José Pablo Zagal
jp@virtualia.cl
Virtualia S.A.
Av. Kennedy 5757, Oficina 1502
Santiago, Chile

Miguel Nussbaum
mn@ing.puc.cl
Escuela de Ingeniería
Departamento de Ciencia de la Computación
Pontificia Universidad Católica de Chile
Casilla 306, Santiago 22, Chile

Ricardo Rosas
Escuela de Psicología
Pontificia Universidad Católica de Chile

A Model to Support the Design of Multiplayer Games

Abstract

Extensive research has shown that the act of play is extremely important in the lives of human beings. It is thus not surprising that games have a long and continuing history in the development of almost every culture and society. The advent of computers and technology in general has also been akin to the need for entertainment that every human being seeks. However, a curious dichotomy exists in the nature of electronic games: the vast majority of electronic games are individual in nature whereas the non-electronic ones are collective by nature. On the other hand, recent technological breakthroughs are finally allowing for the implementation of electronic multiplayer games.

Because of the limited experience in electronic, multiplayer game design, it becomes necessary to adapt existing expertise in the area of single-player game design to the realm of multiplayer games. This work presents a model to support the initial steps in the design process of multiplayer games. The model is defined in terms of the characteristics that are both inherent and special to multiplayer games but also related to the relevant elements of a game in general. Additionally, the model is used to assist in the design of two multiplayer games.

"One of the most difficult tasks people can perform, however much others may despise it, is the invention of good games . . ."
C. G. Jung

1 Introduction

Games have a long and continuing history in the development of almost every culture and society (Huizinga, 1954), and the debate over the use of games and playing activities has extended to electronic games. Electronic games (such as video and computer games) are akin to games in general, and, as such, provide the same developmental functions as other games.

Whereas the vast majority of games played all over the world are collective in nature (that is, they involve the participation of more than one person), practically all electronic games are individual. This obvious dichotomy forces us to ponder the reasons behind the nature of electronic entertainment and why it has targeted the individual player. It also brings to light the importance of collective action: that is, do we really need games that involve more than one participant?

The high costs associated with technology have impeded the equal development of multiplayer games. Basically, we are talking about networks and other specialized hardware that are necessary to involve several people in one game. Also, a certain amount of logistics is involved in the case of computer imple-

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mentations. The computer is most often in an isolated location in homes, and this is an important disadvantage when it becomes necessary to gather a group of people to play (Bunten, 1996). On the other hand, games with more than one player are more fun and challenging. Because humans are social beings, the social aspect of multiplayer games makes them additionally interesting and rewarding to the participants (Bunten, 1996; Costikyan, 1994).

More than twenty years of electronic game development have led to excellent levels of expertise in the areas of game design and development. All these efforts have centered on the individual player, leaving multiplayer activities at great disadvantage. Multiplayer games have been developed for various platforms, but, compared to the whole industry, the number produced is minuscule. Even when multiplayer capability is offered, it's simply one feature among many and not the main focus. At the moment, people simply don't know how to design electronic multiplayer games (Bunten, 1997).

The current situation is one in which there is great interest in electronic multiplayer games. This interest is both academic and general. The boom in Internet use has brought along with it a massification of online play environments that people are beginning to explore and participate in. Online multiplayer gaming is one of the areas with great potential in the gaming industry.

Given the fact that a multiplayer game is vastly different from an individual one, it becomes important to explain and understand the fundamental characteristics that multiplayer games have in common. These are attributes that are not always present in individual games. It is also important to understand how these elements relate to each other and to the game itself. Game design is primarily an artistic creative process, but it is also technical (Crawford, 1984). A game designer usually starts out with an idea or concept that is first specified, then developed, and finally implemented. This work presents a model that supports the initial process of multiplayer game design—its specification—by relating the relevant elements of a game concept to the different aspects of a game. Thus, the design process is focused on the relevant areas, complementing both the creative and specification processes. In essence, this work answers the question "What should I consider when designing a multiplayer game?"

2 Designing Games

The game designer is the visionary who plays the game before it has been invented (Pedersen, 1999). He can imagine how and by whom the game is being played. The following steps can conceptualize the design process of any game. First, the designer has an idea for a game. After his creative spark is kindled, he proceeds to write it down to state clearly the game goals, topics, scope, worthiness, feasibility, and features (Rollings, 2000). The goal is expressed in terms of the effect it will have on the player—that is, the fantasies the game supports and the types of emotions it will engender in its audience. The topic (the setting, world, and/or environment), on the other hand, usually requires some research. For example, if the designer is considering an adventure game about the importance of timing and patience (the goal), set in the ancient city of Byzantium (the topic), the designer will probably have to do some library work to immerse himself properly in the historical setting in which the game will take place. A game must give the authentic feel and texture of the real world, and this can be achieved only if he firmly understands the environment of the game (Crawford, 1984). The resulting document, which conceptualizes the game idea, is called the *concept paper.* It also serves as a sales tool to take the game to market (Freeman, 1997).

The next stage of the design process is to write the design document, which can be as long as hundreds of pages (Freeman, 1997). The design document details all of the possible steps of the game and defines the communication and interaction between player and game. It determines the game structure (how does the system work?), its premise and scope, the tokens (items with which a person interacts while playing) and its interactivity, its style, and its implementation details.

Once a consistent and complete design document exists, implementation can proceed. The development stage is not actually a step in the game design process. However, the game may suffer design modifications

when economic, time, or other restrictions affect the implementation as it advances. The implementation team can also modify the original design; their creativity may offer valuable design suggestions, which make changes a natural part of the production process of a game. The project head, who is not necessarily the game designer, has to have the game goals clearly in mind so to accept only those changes that are in line with the game's objectives (Crawford, 1984).

The model presented in Section 3 assists the multiplayer game (MPG) designer while he prepares the concept paper. It enlightens the designer in the key elements that need to be considered and clarifies how these key characteristics relate both to each other, and the elements that compose a game. Because the model does not deal with the formal specifications of game elements, no specialized technical skills in computer programming are required. Although the model is intended to make the design work easier, its use does not guarantee that the resulting game will be a complete success. The success—or lack thereof—ultimately depends on the underlying ideas and skills of the designer and developers. In particular, the model described makes no considerations whatsoever of the topic of the game, because game content is beyond the scope of this paper.

3 A Simple Model of a Game (SMG)

Costikyan asserted that "a game is a form of art in which participants, termed players, make decisions in order to manage resources through game tokens in the pursuit of a goal" (1994). From this general definition, we can conclude that a game is any form of play, recreation, or sport. The game concept is what we generally understand when we speak about chess, football, or poker. We know what the game is about in general terms, such as those used to explain a game to another person, and we may even have played them at some time.

A game is not a puzzle, because puzzles are static: they present a player with a logic structure to be solved, while games are interactive and change with the player's actions. Toys are interactive, yet they aren't games either. For example, although a ball offers many interesting behaviors such as bouncing, twirling, or dribbling, the game is not intrinsic in the toy. It is rather the set of player-defined objectives overlaid on the toy that make the game. Games depend on decision-making and are thus inherently nonlinear. Stories, on the other hand, are linear and thus unlike games. Finally, and most importantly, games demand participation. Unlike traditional forms of entertainment such as movies, television, or theater in which the audience is a passive receptor, games require active participation (Costikyan, 1994).

Two things basically define a game concept:

Rules and Goals—All games have rules of some form or another. Rules define what can or can't be done in a game. They lay down the framework, or model, within which the game shall take place. Rules regulate the development of the game and determine the different interactions that can take place within it. Games also need objectives that the players shall pursue, and these are the goals of the game.

Props and Tools—The framework laid down by a set of rules is applied and assisted by the use of props and tools. These are the elements with which the game is to be played. Normally, the rules make these elements necessary in order to play the game, at different levels. A prop is an element that is used purely for decorative purposes, while a tool has a certain degree of functionality. That is, a tool is used by the players while a prop is merely looked at.

For example, soccer has rules that detail the number of players, the play time, and how the game is played. The objective of the game is to score more goals than the opposing team within the allotted time span. The tools are the ball, playing field, and goalposts, and the props are the type of grass used, the uniforms of the players, and so forth.

All games require participants to exist. We define a *game instance* as a game in progress, that is, when we add a group of players to a game concept (rules, props, and tools) (see Figure 1). Each game instance is (most likely) different, yet they all belong to the same game concept. Game instances vary from each other in the way the game develops and is played.

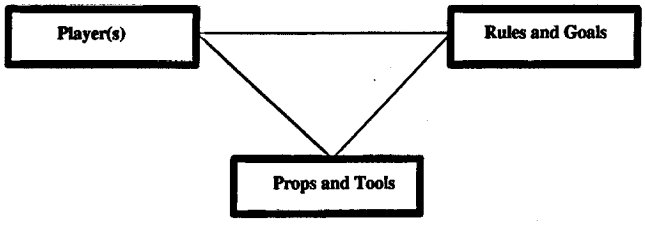

Figure 1. *A simple model of a game.*

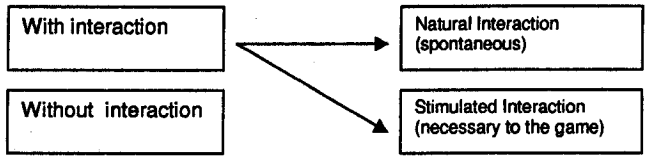

Figure 2. *Types of social interaction.*

4 Characteristics of a Multiplayer Game (MPG)

4.1 Social Interaction

Social interaction, the purposeful and bilateral communication that occurs between at least two human beings, is one of the keys to successful multiplayer games (Costikyan, 1998; Glassner, 1997). On one end of the spectrum of multiplayer games, there is absolutely no social interaction: Chinese checkers played over the Internet where the provided interface allows the player to see only the gameboard. A game with no social interaction is a game in which artificial intelligence could replace the human opponent without the human noticing any difference.

On the other end, we have multiplayer games with a high degree of social interaction. In these games, the main goal can be achieved only if there is social interaction among the participants at one time or another. For example, in the classic game of charades, a person acts (or represents) certain concepts (or things) without speaking, and the other players guess what is being represented. Another example is the *Disease* game (Stevens, 1998), in which the players are forced to a face-to-face relation, being impossible to play without a social relation. Each participant wears a "thinking tag" (Borovoy et al., 1996), where one of them is "infected" with a virus that can spread to other tags. The participants are not informed of any underlying rule (degree of contiguousness, possibility of latency, and so on) and have to "meet" (by bringing the tags together) as many people as possible without getting infected. The game's goal is to discover the underlying rules. This game exhibits a high degree of social interaction due to the rules and the fact that the props and tools used were designed to be as socially unobtrusive as possible.

Between these extremes are games in which social interaction is present but is not necessarily mandated. Games of this type neither promote nor hinder social interaction. For example, it is hard to imagine playing a boardgame of any sort without engaging in idle talk with the other players, although it is possible.

We observe that the three elements of the game model of Section 2 (players, rules and goals, and props and tools) can affect the degree of social interaction present in a game. If social interaction is a feature of the game to be designed, the following questions have to be answered:

- To what extent do the rules affect social interaction?
- To what extent do the props and tools affect social interaction?

As shown in Figure 2, it is possible to identify stimulated and natural social interactions. Stimulated (or forced) social interaction occurs when the rules of a game encourage the players to interact socially. For example, a game of tag encourages the players to chase each other in order to touch each other. Other games, such as *Disease,* force a participant to interact verbally with the other players to meet the objectives of the game. Natural social interaction occurs when the players spontaneously decide to interact. The game rules do not enforce this type of activity; it just happens while the players participate. Most games with social interaction have spontaneous interaction.

The potential for social interaction is determined by the player composition, those who play a given game. For example, a certain game may have a player composition of elderly women or twelve-year-old children. Player composition does not mean "people suitable to play a certain game" (as in "suitable for children over

twelve years of age"), nor does it refer to the preferences that people may show towards given games (for example, "a favorite amongst college students"). In other words, player composition refers to who is playing a certain game instance. Thus, player composition is completely independent of the game concept.

The spatial incidence of the game can also be a key element of the social interaction, because the participants are present in the same physical space (such as in the same room or seated around a table). In electronic multiplayer games (eMPGs), this is an issue because the technological advances in networking (such as the Internet) eliminate the necessity of having all the players together at one place. Thus, social interaction must be enforced differently. For example, *Disease* requires the presence of all the players, while an Internet game of Chinese checkers does not. Therefore, the implementation of the game, as in Chinese checkers, affects the spatial incidence of a game.

4.2 Competition and Cooperation

A multiplayer game is characterized by the existence of human opponents or cooperators, which lead to competition and cooperation—which are not possible in a single-player game. Competition refers to the fact that the participants (opponents) of the game are struggling towards a goal that will result in the declaration of a winner (Costikyan, 1994). In competitive games, there is a distinct difference between winners and losers, whereas in cooperative games the participants strive towards a common goal. Mutual assistance is usually the only way that the players can reach the objective.

Pure cooperative games are very hard to find, and they generally seem to be variants of "let's all throw a ball around" (Costikyan, 1994). Most cooperative games are competitive in nature, but the rules or goals of the game force the player to cooperate if he wants to win. *Disease* is an example of a cooperative game: the participants must cooperate to meet each other as well as to exchange information that may help them discover how the disease works. None of the players will be able to garner the information necessary to understand the disease if he or she does not cooperate with his fellow participants.

Competition and *cooperation* don't have to be opposed terms. The game set-up will determine the degree of competition and cooperation that is present. For example, in games with teams, all players of one team must cooperate yet, at the same time, compete against the other team. Another way to have a cooperation/competition game is to have the goals of the game be non-exclusive, so that a player working to meet his goals does not impede the other players' attempts to meet theirs. Players may cooperate with each other while it's in their best interest to do so, and compete when is required. An example of this type of game is Allan Calhammer's *Diplomacy.* (Calhammer, 1959), which encourages the use of diplomacy. But, in the end, there can be only one winner.

The cooperation/competition characteristic is related to the players and the rules of the game. The rules of the game establish its basic nature regarding the permissibility of competition and cooperation, but it is the players who must cooperate or compete. For example, in the cooperative *Disease,* the rules determine the nature of the relationship between the players. In the competitive *Diplomacy,* the rules are designed to encourage cooperation; the winner is the best diplomat more than the best strategist, and, the key is to establish the right alliances and knowing when to "backstab" your opponents (Costikyan, 1994). *Monopoly* (Darrow, 1935), makes clear how the rules affect the cooperative/competitive nature. Because loaning money or "forgiving" rent is strictly prohibited, there is no effective way to either help or hinder another player, thus making the game a strictly competitive contest.

4.3 Synchronicity

A game is defined as *concurrent* if it requires that all the players participate simultaneously; that is, all the players are aware that they are playing a game in which other people are participating at the same time. For example, *Disease* is a concurrent game that requires that all players are together at the same time and in the same place. Most eMPGs are of this nature.

In *synchronous* games, all players participate at the same time. Their actions are usually synchronized in such a way that they do not act simultaneously, and each player acts when it is his turn to do so. Most non-electronic MPGS are of this nature because they have turn-based systems (as in boardgames). Tennis is also a synchronous game because each player takes turns hitting the tennis ball into the opposing players' court; therefore, the two players are synchronized in their play.

Some games, however, blur this distinction. For example, a multiuser dungeon (MUD) is a game with various participants and where the entrance and exit of the players are independent of each other. In fact, it is not even necessary that they all be present at a certain time. This type of game can be considered as *asynchronous.*

Through the previous examples, we have seen how a game's rules influence its synchronicity. Props and tools are also relevant to synchronicity. For example, in eMPGs, the latency of the network can lead to certain implementations in which games have varying degrees of synchronicity. If, in tennis, two balls were in play, a different synchronicity would occur. With one ball, the position of the ball determines who plays. With two balls, the action can occur simultaneously in both sides of the court (thus making it a concurrent game).

4.4 Coordination

Coordination describes the way the game process is controlled. A single person (or computer) may coordinate the game, or it may be coordinated in a distributed fashion. For example, the soccer referee coordinates the game, deciding when it starts and ends and when to interrupt it to enforce a particular rule. *Disease* is decentralized, and all players work distributedly with no arbitrator. This game works in a distributed way, wherein all the subsystems act together to bring forth the actual game. A user-initiative coordination occurs when a player has the chance to take control of the game, when he or she receives the power to decide whether the game will continue or not. For example, when in chess (without a time limit), one player can freeze the development of the game.

From the previous examples, we can see how the rules affect the control of a game. But props and tools also influence the type of coordination in the way they pose restrictions to the coordination process. For example, an eMPG may require a central server to maintain the information of the game, as in Ultima On-Line (a form of graphical MUD); therefore, the tools necessary to the game have dictated that it be centrally coordinated.

4.5 Prop and Tool Dependence

A rule of thumb to follow to determine whether a game is prop/tool dependent is to try to imagine the same game being played with other props and tools. Generally, an MPG with a low degree of prop/tool dependence can be found when the game concept remains the same despite the removal of the computer. The props and tools just assist the game process. For example, in eMPGs, the computer is generally used to help with calculations and processes, but the computer is not vital to the game in itself. This is the case of *Lazer Tag,* a noncontact game of tag wherein the participants wear special sensors and shoot at each other using "guns" equipped with an infrared transmitter. The game does not require a computer to work, but the computer devices are used to assist the "tagging" process. On a conceptual basis, this game does not require a computer, and, thus, it is not prop/tool dependent.

Compare this to the game of pinball, which is totally prop/tool dependent. The pinball table is essential to the game and thus defines the nature of the game.

4.6 Existence of Meta-Gaming

In some MPG games, especially competitive games, a given player may not necessarily have access to the same information as the other players do. This information asymmetry can lead to the existence of *meta-games,* games that take place parallel to the normal game, at an informal level but central to the development of the main game. For example, the rules of poker establish the winner and loser according to the cards that each player has in his hand. However, because the player knows only his own cards and not those of his adversaries, a game of bluff occurs, with the players trying to convince or deceive each other about the cards they have

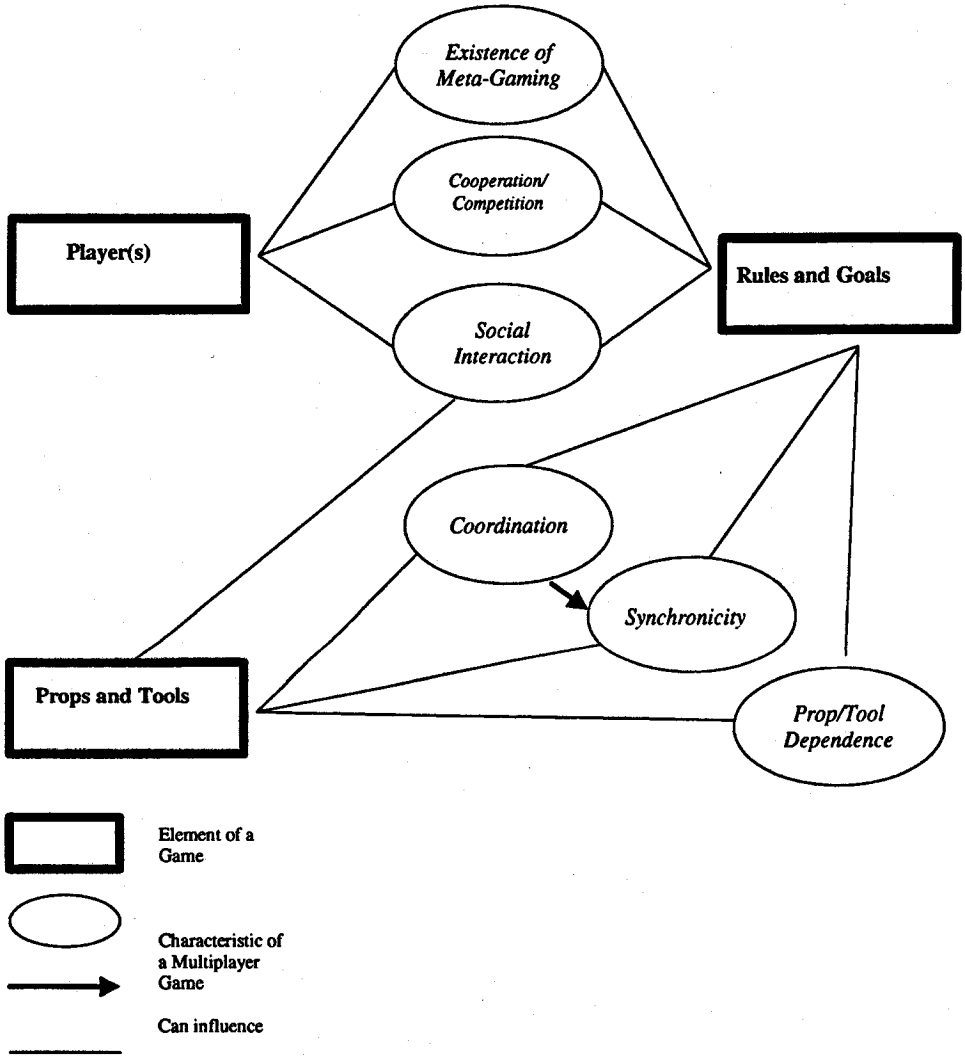

Figure 3. *Characteristics of a MPG.*

in their hands. The outcome of this game of bluff will have a direct impact on the poker game taking place, because some players may opt to fold when, in effect, their cards may have won them the match. We see here that the rules establish the asymmetries in the information available to the players, while the players are the ones who engage in the meta-game.

Another type of meta-game is one that transcends one particular game instance but can't exist without it. For example, in the soccer World Cup, the teams have to qualify first, then participate in a championship that is organized in a special way. We then have rules for the soccer game and (meta) rules for the world cup.

4.7 Model of the Characteristics

Figure 3 summarizes the relation of the different characteristics of a MPG with the constituent elements: players, rules and goals, and props and tools.

5 Design Methodology

This section shows a design methodology guided by the model defined in the previous sections and illustrated with the design of two games. The games will be designed in tandem so that we may see how the model helps define the nature of two different multiplayer

Game A	Game B
Goal: Learn how an advantage is relative to the position of others and that success is highly dependent on the use one makes of the resources at hand.	**Goal:** Learn the importance of communication and the role it plays in the way people's needs are satisfied.
Educational Aim:* Practice sums of numbers between 1 and 9.	**Educational Aim:** Practice sums of numbers between 1 and 9.
Example: 5 + 7 = 12	**Example:** 5 + 7 = 12

*These games were developed for an educational multidisciplinary project. This explains the sudden inclusion of an educational aim as well as the apparent lack of attention paid to the children who will play the games. Both of these have received further treatment that is beyond the scope of this work. Further information can be obtained at www.ing.puc.cl/sugoi.

games for a handheld gaming console. The process to be followed will begin with the definition of the goal and topic of each game. After that, and for each characteristic of the model, we will make certain design decisions, which will be guided by the elements of the SMG that are related to the characteristics of multiplayer games. Finally, once these design decisions have been made, we shall write the concept paper for each game.

5.1 Goal of the Games

We can notice from Table 1 that the goal is highly ambitious. At the end, we will see that we will not be successful as we may have hoped, but, at this stage of the design process, it is important to be both ambitious as well as idealistic. If it were not so, how can we hope to design games that are true works of art?

5.2 Topic of the Game

Both games have different topics. The nature of these, added to the different goals, shall begin to define the style of the resulting game. The choice of topic is strictly creative in nature.

Game A	Game B
Topic: Shall be a variant of the well-known game Tic-Tac-Toe. Two children shall play this game simultaneously.	**Topic:** This game will emulate a marketplace in which different people offer different "things" and require other "things." We can think of a village fair where people go to "hawk their wares." The players will have to trade with other players to obtain the items they need. A minimum of three children shall be necessary to play this game.

At this stage of the design, we have a vague idea of the game. We do not know much about its form or the way in which the game runs. We have yet to define the rules of the game and how it operates. We shall now apply the model of the characteristics of a multiplayer game to assist the remainder of the design process. It is important to consider that only at the end of the design process is there enough information to completely understand both games. In these first steps, we are making design decisions that shall, in the end, result in a game that can be cohesively understood. Taking this into account, it is important to remain patient until the end of the process. We shall describe at that moment both games in a manner that can be understood easily—and we shall also comprehend in what manner the process we are about to undertake was valuable to the final result.

5.3 Social Interaction

Both games have different types of interaction.

Game A	Game B
We want this game to have social interaction: however, this shall not be essential to gameplay. This interaction shall be natural interaction.	We want this game to have a high degree of social interaction. This interaction shall be stimulated interaction.

We shall enforce the chosen type of interaction through the rules.

Game A	Game B
It shall not be necessary for the players to communicate directly to play the game. The rules of the game are such that all the information necessary to play is presented in each player's handheld portable machine (such as Nintendo's Gameboy).	The mechanics of the game shall be such that it is impossible for one player to begin the game with the "thing" he requires. The mechanism through which the players obtain the necessary items will be a face-to-face agreement and a posterior transfer using a handheld portable machine.

We shall enforce the type of interaction chosen through the props and tools.

Game A	Game B
1. A short cable permanently connects the handheld machines ensuring that the players need to be physically close to play the game. This is a characteristic that positively affects natural interaction. 2. When the game ends, the screen shall not display information on the results of the game. The players will have to determine the winner by themselves.	The game screen shall not display all the information that is necessary to play. The missing information will have to be handled by the players. In other words, for the other players to obtain this information, they shall have to converse with each other.

5.4 Cooperation/Competition

The games will also have different natures.

Game A	Game B
Because this game will be similar to Tic-Tac-Toe, it shall be competitive in nature.	Because we want the children to participate in trading activities with each other, this game shall be of a purely cooperative nature.

We shall choose to enforce this characteristic through the rules and goals.

Game A	Game B
The goal of this game shall be to obtain higher results in math operations.	The goal shall be for all the participants to complete their mathematics operations in the least amount of time. The faster all the players finish, the better. Each player will have certain information that the other players will not. It will be necessary for the players to communicate and share information to succeed.

5.5 Synchronicity

The games also differ in their synchronicity.

Game A	Game B
We want this game to be synchronous.	We want this game to be concurrent, because it is important for all the children to participate simultaneously.

We shall choose to enforce this characteristic through the rules and goals.

Game A	Game B
The rules of the game will state that the players will play alternately. The starting player will be chosen at random.	The rules state that any player can interact with any other at any time. The number of players necessary to play is not fixed, and the players can freely enter or exit the game at will.

Props and tools will enforce this characteristic.

Game A	Game B
The game screen shall clearly show when it is a player's turn. The other player shall not be able to make any moves until the other player has moved. A sound will signal when it is the other player's turn.	Because only two handheld machines can be connected at once, it is clear that this tool would seem a hindrance towards a concurrent game. Thus, it is very important that the rules of the game offset this deficiency.

5.6 Coordination

The games differ in coordination, too.

Game A	Game B
This game shall be coordinated and will allow for user initiative.	This is a distributed game in which the only moments of coordination will be the start and end of the game.

We shall choose to enforce this characteristic through the rules and goals.

Game A	Game B
The rules do not state a time limit or any other factor that would affect the time a player can take to perform a move.	The rules state that all players are the same (no leader).

We shall choose to enforce this characteristic through the props and tools.

Game A	Game B
The implementation of the game shall decide the order of play. It shall also indicate clearly to each player when it is his turn to play.	All the game screens shall be the same: no player will have more information available than the rest.

5.7 Prop and Tool Dependence

The games do not differ in their dependence on props and tools.

Game A	Game B
This game shall have a low degree of prop and tool dependence.	This game will have a low degree of prop and tool dependence.

We shall choose to enforce this characteristic through the rules and goals.

Game A	Game B
The rules are such that the game could be played with pencil and paper. The random element could be introduced with the use of a die or spinner.	The rules are such that the game can be played with cards and counters.

We shall choose to enforce this characteristic through the props and tools.

Game A	Game B
The implementation of the game shall not include any elements that would make this game difficult to play in different conditions.	The reason for using handheld machines is to avoid the necessity of central coordination (as would be the case in a card-and-counter version)

5.8 Existence of Meta-Gaming

It must be decided if the two games will allow the possibility of meta-gaming.

Game A	Game B
This game shall include the possibility of meta-gaming.	This game shall not allow meta-gaming.

We shall choose to enforce this characteristic through the rules and goals.

Game A	Game B
The rules will state that the players will convene on the amount of games they will play. This will allow them to establish a meta-game by providing an instance for "championship" play for which the players might be interested in keeping track of their game record.	The rules of this game rely on the fact that the players need to share all the information they may have between each other. Thus, there are no asymmetries in information that could lead to meta-gaming. On the other hand, each time the game is played, everyone either wins or loses. It makes no sense to keep a record if it is the same for everyone.

5.9 Concept Paper

As a result of the previous process, we are ready to write the concept paper. The previous work helps to clarify ideas about the game to design. The information present in the concept paper can be organized as the designer wishes. The titles presented here are an example, and they may vary according to the nature of the game that is being designed. It is important, however, that information about genre, target audience, description, features, market information, and cost and time to develop is included (Freeman, 1997).

The concept paper presented does not contain information about development costs, time, or marketing possibilities, thus leaving the analysis focused on the issues of our model. The presented design work is far from finished, because it is only the first step in the process of game design. Many questions remain to be answered: What happens in Game B if someone decides to turn off his handheld in the middle of the game, or, in Game A, if the machines were disconnected?

6 Conclusions

Use of this model has enlightened us to the fact that, despite identical target audience and educational goals, it is possible to design games that are radically different both in their gameplay as well as features. This result, while evident in some sense, is the direct product of a methodical process in which, by asking certain questions about the key characteristics of a multiplayer game and later relating these to the principal elements of a game, we were able to better focus the game design effort. In fact, the questions we answered also helped us to maintain a firm view of the way the game was originally perceived. Thus, when we try to answer questions about items that are not very clear in the different design documents, we can refer to the initial questions we answered and decide the appropriate measures to take.

Considering that many game designers are artists who do not necessarily know how to program a computer or set up an Internet connection, it is relevant that the presented model is technologically independent. It leads to clear and concise questions about the nature of the games we are designing. For example, we were forced to consider the type and nature of the social interaction we wanted to present in our games. We chose different alternatives for each game, and we had to think how we were going to carry these out. We were able to weigh the different options depending on the characteristic we were analyzing as well as what elements of a game were related. For example, in the case of social interaction, we could choose to let the rules enforce the degree of social interaction. We were also led to question how certain ideas we had about the game might have hindered others. In the case of Game B, we chose to design a game that was concurrent regarding its synchronicity. However, we later realized that an implementation using the handheld would be a hindrance towards this goal. Thus, we opted to enforce the concurrence of the game through the rules of the same.

The decisions we took before reaching the concept paper will also prove valuable afterwards. They will help to maintain a degree of focus on the type of game we originally set out to design by supporting the answers that guide the crucial decisions while the game design matures. For example, Game B presents a question regarding its coordination, and we decided that the game would be totally decentralized in its coordination. How do we know that a certain situation, such as no one hav-

Game A	Game B
Target Audience: A game for two children of five-to-seven years of age.	**Target Audience:** A game for three or more children of five-to-seven years of age.
Game Goal: To obtain higher results in math exercises opposed to those of the opponent. The same also has an educational aim: to practice basic math operations.	**Game Goal:** For all the participants to complete their math exercise as fast as possible. The same also has an educational aim: to practice basic math operations.
Rules Summary and Victory Conditions: Each player has three exercises with two boxes each. Players take turns placing a randomly generated number (between 1 and 9) in any open box (including opponents). The two numbers in a player's exercise are added together. The player with the highest total, in the respective exercise, "wins" that exercise. When all twelve boxes are filled, the player who won two out of the three exercises is the winner.	**Rules Summary and Victory Conditions:** Each player has an incomplete math exercise and three numbers. These numbers are different from the ones he needs to complete his exercise. The players must, as fast as possible, trade the numbers they have for the numbers they need. As soon as all the players have completed their exercises, the game ends. It is a race against time in which efficiency in communication is vital (both in letting the other players know what numbers he has as well as learning the others' numbers and obtaining the ones needed).
Items Needed: Each player uses a handheld portable machine, connected via the serial cable.	**Items Needed:** Each player uses a handheld portable machine, with a serial cable to connect his machine to another.
Description of the Play: The players connect their machines with the cable and turn them on. Both players wait until the screens display a message, "Press Start to Begin." Once the Start button is pressed, each machine displays the starting screen (Figure 4). The game screen displays two columns of three incomplete math exercises. Underneath these is a box that indicates which exercises belong to each player. The box is under either the left or the right column of the exercises and displays a message that reads "My Side." When it is a player's turn, his machine emits a sound. Then, a box appears at the bottom of the screen between the two columns of the exercises. This box has a number (generated randomly) that can be placed in an empty space. The place where the number will be placed is indicated by a cursor which can be moved using the joypad (pressing either up or down). The cursor always moves towards (or back) to the next available position. Note that a player can place a number in any available position on the screen, even his opponent's. To place a number, he must move the cursor to the desired location and then press a button. When he presses either button, two things happen. First, the number is placed in the position and the result of the exercise is displayed (if both operands have been placed). Second, the cursor and the number box disappear, and it is the opponent's turn to play (Figure 6). This sequence is repeated until all available positions are occupied. When this occurs, the winning machine emits a sound, and the players are shown the score screen (three text boxes that display the following: "Wins = X," "Ties = X" and "Losses = X"). Pressing the button begins a new game.	**Description of the Play:** All the players switch on their machines when the play starts. They are presented with a screen that shows an incomplete math exercise (Figure 5). At the bottom of the screen are three numbers that do not complete the exercise correctly. The right side of the screen (the side in which the serial cable is plugged) displays an arrow. Each player calls out trying to find out who has the number that completes his exercise correctly. Once he finds someone, he must convince that person to trade numbers with him. This trade is accomplished by connecting both machines with a serial cable and then pressing a button. The arrow begins to blink, and a cursor appears around one of the boxed numbers at the bottom. The cursor can be moved left or right by pressing the respective buttons on the joypad. Once the number has been chosen, the player must press a button. The number he chose will be replaced by the number his companion sent him. When the arrow stops blinking, it signals that the trade has been successful, and the machines can be disconnected (Figure 7). If the number received completes his exercise correctly, then the machine automatically plays a tune. When the tune ends, the player must continue to trade numbers with his companions (so that everyone has a chance to complete his exercise). As soon as the last player completes his exercise, he raises his hand and everyone celebrates. To play again, all must reset their machines.

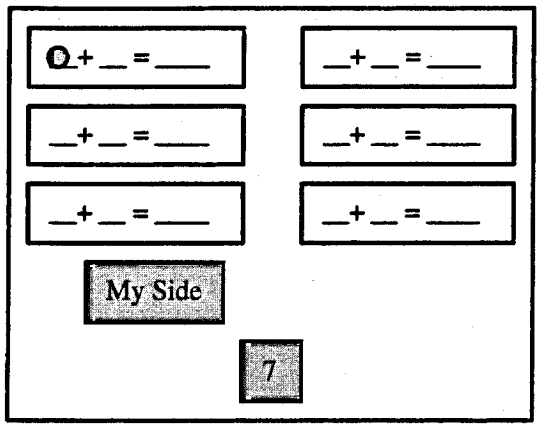

Figure 4. *Sample initial screen (Game A).*

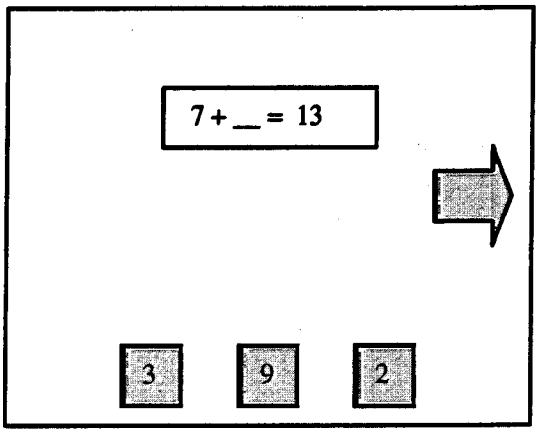

Figure 5. *Sample initial screen (Game B).*

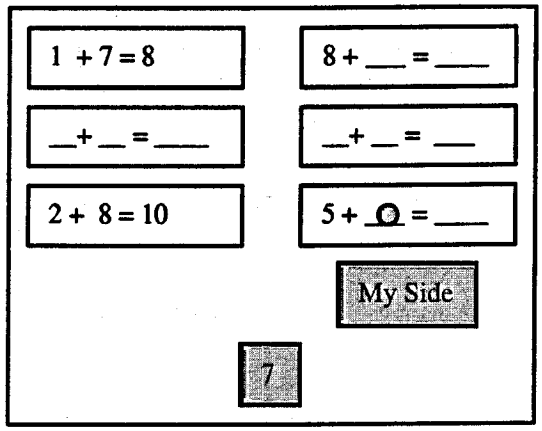

Figure 6. *Mid-game screen (Game A). The player on the right-hand side is about to place a "7" and win the third exercise (12 > 10). He has already won the first (because 8 + anything is >8), thus he would win the game.*

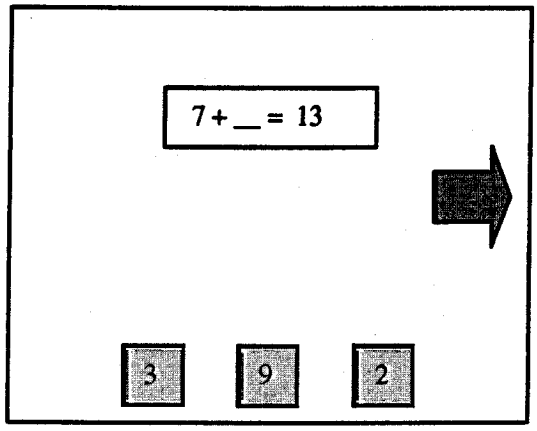

Figure 7. *Mid-game screen (Game B). The player is going to trade his "9." The arrow is blinking indicating that the handhelds are connected.*

ing the number needed by a certain player to complete his exercise, will not lead the game to stalemate situations from which no one can win? At that moment, we will wonder how to handle that sort of situation without resorting to methods that would centralize the coordination of the game.

We would also like to stress that, because multiplayer game design has received scant attention in the past, this work is a first approach at laying groundwork that future research can extend, complement, and perfect. This work opens the possibilities for investigation into vast areas that are only hinted at here. Because this work deals exclusively with the design processes involved in the creation of games, it would be interesting to explore the novel characteristics of multiplayer games in other areas of specialized research. For example, the design of collaborative game environments could be assisted by investigations to answer questions such as, "What type of rules better support collaborative gameplay?" Unfortunately, very few cooperative games are actually any fun, yet this area of investigation could yield valuable results. Another interesting area for future work is social psychology. Multiplayer games tend to thrive on the so-

cial interaction that takes place during gameplay; it is therefore very interesting to explore the nature of this interaction. The possibility of designing multiplayer games that explore different characteristics of human nature can bring insight to this field. Clearly, the field of social psychology can offer the same type of insight towards game design. Finally, multiplayer game design can be tackled from many different angles. Alternative approaches such as heuristics are also an area for future development.

Acknowledgment

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