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15.GAME DESIGN PATTERNS

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ABSTRACT
We present a model to support the design, analysis, and comparison of games through the use of game design patterns, descriptions of reoccurring interaction relevant to game play. The model consists of a structural framework to describe the components of games, and patterns of interaction that describes how components are used by players (or a computer) to affect various aspects of the game play. Focusing on the patterns and identified methods for using them, we describe the development of the model and how we are currently working to enlarge and validate the collection of patterns.

KEYWORDS
Game Design, Patterns, Taxonomies, Game Models

INTRODUCTION

The interest for developing a field of game research, ludology, has steadily been growing over the last few years. But games vary greatly, not only in content and game play, but also in medium and why they are played, which offers many approaches to the subject. This can be observed by looking at current research, which is done by applying methods and concepts from a wide range of research fields, e.g. sociology, pedagogy, literature studies, media studies, and computer science. In addition, this work is being done with many different research goals in mind such as answering questions regarding player activities, describing narrative structures, finding best practices for game development or fulfilling artistic challenges. Assuming that a unified approach to studying games is optimal, what framework can encompass this diversity?

In this paper we present a general framework for the study of games based on game design patterns. The paper begins with an overview methods currently used in industry and academic, which form our motivation to use game patterns. We describe the components of our framework together with examples and ways of using the framework. The paper concludes with a discussion on the perceived strengths and weaknesses of the approach as well as future work.

Industry

Digital games have become a major industry with the most popular games selling over a million copies each and total yearly sales in the range of billions [39]. To manage the big projects that a major game release requires, the

industry uses a mixture of techniques and concept borrowed from software development, the movie industry, and traditional games. Although this works, as seen from the games reaching the market, there is an explicit concern among professional game designers that a developed design discipline for digital games is lacking (e.g. [14, 41]), especially one developed to support the multidisciplinary groups that in practice create the games. Although the demands of delivering games on deadline leave little time for developers to pursuit research, there are examples of designers who work on models for game design (c.f. [15, 43, 48]) but these are few compared to the games being designed, and are seen as exceptions to the normal game designer. Beyond the problem of managing game projects, the game industry has been perceived as stagnating; mainly producing sequels, expansions, conversions to other platforms, or brand-based games (c.f. see the commonality of sequels in sales in [21, 22]). Undeniable an economical sensible strategy, at least short-term, the successes of repackaging have been described as a challenge to the creativeness of designers [42].

Thus, parts of the game design industry is seeking methods that can bring more structure to game design, in order to expand the design space of games beyond what has previously been commercially successful. Other current issues the industry is seeking answers to include making games that make full use of the context of new platforms (mobile phones and PDAs), structured methods to discuss merits of a game design, and knowing what patents exists that can influence the possible choices when creating a concept.

Academia

Not counting mathematically-oriented subjects such as game theory, most work within the field of game research has either describes the historical development of a game genre, often together with a taxonomy, (c.f. [3, 26, 38] or explored the role of games from a sociological approach [11] or as cultural phenomenon [20]. In contrast, the study of digital games have often focused on games as a medium for story-telling and thus been based on theories and methods from narrative fields such as literature, theatre, film etc. (c.f. [28, 29, 34, 36, 37, and 46]). Recently, there has been a strong interest from applied research in how new computer technology (c.f. [23]) that has been used to explore new interaction forms within games [2, 5, 6, 12, 16, 19, 40, 44, 45] (or sports [35]). These systems have usually created a new context for game play while those who wish to maintain the traditional game setting have embedded computational technology in traditional components [18, 33] or cards and game boards [30, 32].

Thus, there are many examples of scientific and academic interest in games. However, the results have mostly stayed within one research field, probably due to the highly specialized language within all research fields, which has limited the development of game research.

The Need for a Common Language for Games

Looking at the work conducted both within academia and industry, one can conclude that there is a need for a language to be able to talk about game both while designing games and while analyzing game play. To reap most benefit from such a language it should be usable by the all interested parties to maximize knowledge transfer. This makes it difficult to ground any game-centric language in one research discipline or engineering practice. Although concepts, methods, and theories from numerous fields can, and should, be incorporated into a conceptual game language we believe that the foundation for such a language should be created from studying games as a phenomenon in itself.

RELATED WORK

Genres

The use of genres such as sport games, first-person shooters, strategy games etc. are the most common way to give product information about computer games. However, the definition of genres strongly depends on the popularity of various games which is not surprising as the "genre conceptions originate mostly from game journalism, not systematic study." [24] Looking at the academic field, the game taxonomies mentioned earlier [26, 38] (but also [15]) can also be seen as genre collections, although the term genre is not explicitly used. However, when genre identification is based on the interactivity, a categorization can easily result in 42 different genres [47], something that has been argued to potentially make their usefulness suffer [25].

Due to these problems of trying to define genres that are both generic and relevant within a specific subcategory of games types, we do not propose that a redefinition of the concept of genre would provide a feasible basis for a common language of game research. Instead we believe that finding components that can be used to describe genres would be beneficial to all types of categorization of games.

Game mechanics

A natural starting point in trying to identify the components that constitute a genre is to find the common components in the games that are used to exemplify the genre. When studying various communities of gamers and game designers we found that many used the concept of mechanics or mechanisms.

However, the definition of a game mechanic is general ("Part of a game's rule system that covers one general or specific aspect of the game" [9]) and not useful for academic research. A typical mechanic is "roll and move" that simply states that dice are rolled and that something else is moved related to the outcome of the die roll. The mechanic does not state how something should be moved or why; this is determined in the rules for the particular game. Computer game designers also frequently use the term mechanics but the term is not strictly defined – it is used both in the way it is used for board games and within technical programming contexts [30].

Even though lacking a rigorous definition the concept of mechanics, i.e. that a game can be regarded as an entity put together by a number of smaller components, seems to be very useful. However, as has been argued [25, 31], a structure to define mechanics more rigorously and include information about their relationship as well as how to apply them seems necessary.

Other related models

In addition to genres and game mechanics, a number of alternative approaches have been suggested, primarily from professional game designers. Although they have not been widely applied within either the game industry or academia, they are mention here as they have been important influences to our approach.

Writing to a designer audience, Church [13] introduced the concept of Formal Abstract Design Tools (FADTs) as a way to reach a shared design vocabulary. Although he stresses the importance of formalism and abstracting away from specific instances, the FADTs are one sentence descriptions. For example, the FADT Perceivable Consequences is defined simply as "A clear reaction from the game world to the action of the player."

Barwood & Falstein have introduced 400 Design Rules project [4]. The aim of the project is to collect proven game design rules and techniques which are stated as instructions. Consisting of the sections

Imperative Statement, Domain of Application, Dominated Rules, Dominating Rules, and Examples Aliases the rules are aimed at practical game design and are less suitable for analytic studies.

DEVELOPMENT OF OUR MODEL

Theoretical foundation

Most academic research to date has studied games using terms and concepts from narrative fields such as literature, theatre and film. The focus on narrativity that this naturally brings risks that the aspect of interaction is lost; something that can be argued is a more defining characteristic to games than narrative structures. This emphasis of narrativity may have resulted in the limited success of academic results being adapted by other disciplines and by the industry. To avoid this, we wished to find a basis for a game language centered on interaction rather than narratology. With interaction we mean both the interaction between players playing a game and the interaction between players and the game.

As we described in the section above, the use of game mechanics seemed to be a promising starting point to describe interaction elements in games. However, to be able to use such collections of game mechanics more effectively, a structure to describe how they influence each other would be required. Design patterns [1, 10, 17] is a method of codifying design knowledge in separate but interrelated parts and have been used to describe game elements related to interaction [27]. Further, game mechanics can easily be converted to design patterns making it a seemingly ideal candidate for our model. However, design patterns are not ideally suited as analytical tools due to their initial introduction as a problem-solving tool:

> "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." [1, p x]

So while design patterns seem to be applicable for our use, we argue that 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 support these activities a redefinition of the pattern templates would be required.

Empirical development

In order to develop a suitable pattern template, individual game design patterns and the overarched structure we proceeded by gathering data through a variety of methods.

Transforming Game Mechanics

Given this initial conceptual framework, we proceeded by examining game mechanics and converting them to patterns. This included discarding a number of mechanics, merging some mechanics into one pattern and especially identifying more abstract or more detailed patterns.

Harvesting Patterns by Analyzing Games

The second approach to create an initial pattern collection was by "brute force" analysis of existing games, concepts and design methods of other fields (such as architecture, software engineering, evolutionary biology, mathematics, and interaction design), and extrapolating possible person-to-person and person-to-environment interactions from the fields of sociology, social psychology, psychology and cognitive science. Our method for harvesting consists of five iterative steps: recognize, analyze, describe, test and evaluate. The recognition phase creates a quick pattern candidate collection around a certain idea or interac-

tion area. The next step is that the collection is analyzed by describing how the pattern is used in example games and then trying to remove the pattern from the games and explaining how it would change the game play. The pattern is then described using the developed pattern template. The description is tested by creating a simple prototype game utilizing the pattern and finally the pattern is evaluated using usefulness and sufficiency of the description as criteria. As the work progressed the strict five step method was transformed to a dynamic, recursive one where pattern fusion, mutation and creation of new candidates was possible at almost every stage. The different phases, however, were still used but not in a strict sequence. The result was over 200 pattern candidates together with unexplored but promising areas of interaction.

Interviews

In order to collect information about how game development uses game concepts we interviewed 9 professional game designers that together represented designers of the full spectrum of game mediums. All used the terms genre, theme and mechanisms casually; this was clearly concepts they were very familiar with. However, they didn't mention very many mechanics by a specific name (perhaps because there are no standardized names and no collection). The typical exceptions (for board and card game developers) were Bluff, Tension, Action Cards, Storytelling, Trading, Action Points and Cooperation. Some of the designers were themselves interested in creating structured frameworks for games and several of them were already aware of design patterns methodologies.

All though the data has not be fully analyzed, the interviews provided feedback that our proposed solution was compatible with the way developers worked as well as providing many concepts that could be developed to become patterns.

AN INTERACTION-CENTRIC MODEL FOR GAMES

The development of our model for games and game play has been alternation between working on a structural framework that describes the components of the game and the game design patterns that describe player interaction while playing. Although the two parts are the results of an intertwined process they can be used independently; the structural framework can be used without the patterns to describe games and the use of design patterns can be based on other structural frameworks. Due to limited space, we do not present a detailed description of the structural framework and refer interested readers to the companion paper to this paper [8].

Structural Framework

The structural framework was developed from an initial analysis of how the terms used to describe games. This framework was expanded and refined by examining the relationship between the terms as well as try to use the structural framework to describe games and interaction in games.

On the highest level of abstraction the structural framework consists of game instance, game session and play session which logically and temporally delimits the activity of playing a game from other activities. To describe the actual games, components are used that belong to one of three different categories: bounding, temporal and objective.

The bounding category consisting of goals, rules, and game modes, is the most abstract and include components that are used to describe what activities are allowed or not allowed in the game. The temporal category consists of actions, events, end conditions, evaluation functions and closures, and describes the temporal execution performed during game play. The objective category consists of play-

ers, interfaces, and game elements (e.g. tokens, dice, cards, player avatars, NPCs, movable objects, tiles, backgrounds) and represents components that are physical (or in the case of digital games virtual). Game elements have control/action structures and information structures (including scores, attributes, etc.) which dictate how players can affect the game and what knowledge they have of the game state.

Game Design Patterns

Unlike most design patterns we have chosen not to define patterns as a pure problem-solution pairs. This is due to two observations. First, defining patterns from problems creates a risk of viewing patterns as a method for only removing unwanted effects of a design. In other words, using patterns as a tool for problem-solving only and not as a tool to support creative design work. Second, many of the patterns we have identified described a characteristic that more or less automatically guaranteed other characteristics in a game, i.e. the problem described in a pattern might easily be solved by applying a more specific subpattern.

Name

Although not explicitly stating this in the template, we have in the naming process of patterns aimed at short, specific, and idiomatic names. The main purpose for this was not to provide intuitive names, but names that could provide mnemonic support after the pattern description had been read. In the cases where patterns were adapted from concepts in other research fields, we have maintained that name to provide a link to that field. We have deliberately not included aliases to minimize the number of names that need to be remembered; we instead take an approach similar to that of a dictionary by provide synonym-analog in the form of references to similar concepts in other models and fields of study.

Description

The pattern starts with a concise description of the pattern, often with notes on in which game it was identified and if the pattern has been identified in previous models. Further, the description contains information on how it affects the structural framework (especially if the pattern can be instantiated on different scales in the game) and examples of games in which the pattern is typically found.

Consequences

Each solution has its own trade-offs and consequences. Solutions can, in turn, cause or amplify other problems. To take a design decision for or against a given solution, its costs and benefits have to be understood and compared against those of alternatives. This section describes the likely or possible consequences of applying the solution suggested by the pattern.

Using the Pattern

As patterns are general solutions the application of a pattern to any given situation requires a number of design choices specific for the current context. However, the high-level choices can often be divided into categories. This section is used to mention the common choices a designer is faced with when applying a pattern, often exemplified by specific game elements from published games.

Relations

Here the relations between different game design patterns are stated. These are basically three forms of relationship: patterns that are superior in the sense that they describe more abstract characteristics (often mentioned in the consequences section) and can be implemented by applying the given pattern, subpatterns that can be used to implement the given pattern (often mentioned in the using the pattern section), and conflicting patterns that are difficult to implement with the given pattern.

Pattern examples

During our work we have found over 200 game design patterns which we are currently describing and testing. To give better understanding to our patterns, we present one pattern below whose effect on games have been described several times in other forms (see the references in the description). Italic texts indicate referenced patterns.

PAPER ROCK SCISSORS

Description: This pattern is based on the children's game with the same name. It means that players try to outwit each other by guessing what the other ones will do, and by tricking other players to take a wrong guess on one's own action. The original game is very simple; after a count to three both players make one out of three gestures, depicting rock, paper or scissors. Rock beats scissors, scissors beat paper and paper beats rock. That there is no winning strategy is the essence of the pattern: players have to somehow figure out what choice is the best at each moment.

This game pattern is well-known with the game design community (sometimes called "triangularity", see Crawford) and is a mnemonic name for the logical concept of non-transitivity (basically, even if A beats B and B beats C, A doesn't beat C).

Examples: Quake (relation between weapons and monsters), Drakborgen, SimWar, protogame to show non-transitivity (Dynamics for Designers, Will Wright, GDC 2003)

Consequences: Paper-Rock-Scissors patterns can either be implemented so it choices have immediate consequences (as in the game that gave the pattern its name) or long-term effects. In both cases it promotes *Tension*, either until the moment when the choices are revealed or until the success of the chosen strategies is evident. A paper-rock-scissor pattern introduces *Randomness* unless players can either gain knowledge about the other players current activities or keep record over other players behavior, as otherwise a player has no way of foreseeing what tactics is advantageous. If the game supports knowledge collection, the correct use of the strategies allows for *Game Mastery.*

Using the Pattern: Games with immediate consequences of choices related to Paper-Rock-Scissor usually have these kinds of choices often in the game to allow people to keep records over other player behavior. *Quick Games* using the pattern, such as the game which lent its name to the pattern, usually are played repeatedly so some form of *Meta Game* can be used to allow players to gain knowledge of their opponents' strategies.

A common way to implement the pattern for having long-term effects is through *Investments* to gain *Asymmetrical Abilities*, either through *Proxies* or C*haracter Development*. See Dynamics for Designers (Will Wright) for an example based on proxies. For this kind of use of the pattern, players can be given knowledge about other players through *Public Information* or in the case of games with *Fog of War* through sending *Proxies*. Allowing players to keep record over other players' behavior is trivial if play commences face-to-face, otherwise some form of *Personalization* is required.

Relations: Superior patterns are *Player Balance, Tension*, *Secret Tactics*, and *Game Mastery*. Subpatterns are *Trump*, *Randomness*, *Asymmetrical Abilities*, *Public Information*, *Investments*, *Proxies*, *Character Development* and *Meta Game*.

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APPLYING GAME DESIGN PATTERNS

Unlike earlier uses of patterns, we do not propose one single (problem-solving) method for using patterns. Instead, we see the patterns and the structural framework as a tool, similar to a pen, which can be used in several different ways for several different reasons. This is because we see several potential user groups which have inherently different working methods. This being said, we have identified a number of different types of uses that patterns can be used to support. Although we have yet to collect substantial amounts of data regarding the feasibility of using various approaches, we do believe that the use areas described below hold potential.

We do not state target users for the various protomethods as we believe that this is highly dependent on the specific use context and how rigorously the users structure their use of patterns. For example, the act of categorizing games and genres may seem most suited for academics but could also be used by critics writing reviews or gamers making decisions about purchases. However, we stress that game design patterns are beneficial to multidisciplinary groups as they ease communication by being neutral definitions based on the interaction in games and not based on any research field or professional jargon.

Idea generation

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 may be to study an individual game design pattern and try to implement it in a novel way.

Development of game concepts

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

Pre-production process

Having a game described using patterns offers advantages when presenting the game design to people. Besides allowing a structured description of the design, motivations for particular design choices (describes as patterns) can be done by relating to other games using the same patterns or by describing how replacing the pattern with other patterns would change the design. This advantage is increased if the people already have been introduced to design patterns from previous game design as they easier can compare the designs.

Identifying Competition and IP/patent 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.

Problem-solving during development
Similar to the rational 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 in a design.

Analyzing games
The availability of a pattern collection can provide a simple way to start analyzing an existing game. By simply iteratively going through the collection and see if a pattern exists, or rather, to which degree a pattern exists in a game. Further information about the game can then be gained by studying if previously identified subpatterns are used to create a pattern or if novel elements have been introduced.

Categorizing games and genres
Assuming that a patterns-based analysis has been performed on a collection of games, these can then be categorized by their similarities or differences. Besides offering a multitude of dimensions of how to measure in what way games compare to each other, collections of patterns found in games belong to a genre can be used to describe or understand that genre.

Support to explore new platforms and medium
As mentioned in the introduction, the game industry has due to the economically successful model of sequels and branding become what can paradoxically be called conservative. This lack of going beyond existing frames exists not only in thematic and game play styles but also in platform. We believe that the use of patterns can help the exploration of new types of games and they can provide a structured way to compare how game play changes with a changed environment. This is especially likely for novel game mediums such as pervasive gaming which is a development of computer games but need to function in social conditions similar to those where more traditional games are played.

DISCUSSION
Our work with game design patterns is still in its initial stages and as such we have identified several different areas of work required to be able to draw more substantial conclusion of the feasibility of game design patterns in various use areas.

Further, even if a pattern approach satisfies the need for understanding games and game design, some issues may hinder the wide-spread use of patterns in game development and research. In the lack of a collection of suitable patterns, the process of making a pattern collection which would be useful is difficult and time consuming. Making one large collection containing all identified patterns in an encyclopedic endeavor may solve this problem by containing all possible sets of required patterns, but finding the specific patterns in the day to day design work may be too time-consuming especially as identified patterns may be linked to many patterns that are not

relevant to a particular case. This problem has led us to start investigating ways of aiding users to quickly identify relevant patterns without an extensive know-how of the collection, and will probably require different solutions to each of the suggested use areas.

Validating patterns

To create the pattern collection, we have engaged in various activities as described in the empirical development section. The identification of the same game design patterns in very different kinds of games (Carcassonne and Qix in one example, Pac-Man & King of the Hill variants of FPS in another) we believe to be indicators of the value of patterns to understand interaction in games.

The use of patterns in analysis has already proven fruitful in analysis of the games Pac-Man, Missile Command & Mind-sweeper in a research-orient workshop[1] and the patterns have also been used in various experimental game prototypes [7].

However, to validate the analytical, problem-solving and communicative values of patterns they need to be put to use. To support this we are in the process of making all patterns available online as well as engaging both industry and academia in workshops focusing game play analysis or experimental game design.

Creating the pattern collection

One of the problems with creating the design pattern is determining exactly how much unique information is required for a concept to be a pattern in its own right and not just a variant or comment mentioned in a (superior) pattern. Although we currently flavor an inclusive approach and with an evolutionary refinement process based on use and feedback from researchers and designers, we note that it might be desirable to have a slightly weak superior pattern if it has several clear and useful subpatterns or to have an insignificant pattern as a separate pattern if it has more than one superior pattern, in order to show the connection.

Subpatterns & Superior Patterns.

The structure of the pattern collection is not a strict hierarchy but a network with several base nodes. Although we have not found and circular structures, our current definition of the sub-superior pattern relationship can be unintuitive for certain user groups. Further, we have identified case when the sub-superior or potentially conflicting relations are insufficient; for example, some groups of patterns are normally used together to instantiate each other.

Navigating the pattern collection

With over 200 pattern candidate identified, we have already identified the problem of finding the relevant patterns for any given situation. This problem is especially apparent to new users of methods using game design patterns and to address this we are seeking various forms of categorizing patterns for different use areas, game themes and relations to

[1] Although not finally analyzed, material from the workshop can be found at http://www.gamedesignpatterns.org.

our structural framework. One especially interesting line of research would be to use game design patterns to define game genres and then explore if these patterns are those which are most useful for development or research within those genres.

The Danger of Stereotyping

Some may object that the use of patterns takes the creativity out of game design or renders the designers as "mere pattern cranking machines" that automatically churn out games. Another common fear is that the use of patterns will lead to a situation where all the games follow the same pattern and fall into stereotypes where nothing new is or can be created. These both stem from confusing the everyday meaning of pattern as something repetitive with the actual basic philosophy of design patterns as introduced by Alexander. In one sense the choice of pattern term might be regarded as a mistake but as the term has clear and firmly established meaning in several professional fields we see not necessity for inventing new terminology, something that would indeed lesser the usefulness of the pattern concept as a tool to overcome communication differences in various professions. A more appropriate comparison of the use of patterns is to the artistic endeavor in general: the artist has much better chances to create something novel when familiar, though not necessarily consciously, of the basic elements of her craft, be it painting, composing or scriptwriting.

CONCLUSION

During our research, we have identified the need for a unified vocabulary and common concepts regarding games and game design. Studying earlier approaches to create common vocabularies, we have concluded that it is appropriate that such a vocabulary emerge either from terms and ideas that are already rooted within the gaming community, or that suitable concepts, terms and methods are taken from other disciplines and are carefully adapted to the gaming field without adopting larger conceptual structures. In addition, the supplements should focus on the interaction in games, rather than on e.g. narrativity. Furthermore, they need to be applicable to all kind of games to avoid the risk of being stuck in the developed conventions of digital games. As a solution to these problems, we propose the use of patterns.

In line with this, we have created a collection of patterns, primarily based on transforming documented game mechanics or well-defined concepts from other research fields. This collection has then been the basis for initial tested of use areas for game design patterns. These tests have confirmed our belief that game design patterns are usable for analysis, comparison and design of games; thus useful in most aspects within game studies, in turn making them a suitable candidate to serve as a basis of a lingua franca within gaming. We do not believe that the use of game design patterns is the final solution to finding a common language for ludology. However, we believe that many of the characteristics of design patterns will be included in such a language, and that continued work with design patterns will help reveal truths about game and game play until such a language is found.

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