designer can make an implicit cognitive representation of the design situation (Visser, 2006). Lawson, however, is discussing external representations. According to Lawson the designer makes sense of the design situations by making representations; the designer is in a conversation with them (Schön, 1984). Lawson states that the designer is almost always working with multiple representations as they are used in shaping the design situation, and they provide a way to make possible design choices more concrete. It is conceivable that the designer can entirely work without external representations but this seems to be very rare. The representations can be on any of Löwgren and Stolterman's (2007) three abstraction layers but that the forms of representation can differ significantly from layer to layer.

Analogies and precedents in the form of other related designs or products are a strong form of representation as they can communicate important aspects of the design situation. Lawson (2004a) points out that precedents can act as anchors to design knowledge of very complex design characteristics. Lawson provides an example where the architects of a design office used the word "belvedere" to denote "a whole series of devices for organising space vertically in order to afford dramatic views that helped building users to build mental maps of their surroundings" (Lawson, 2004a). According to Lawson (2004a), it appears that in addition to communicating design knowledge, experienced designers use precedents also to organise and understand the characteristics of design representations and situations. This is further supported by an experiment by Ball and Christensen (2009)] in which they linked analogies and mental simulations to uncertainty resolving mechanisms.

11.3.3 *Moving*

According to Lawson (2005) designers are solution oriented and work by "generating ideas about the whole or partial solutions". Sometimes

these ideas are abandoned during the process and sometimes the ideas become part of the design situation and generate new kinds of design problems. One of the designer's activities is thus to create these solutions and Lawson uses the term 'moving' to describe these activities. A design 'move' can create a whole new solution to a particular situation or they can alter and shape existing ones. Lawson distinguishes between interpretive and developmental moves. The interpretive moves are based on the reflection on the current (implicit and explicit) representations of the design situation and they might be entirely novel or derived from existing ideas. In the developmental moves an idea is developed further and clarified, usually with some kind of a representation. Goel (1995) refers to these two types of moves as 'lateral' and 'vertical'.

Lawson notes that designers often develop early solutions to a design problem before even understanding the problem. He claims that this is often done through a concept of primary generators introduced by Jane Darke (1979). According to Lawson (2005), the primary generator is basically a simple handle to the design situation that narrows down the complexity of the problem and presents some aspect of the problem that is seen as central by the designer. The concept is very close to the vision abstraction layer of Löwgren and Stolterman (2007). Primary generators can be beneficial by allowing the designer to focus on a limited number of inter-related solution candidates and therefore can improve creativity of the designer.

As described by Schön (1983), elemental design moves often take the form of surprises as the designer makes exploratory moves that allow her to see the design situation in a new way. Cross (1997) uses the concept of creative leaps to describe a similar situation, where a novel or creative solution candidate suddenly emerges while working on the design situation. Both Schön and Cross note that although surprising, these moves are really the result of a gradual process. Cross calls this being "more akin to bridging than leaping the chasm between the problem and the solution" (Cross, 1997).

11.3.4 *Bringing Problems and Solutions Together*

We have already discussed the difficulty of viewing design as a problem solving activity and that it is often difficult to discern the problem from a solution. In some cases the problem may be clear and that it is possible to move from the problem to a solution in a rational path but sometimes the problem itself emerges from generation of possible solutions and that it is not necessarily clear in which order the problems and solutions appear. Lawson states, in parallel with our earlier discussion, that "[...] problem and solution are better seen as two aspects of a description of the design situation rather than separate entities" (Lawson, 2005).

11.3.5 *Evaluation*

Designers are making implicit subjective evaluations all the way through the design process. They generate alternative solutions and have to decide which of them to take further and which to leave out. Most of

these evaluations happen intuitively during design thinking concerning particular design situations but the designer has to also be able to make judgements concerning the overall design situation. Lawson distinguishes between subjective evaluations ("does this feel right? ") and objective ones ranging from mental simulations to user testings. Doing right kinds of evaluations at the right time is crucial for design ability, although Lawson notes that being good at evaluations does not necessarily coincide with doing good design moves.

11.3.6 *Reflecting*

Interpreting Schön's idea of the 'reflective practitioner' Lawson discusses 'reflection in action' and 'reflection on action'. Reflection in action is covered by Lawson's formulation, moving, and evaluation activities since the designer is continually thinking about the current design situation. Reflection on action is a higher level activity where the designer is monitoring the process, not the design itself. The designer is taking a step back and looking at the design process asking questions such as "are the relevant issues taken care of? ", "which activities (formulating, moving etc.), if any, have been neglected? ", and "am I doing this the right way? ". Lawson stresses that the skill of reflecting on action at the right time and asking the right questions might be one of the most important skills the designer can have. Another aspect of reflecting is that the designer looks outside the current project and reflects on what kind of an effect this particular project has for the designer's wider work. In other words, the designer thinks about his or her own understanding of design as an activity. This also includes collecting precedents and references from relevant domains. An architect might collect blueprints and take photos of buildings for reference material and game designers usually play a lot of different kinds of games. The references do not have to be in the same domain; the game designer might also collect same kinds of references as the architect.

In line with Schön, Lawson also sees design as being governed by the designer's subjective system of values. What Lawson calls the guiding principles, are basically a set of subjective values and priorities evolved over the years, that guide the designers in their work. Although quite similar to Schön's appreciative system (Schön, 1984), Lawson's view on the notion is more precise and expressed better in terms of design activity. To Lawson, the guiding principles are the expression of the designer's approach to design and often recognisable in the designer's work.

11.4 GAME DESIGN LITERATURE

11.4.1 *Overview*

We analysed six game design books looking at how they corresponded to the theories of the general design research, with a specific focus on the models presented in the previous section. The six books in question are:

- Björk, Staffan and Jussi Holopainen (2005b) Patterns in Game Design
- Fullerton, Tracy; Christopher Swain & Steven Hoffman (2004) Game Design Workshop: Designing, Prototyping, and Playtesting Games
- Rollings, Andrew and Ernest Adams (2003) Andrew Rollings and Ernest Adams on Game Design
- Rouse, Richard III (2001) Game Design: Theory and Practice
- Salen, Katie and Eric Zimmerman (2003) Rules of Play: Game Design Fundamentals
- Schell, Jesse (2008) The Art of Game Design

Our selection of the game design books is by no means comprehensive, but we feel that it represents the diversity of the game design literature to a sufficient detail. We are also aware that one of the authors of this article is also an author of the Patterns in Game Design. The book was not selected due to self-promotion, but because we felt it presented an interesting and a rather distinct view on game design that should be taken into account.

Almost all books about game design describe at least in some way how the design as activity is split into different stages or phases. Some of these descriptions are stage models where the design moves through distinct stages linearly from one stage to another. Common such stages are, for example, initial idea, concepting, designing, prototyping, implementing, and playtesting. See, for example, Adams and Rollings (2006), Rouse (2001), Bateman and Boon (2005) for other kinds of stage models. The stage models do have their advantages as they can be used to describe different kinds of actions and competencies the designers (and other developers) have to have in different stages. Other authors suggest that the stage model itself is too rigid and promote iterative game design (see for example Salen and Zimmerman (2003), Cerny and John (2002), Fullerton et al. (2004)) where the design emerges through rapid evolution and iteration of concrete prototypes ranging from simple paper ones to complex, and almost finished, software implementations. Even in the case of iterative process models the stages within one iteration are clear: design, test, and analyze.

It seems that the process models described in the game design literature are, in the end, regarding the design activity itself as monolithic; the designer might do something else with the current design situation, such as testing it with real players, but in the end it is the design stage where the magic happens. In both stage and iterative models the design as a process is first decomposed into different stages, but, in the end, one of the stages is called somewhat recursively "design". What seems to be missing is to, first, accommodate for the fact that design takes place throughout the whole development cycle and, second, to be still able to analyse and discuss different types of actions and activities of the design in a meaningful way.

The notion of understanding game design as evolving design situation is implicitly evident in a number of books. By understanding design as a process and the artefact as a system where changes affect the whole system, it is safe to say that Salen's and Zimmerman's view

on design activity is situated. The same implicit support for situated design can also be seen in Fullerton's insistence on testing the whole game after making minute changes Fullerton et al. (2004) and in Björk and Holopainen's decision of not viewing their game design patterns as means of mechanical problem solving due to the effects of single patterns affecting so many different aspects of gameplay Björk and Holopainen (2005b).

11.4.2 *Content*

The view that game design is a second order problem where the designer can only indirectly affect the players' experience is embraced in a number of books (Salen and Zimmerman, 2003, Schell, 2008, Björk and Holopainen, 2005b). Although typical to other disciplines of design as well, especially those related to entertainment in general, this problem of design goal being outside the reach of the designer is particularly characteristic of game design. As pointed out by Schell (2008), a game design is unique in the amount of freedom given to the player, this leading to complexity of the artefact that is really difficult to control. The designer works by designing the formal system of game rules, but the experience and the meaning that players create is dependent also on the larger social and cultural contexts (Salen and Zimmerman, 2003).

The problem of the second order design is particularly evident when viewed in terms of the model of designing by Löwgren and Stolterman (2007). The higher the abstraction level the designer is on, the more difficult it is for the designer to anticipate the successfulness of the artefact. As the game design process starts out with a vague and unformed vision, the designer's tacit knowledge and understanding of the subject matter plays a critical role in forming the vision into an operative image. In terms of Lawson's (2005) model of designing, the designer's ability of formulating the design situations is pivotal in game design. This notion is also clearly underlined in the game design literature. Knowing and understanding the structures and principles that can be used to constructing great experiences for the players is seen as the key ability for the game designer.

Almost all of the books provided a conceptual framework to support the designer in shaping the elements and the relations between them in a design situation. The frameworks varied in their scope of application and level of abstraction. In Fullerton et al. (2004) the designer formulates the design situation through a generalised structural model of gameplay consisting of formal game elements, dramatic elements and system dynamics. Schell (2008) approaches the question through a higher-level model of mechanics, story, aesthetics and technology. Rollings and Adams (2003) look at design elements especially in terms of game genres and the elements typically present in them. Salen and Zimmerman (2003) provide an organised and systematic view on the elements of game design through their concept of game design schemas, which are grouped into formal, experiental and cultural schemas. Rouse III (2001) also provides a framework of design elements, but with an inclination towards evaluating design situations.

As a rather extreme approach, Björk and Holopainen (2005b) introduce a collection of nearly 300 interrelated game design patterns

each describing a distinct design aspect analysed from existing games. In addition to allowing the designer formulate the design situation, they are interesting in relation to our notion of design situation. With the relations between the patterns narrowing down the design space but also showing the rationale between situation changes, game design patterns could be said to support the formulation of an evolving design situation.

The usefulness of asking questions throughout the design process in order to better formulate the situation and to make sure that all the necessary elements are included is expressly promoted in a number of the books (Rollings and Adams, 2003, Rouse, 2001, Schell, 2008, Fullerton et al., 2004). Apart from this conversational view on design, framing as a design tool is advocated only in two of the books. Salen and Zimmerman (2003) divide their broader schemas into a number of subschemas, each providing a limited perspective on an aspect of game design. Similarly, Schell (2008) introduces a collection of 100 lenses each consisting of a number of questions on unique perspectives on game design. Individual schemas present a lot more broader view than an individual lens, however, the lenses as a whole cover more fully the design process than schemas. The schemas are more clearly provided as ways for controlling the complexity of the situation whereas lenses also act as creativity tools by attempting to maximise the number of frames available to the designer.

11.4.3 *Design as an activity*

Representation touches the issue of formulating intimately. If formulating the design situations is an act where the designer identifies the relevant elements in the situation, then representation is the medium through which the designer does the identification. It is interesting how issues related to creating and using representations are discussed in the game design literature. Although this is partly explained by the emphasis on gameplay design in a majority of the books (Rollings and Adams, 2003, Rouse, 2001, Fullerton et al., 2004), it would appear that the designers mostly work through prototypes and textual descriptions. Schell (2008) comments also on using illustrations as tools of prototyping and all of the books contain screenshots and concept art from games, but discussion on the various forms of representations is very limited. This leads to a somewhat perplexing notion, that even though games are seen as complex and diverse mediums, apart from actually building the game, they are best described by text and playing simple prototypes.

In line with Löwgren and Stolterman (2007), the detail of representation is tied to the stage the process is currently on. During the early stages of design, the use of minimalistic paper prototypes is strongly promoted (Salen and Zimmerman, 2003, Schell, 2008, Fullerton et al., 2004) and there are explicit instructions on keeping the textual (Schell, 2008, Rouse, 2001, Rollings and Adams, 2003, Fullerton et al., 2004) description brief as well.

It seems obvious at least from the interviews of the designers included in the books we reviewed, that game designers also rely heavily on precedents when describing and communicating design

situations. This was also evident in the way existing games were used in the books as examples of game elements. In particular, game design patterns (Björk and Holopainen, 2005b) make heavy use of precedents by each pattern providing at least one concrete reference to a game that implements the said game design pattern. However, basically none of the books studied the issue in depth or gave guidance to the reader how to use references to games as means of communicating the design. It is as if the use of precedents is seen so natural to the designer, that there is no need to actually discuss it.

Creating design solutions is central to design and this view is clearly reflected in the game design literature as well. However, as was discussed earlier about game design being regarded as monolithic, there is something similar here as well. There is tendency towards equaling solution generation to brainstorming game ideas, which are then gradually revised into game designs through an iterative process (Rouse, 2001, Schell, 2008, Salen and Zimmerman, 2003, Fullerton et al., 2004). This view is somewhat problematic because it hides the intricacies of solution generation under the heading of brainstorming thus making it harder to understand and talk about the mechanisms behind it. It also suggests that solutions are only created at the initial stages of the process thus further blurring the idea that design takes place throughout the whole development cycle.

11.4.4 *Designer*

Apart from Schell (2008) who saw the designer in a broader role, the books that made explicit comments on the role of the designer (Rollings and Adams, 2003, Rouse, 2001, Fullerton et al., 2004), clearly defined game designer as the designer of gameplay. In view of situated design, the limitation to only designing gameplay is clearly a constraint on the designer as it fails to acknowledge the numerous aspects that affect the design situation.

In a way, the books themselves are examples of reflection-on-action. Although the authors probably aim for objectivity, each is still an account of the author's understanding of game design and reflect what Lawson (2005) describes as the guiding principles of the designers. This is also acknowledged in all books (Björk and Holopainen, 2005b, Rollings and Adams, 2003, Rouse, 2001, Salen and Zimmerman, 2003, Fullerton et al., 2004). The notion that one can become a designer mainly through practice is evident in most of the books (Fullerton et al., 2004, Salen and Zimmerman, 2003, Schell, 2008, Rouse, 2001, Rollings and Adams, 2003). Although the idea of reflection-on-action as a tool of monitoring the process and the design activity itself is implicitly present in basically all of the books we reviewed, it is not explicitly touched upon by any except for Schell (2008) who promotes this through some of his lenses.

The various forms of objective evaluation were somewhat thoroughly discussed in the literature. Especially Fullerton et al. (2004) and Schell (2008), but also others (Rouse, 2001, Rollings and Adams, 2003, Salen and Zimmerman, 2003), discuss the importance of playtesting as means for evaluating the design constructs. As for subjective evaluation,

those that touched the subject, all agreed that it was up to the "gut feeling" of the designer (Schell, 2008, Rouse, 2001, Fullerton et al., 2004).

Regarding the social nature of the design process, only Fullerton et al. (2004) and Schell discuss the (2008) the issue, but quite briefly. Fullerton et al. (2004) mostly describe the different roles of people involved in a game design team, giving quite little attention to group dynamics or team communication. Schell goes on to more depth, but even then it is more about the forms of communication, how to get along in a team, than it is about transfer of knowledge or negotiating common understanding of the design situation.

11.5 CONCLUSIONS

Judging from the selection of the game design literature we analysed, game design is heavily governed by the object of the design, games. Although this may seem like an overly obvious statement, it carries with itself the connotation that the activity called design, is left to too little attention. Whereas the books concentrate on teaching the reader the principles and elements of game design, at the same time they leave aspects of design activity such as representing, moving and reflecting to little consideration. Naturally, it is critically important for the designer to build up knowledge of the multitude of elements that can be used to construct games, yet in our view, it is equally important to know about the activity itself as well. At the moment, it is not discussed as explicitly as it could be.

The disposition to describing game design through stage models or iterative spirals leads to a rather abstract view on design where the various forms of activity involved in design are lumped together without properly addressing their distinctive characteristics. This is also notable in the manner the books look at solution generation.

We argue that game design should be studied through models such as Lawson's that address the various kinds of activities inherent in design thinking. In our view, this will not only allow for a better understanding of game design, but also open up new possibilities of improving the methodologies of game design.

Secondly, we suggest that game design should be addressed as a situated phenomenon acknowledging the very complex network of issues affecting it. At the moment, the picture painted by game design literature overly emphasises the design of gameplay. Although Schell (2008) discusses at length also other factors such as other stakeholders and the design context in the design process, in general they are still viewed more in connection with the process instead of the design activity itself.

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ABSTRACT

People in all known cultures play games and today digital gaming is an important leisure activity for hundreds of millions of people. At the same time game design has developed into a profession of its own. There are several practical game design guidelines and text books but they rarely manage to connect their findings into relevant areas of research such as psychology and design research. Understanding game design, both as an activity and as an end result of that activity, in a more profound way could alleviate this problem.

The main goals of this thesis are to understand in a more profound way how to design games and based on that understanding develop frameworks and methods for aiding game design. By extending knowledge about game design can not only improve the quality of the end-products but also expand the potential design space even in unpredictable ways.

Game design contains many sub-areas. Character, story, and environment design are integral parts of the current game development projects. The aim of this thesis, however, is to have a critical and exploratory look at structures of gameplay as design material. Gameplay is the interaction between the game rules, challenges, elements, and players. In one sense gameplay defines the game.

The focus of the thesis is mainly analytical, although parts of the results are based on practical research through design activities. The thesis contributes to game research in three interralated ways:

(1) An analytical contribution to understanding gameplay was done in the gameplay design patterns work. The patterns are described as an approach to both analyse existing games and aid in designing new games. The patterns describe recurrent gameplay structures and also analyse these structures from the design material point of view.

(2) A theoretical study of basis for gameplay experiences was conducted through review of relevant models and theories in neuroaesthetics, cognitive and social psychology and game research. The framework offered in the thesis explains why certain gameplay structures are more recurrent based on defining gameplay as caricatures of intentional behaviour.

(3) The game design patterns approach and research through design projects have contributed to the analysis of game design as an activity and practical guidelines for concrete design work in more specific areas of game design.

The goals of this thesis are ambitious and many questions are left unanswered. Using the patterns approach in conjunction with game design and ideation methods is still in its infancy. The concept of gameplay as caricatures of intentional behaviour should be explored further, especially in conjunction with other theories and frameworks relevant for understanding gameplay experience such as user engagement, immersion, and presence. Empirical experiments validating or falsifying this view on gameplay would be valuable as further contributions to game research.

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