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*Chapter 4*

# Video Game Designs by Girls and Boys: Variability and Consistency of Gender Differences

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## Introduction

Over the past ten years interactive technologies have become a significant part of children's culture. Video games such as "Super Mario Brothers" or "Sonic" have found a stable place in children's playrooms, particularly when the games cater to boys' interests in sports, adventure, and combat (Provenzo 1991). Only recently has so-called "pink software" established a playground for girls, promoting games and software such as "Barbie Fashion Designer" or the "Babysitter Club" that draw on characters and activities popular among girls. In many ways, the production of interactive toys and games seems to replicate gender differences found in traditional toys and games and the interests these generate in children (Garvey 1990; Kinder 1991; Singer and Singer 1991; Sutton-Smith 1986).

There is ample evidence in the research literature for the existence of gender differences in children's video game interest, use, and performance (Goldstein 1994; Provenzo 1991). These gender differences also appear when children are asked to make their own video games (Kafai 1996). But there are some indicators that these differences are not as universal as they may appear at first: some software such as "Where in the World is Carmen Sandiego?" seems to have equal appeal for boys and girls, and some girls like to play video games, albeit with different interpretations (Gailey 1993). Furthermore, gender differences in play performance disappear after extended exposure (Greenfield and Cocking 1994), a claim also supported by research on girls' general use of and interest in technology (Linn 1985). While these are isolated indicators, they point out that gender differences are not as consistent as one might believe. It is possible that children display more versatility and range in their play interests and that particular factors such as game structures or context settings might have an impact. Research on children's toy and play preferences has provided evidence that structures of toys and play settings can elicit certain behaviors from play participants (Karpoe and Olney 1983; Ross and Taylor 1989).



The current analysis of video games designed by boys and girls intends to shed some light on the discussion around gender differences by comparing and contrasting two different game-design contexts.[1] In one context, I asked students between the ages of nine and ten to design and implement educational video games to teach fractions to younger students. In the second context, I asked children to design and implement educational video games to teach younger students about the solar system. The context differences refer to differences between subject matters: mathematics and science. In the following sections, I first review pertinent research and describe the research context in which the students produced the video games. Next, I compare and contrast the games designed by boys and by girls in the two different contexts, taking into consideration features such as genres, worlds, character design, interactions, and narrative. In the discussion, I address the context dependency of gender differences and what insights these results provide for developing video game design and play environments.

## Review of Research

The context dependency of gender differences in interactive technologies is not well researched. As Garvey (1990) notes, most research on gender differences in children's toy preferences and play styles "has focused on profiling behavior of boys as a group and girls as a group. It has as yet failed to pursue any of the interesting questions about the range and versatility of children's play behavior or the conditions under which children might demonstrate flexibility in the cognitive and communicative aspects of make-believe or other types of play" (p. 154).

Most research has focused on documenting gender differences in relation to computer interest, use, and performance. Studies have pointed out gender differences in game playing interests (Inkpen et al. 1993; Provenzo 1991) and use (Kubey and Larson 1990). Other research has focused on gender differences in children's spatial and attentional skills while or as a consequence of playing video games (Greenfield, Brannon and Lohr 1994; Greenfield, deWinstanley, Kilpatrick, and Kaye 1994; Okagaki and French 1994; Subrahmanyam and Greenfield 1994). These theories of gender differences have been further elaborated by

studies that examined children's preferences based on their real and imaginary designs of video games and electronic machines. For example, Kafai (1996) asked girls and boys to design and implement their own video games and found that the games designed by the girls differed significantly from those designed by boys according to the use of violent feedback, characters, and game genre. In a related research approach, Brunner et al. (1990) asked girls and boys to design fantasy machines and found that the girls designed machines with human-like qualities whereas boys focused on fantasy machines with numerous technical details.

When researchers analyze how children perceive gender stereotypes in video games, interpretations point in different directions. Researchers such as Kinder (1991) argue that the values embedded in movies, toys, television, and video games provide powerful stereotypes for children's thinking. By contrast, Gailey (1993) questions to what extent these messages are received as transmitted. She analyzes what values video games convey, how children as players interpret the play process, and what children get out of the games. Her research has demonstrated that children do not accept the universals provided in video games; they make up their own descriptions. Irrespective of the considerable gender stereotyping found in many video games (for example, in portraying women as victims or prizes), girls seem to resolve the dilemma by redefining their positions in casting themselves in managerial roles.

While gender differences are pervasive, there are also several documented instances where they appear less prominent. Recent research interrogating the video game-playing performance of girls and boys found that repeated play exposure attenuated preexisting gender differences (Greenfield and Cocking 1994). In analyzing computer programming performance, Linn (1985) noted that girls could be as effective programmers as boys when having the same opportunities. These results were supported by Harel (1991) and Kafai (1995), both of whom examined long-term software design activities and found no significant differences between boys' and girls' programming performance and interest.

Gender differences also seem less prominent in the formation of the motivational appeal of games. Malone and Lepper (1987) created a taxonomy of intrinsic motivations based on their research of different educational games. They found that the presence of game features such as challenge, curiosity, control, and fantasy, as well as cooperation, competition, and recognition increased motivational value for all players. They only found one instance where there were significant differences between boys and girls in what they liked about the games:



> The boys seemed to like the fantasy of popping balloons and the girls seemed to dislike this fantasy. The addition of musical rewards, on the other hand, appeared to increase for girls, but to decrease for boys, the intrinsic interest of the activity. (Malone and Lepper 1987, p. 226)

These results convincingly suggest that boys and girls find many (but not all) of the same game features appealing. Research that analyzes players' and programmers' explanations notes the particular personal resonances that these activities hold for people (Turkle 1984). In my study of children's making of video games, I found significant gender differences in the kinds of characters created, in feedback, and in narrative development (Kafai 1996). But I also found that in other game features such as game interaction, game worlds, and genres there were trends rather than significant differences between girls' and boys' game designs. In other words, while gender differences are prevalent, there is a much richer picture behind what motivates and interests children in the playing with and making of interactive technologies. What this research pointed out is that girls are interested in making video games but that their video games look different from those designed by boys. The students drew from models of commercially available software in many ways: boys emulated video game design in the beginning and included characters and prizes found in popular video games; girls took existing educational software as a model. Many of the designed game contexts had little to do with the learning content, fractions. For that reason, the second study chose a science topic, the solar system, because it would provide a natural context, outer space. While certain topics in science such as biology and environmental studies have been known to draw larger numbers of women, it has been clear from the outset that both domains, mathematics and science, are not traditionally favored by girls (Sadker and Sadker 1994).

### Research Context and Methodology

To examine the context dependency of gender differences in students' game designs, data sets from two different game design projects were analyzed. In each project, a class of sixteen fourth grade students was asked to program educational games to teach either fractions or the solar system to third graders. These projects were known as the Mathematics Game Design Project, or MGDP, and the Science Game Design Project, or SGDP. The MGDP had eight girls and eight boys; the SGDP had nine girls and seven boys. The students, who came

from various ethnic backgrounds and were between nine and ten years old, met every day and transformed their classroom into a game-design studio for six months, learning programming, writing stories and dialogues, creating package designs and advertisements, and considering interface-design issues, as well as devising teaching strategies.[7] The collaborative structure provided opportunities for the game designers to discuss their project with their classmates, and to show it to their potential users and to a wider public. Several "focus sessions" presented opportunities for the teacher and researcher to initiate discussions around issues and ideas relevant to all game designers. Games, students' experiences playing games, what they learned, and programming ideas were among the topics discussed.

The research for both projects, MGDP and SGDP, took place in an inner-city public elementary school in Boston. One part of the school is an MIT Media Laboratory experimental site, which in the more than twelve years since its establishment has investigated on a large scale the implementation and rituals of a computer culture. The school houses fifteen classrooms with approximately 250 students and has 110 networked computers. The computers are arranged in four circles in the open areas, which are surrounded by classrooms with additional computers. While this feature distinguishes this site from more conventional classrooms, the student population—containing a high proportion of Hispanics and African Americans—is nevertheless characteristic of other urban schools.

The most distinctive aspects of the regular classroom activities are that all the students have daily access to the computer and that they mostly create their own software, using the programming language Logo, rather than using predesigned program packages. The implications of students' programming experience are important for understanding the results of this study. All of the students who participated in either MGDP or SGDP probably had more technical experience than most students in other schools. While programming the games was still a difficult enterprise, it was also feasible because the students had sufficient understanding of programming to begin the task. What is important to point out is that, because there were enough computers for each student, both girls and boys had the opportunity to build this technical knowledge over time. Consequently, girls would spend as much time on the computers as boys did. Because both studies were conducted at a time when most students did not have computers at home, outside experiences were negligible.

While both game-design projects took place in the same school context, the two studies did not happen at the same time nor were they working with the same students: the MGDP took place two years before the SGDP. But the two projects shared enough features to be comparable: the same teacher and researcher conducted them, and students for both projects entered with similar programming backgrounds and video game experience. For that reason, it seems unlikely that the time difference of two years created a different cultural environment and significantly influenced the games that were designed.



A combination of qualitative methods was used to document the students' ideas, thoughts, and progress in game development. Interviews gathered information about students' interest, knowledge, and evaluation of video games. In the interviews that I conducted with each student before the projects began, I found that all students had an awareness of and hands-on experience with video games. However, the extent of the video game play experience varied considerably. The major difference was between girls and boys: most boys played video games actively and consistently, whereas only two girls acknowledged having done so. To summarize, the girls' and boys' knowledge of video games were not comparable. Perhaps this result is not surprising considering that the majority of commercial video games are played by boys. (See, for example, Greenfield, Brannon, and Lohr 1994; Provenzo 1991.)

## Results

In all, thirty-two final video games were analyzed according to the following features (Kafai 1996): the game genre; the game worlds and places created; the game characters and supporting cast of actors developed by students; the interaction modes and feedback provided for the player; the narrative development as part of the game structure. To facilitate comparisons, all the results have been transformed into percentages, and game designs of the two different contexts are compared for each gender (see Table 4.1).

### Game Genres

There are various kinds of video games and many ways to group them. In the game industry, five major types of games are distinguished: sports, role-playing, action, strategy, and simulation. For this study I divided the students' games into the following categories: adventure, sports/skills, and teaching context. The categories "adventure" and "sports/skill" were based on existing commercial game formats, whereas "teaching" is usually not found in commercial games. Also, this categorization is by no means exhaustive and exclusive, as

Table 4.1 Overview of game design features by gender in MGDP and SGDP contexts

| Games | Girls (%) MGDP n = 8 | SGDP n = 9 | Boys (%) MGDP n = 8 | SGDP n = 7 |
|---|---|---|---|---|
| **Genre** | | | | |
| Adventure | 38 | 33 | 88 | 54 |
| Sport/skill | 38 | 0 | 13 | 14 |
| Teaching | 24 | 67 | 0 | 29 |
| **Worlds** | | | | |
| Fantasy | 25 | 0 | 75 | 0 |
| Realistic | 75 | 100 | 25 | 100 |
| **Player** | | | | |
| Generic "you" | 63 | 77 | 13 | 58 |
| Animal/fantasy | 25 | 0 | 25 | 0 |
| Gender specific | 12 | 23 | 62 | 42 |
| **Cast** | | | | |
| 0 and 2 | 88 | 100 | 25 | 100 |
| 2 and more | 12 | 0 | 75 | 0 |
| **Feedback** | | | | |
| Violent with wrong answer | 13 | 0 | 100 | 0 |
| **Narrative** | | | | |
| Presence | 38 | 22 | 87 | 28 |

many games actually fall in several categories at the same time. For example, an adventure game may also be a skill game, since it requires the player to demonstrate skills to overcome many obstacles. Or, a simulation game of city building may also have educational purposes, since it requires the player to deal with the complexity of dynamic networked systems. Nevertheless, this general categorization may serve as a starting point. For the analysis of the designed games, the category "adventure" has been used when the player experienced extraordinary events or was sent to explore unknown places. The category "skill" has been used for games of an athletic nature such as basketball or skiing. The third category was games that used the "teaching" context in an explicit fashion.



The "adventure" genre was popular in both contexts, more so for boys than for the girls. A central feature of many adventure games was the contest between good and evil. The player is on the good side fighting off the bad guys in order to achieve the goal. This moral dimension was present in all of the boys' games in the MGDP where the player either had to recover "a stolen fraction wand" or "a stolen jewel," or "to defeat demons, evil fraction aliens, globe ghosts or mash Martians" in order "to receive a bucket full of gold, a trip to Orlandoville, a wedding to a princess," or "a ticket to the summer park." Few boys opted to include this feature in their science-oriented games, however, which instead tended to be based on goals such as "supporting someone who has been captured by aliens." Often, the player engages the aliens in a game of tag in order to "recover information" to return to earth, or lands on a particular planet for exploration purposes. Most girls, on the other hand, did not include the morality dimension in either context, with the exception of one girl whose game focused on saving Mars (SGDP), here the player had to defeat aliens in order to continue the game.

The "sports" genre was selected by only a few students in either context: students used basketball on the moon (SGDP, boy) or dunking basketballs for learning fractions (MGDP, boy), or skiing down the hill (MGDP, girl), or navigating a maze (MGDP, boy) or a spider web (MGDP, girl) (see Figures 4.1a and 4.1b). These choices were mostly triggered by personal preferences. One could also argue that the sports genre, despite its prominent presence among commercial video games, did not lend itself easily for the design of educational games.

"Teaching" was the second popular theme (genre) in both contexts. In the MGDP, the two teaching games were both located in the classroom and involved a teacher, whereas in the SGDP the game designer engaged the player in word searches, a variant not observed in the MGDP context. These word searches were programmed by four students. The program displayed a grid of 100 letters, ten to a row, and the player was asked to "recognize" pertinent words related to the solar system (such as the names of planets or key concepts) by stamping over the appropriate letters (see Figure 4.2a). This particular teaching technique might replicate students' science learning experience, which is more than often simply the memorization of words printed in boldface or colored type in science textbooks. Other teaching games asked the player to rearrange or recognize the correct order of the planets (see Figure 4.2b).

One can speculate on why so many girls favored this particular game genre. One interpretation is that girls implicitly embedded a gender bias found among professional software designers when they design software for boys or

MY PLANS FOR TODAY:

MY PLANS FOR TODAY:

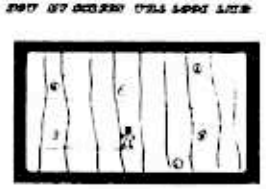

Figure 4.1a and 4.1b Designer Notebook entries—Caby's and Trevor's game designs. Caby's game describes a spider web in which the player moves around as a fly away from the spider and turns on fraction blocks where questions are posed. Trevor's grid shows the different coins that the player has to reach to get to fraction problems.



MY PLANS FOR TODAY:

WHAT MY SCREEN WILL LOOK LIKE:

MY SHAPES:

MY PLANS FOR TODAY:

HOW MY SCREEN WILL LOOK LIKE:

MY SHAPES:


Figure 4.2a and 4.2b Designer Notebook entries—Cheryl's and Rachel's game designs. Cheryl's design describes the word search and arrangement of words. Rachel's design shows the planets to be arranged in right order.

for girls. Huff and Cooper (1987) found that expectations held by many software game designers are central in determining the way the software design interacted with the user. Software that is explicitly designed for girls is often classified as a "learning tool," whereas programs designed for boys are often classified as "games." Girls' preferences for this software format might have been based on their choice of designing for other girls. Another interpretation is that girls might have simply followed the directions of designing an educational video game down to the letter of the word. While either interpretation offers some insights into possible motives for the choice of this genre, neither provides an explanation why this genre became more prevalent with girls and boys in the SGDP compared to the MGDP.

### Game Worlds

The influence of context became even more evident in the choice of game worlds. All the game designs centered around a location (or the exploration of different locations). While the MGDP generated the greatest variety of places—spider webs, coin grids, street scenes, map games—the worlds in the SGDP were mostly located in space, either in the solar system or on an individual planet such as Mars. A major distinction could be drawn in the reality aspect of the game worlds. In many instances game worlds could be described as either realistic, because they featured well-known places such as classrooms, ski slopes, and airports, or as fantasy places that teach the player about the content.

All the game worlds in the SGDP had a space setting, which given the nature of the games would be considered a "realistic" setting. One distinction was whether the setting was centered around one planet or whether it encompassed the whole solar system. Some games used the introduction sequence as an entrance to the solar system, whereas others situated travel through space and visited different planets (see Figures 4.3a and 4.3b).

In contrast, the MGDP created greater variation between fantasy and realistic contexts. Many boys had invented fantasy places like "Orlandoville" or "Island of the Goon." This choice might reflect boys' need for extended play space. Jenkins (in this volume) observes that over the past fifty years the play spaces of children, and in particular those of boys, have moved from streets and playgrounds to the safety of children's' homes. Video games have provided the opportunity for boys to extend their play space into the virtual world. By contrast,


Figure 4.3a and 4.3b. Designer Notebook entries—Deanna's title screen design for her game "The solar system we go" and Carleton's screen design for his "Cam Capsule" game.

most girls have been confined to the space of the home. This might explain their choice of more realistic settings such as classrooms, ski slopes, and spiderweb.

In their design of game worlds, the children made reference to features found in commercially available video and computer games. For example, a fraction game using warp zones was reminiscent of the "Super Mario Brothers" tunnel system (see Figure 4.4a). One science game followed the blueprint of an existing education game that the girl designer had played when she was younger (see Figure 4.4b). Many of the science games used the exploration of the solar system as the focal point, a feature used in popular educational games such as "Where in the Space is Carmen Sandiego" and "The Magic School Bus in Space."

*Development of Game Characters*

The places or worlds in which the games were situated were populated with an interesting cast of characters. The characters can be divided into two groups: those who represent the player and those who make up the supporting cast. In the majority of games the player became a generic "you," leaving the possibility open for the younger student to be a girl or a boy. Here is a game introduction written by a girl in the MGDP:

> You want to go to the home of Zeus but the map was ripped up by the Greek God Hades. All of the Greek Gods and Godesses have a fraction of the map. You are to go to the Gods and Godesses one at a time and they will ask you a fraction problem. If you get it right you will get a fraction of the map. When you get the whole map you will be at the gate of Zeus' home. The bull at the gate will ask you three hard fraction problems. If you get them right you will go inside Zeus' home and get to become the God or Godess of fractions and meet Zeus!

In one solar system game, the girl designer provided the player with a choice to pick either "player 1" or "player 2" but made no reference to the gender of the player. The majority of games designed in the SGDP used a generic character design, while the gender-specific character appeared more often in the MGDP. Most of the boys chose a fantasy figure such as "Gemini" or "Swartz" and demonstrated their assumption that the player, too, would be male by choosing character names such as "Mike" or "Tommy." One might interpret this choice of



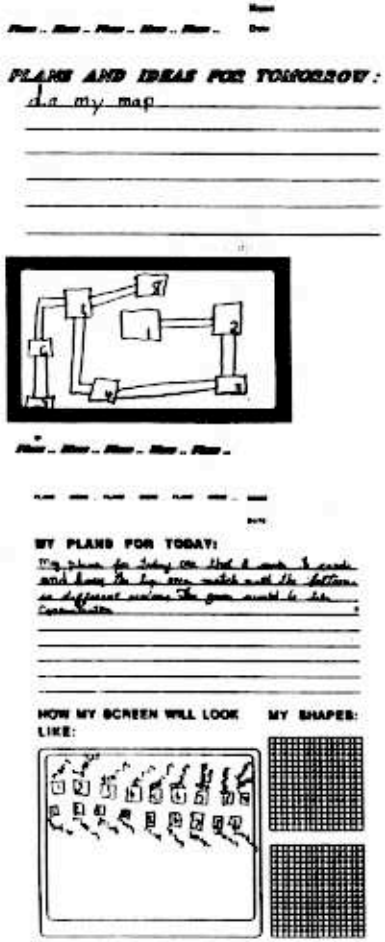


Figure 4.4a and 4.4b. Designer Notebook entries—Jera's and Kim's game designs. Jera's map shows the different stations or levels of the world that the player has to pass. Kim's screen design shows the arrangement of cards and planets.

gender-specific character design also as involving a more personal identification: the player and the character are one and the same. This form of player positioning chosen by the boys might also reflect conventions of the commercial market. To a lesser extent, this form also appeared in the SGDP, as in the following example:

> It was a dark day for Commander Keen's fans everywhere. Their favorite hero had been seriously hurt while trying to start the enormous "Dope fish." After that he decided to take a little vacation. Little did he know that he was going to be captured by the Potato King, Hoopus Snoopus. Oh sure, I know what you are thinking. You're thinking that Hoopus Snoopus got turned into a hash brown in "Keen Dreams" but he has come back and he wants revenge. Who can save Keen? If you haven't guessed yet you must be really stupid, yes, it's his little brother Deen. That's why this game is called "Deens World."

Some of the player characters had fantasy names, as already noted above, hence making the relevance of gender more difficult to hypothesize. While there were some animal characters in the MGDP context, this feature was virtually absent within the SGDP.

In terms of additional cast members, we could observe further differences between the two game-design contexts. There was a small number of additional characters designed in the SGDP, always involving fictive aliens, and only in one instance fictional characters such as a commander and a figure named, "Keen" (SGDP, boy). By contrast, the MGDP generated greater variety in number and kind of characters. Most boys created several characters (demons, aliens from planet zork, magicians, dragons, soldiers from loft, goons) with fantasy names (Zork, Zarcon, Garvin, Sparzi, Marley) for the game world in which the player had to interact and learn about fractions. In contradistinction, the girls created fewer additional characters in this context. It is apparent that the girls had a significantly different take on the role of the player and actors.

These results run counter to some interpretations. It has been argued that commercial video game figures provided the inspiration for the game figures designed by the boys in the MGDP. This argument gains support if one considers the abundance of available video games and their focus on a male audience (Provenzo 1991; Kinder 1991). For the girls, on the other hand, there are fewer examples to draw from because of the paucity of gender-appropriate video games. The choice of familiar and personal figures provides room for the interpretation that girls grounded their designs in what they knew and liked: Rosy liked cats, and hence a cat plays a major role in her game; Miriam used a skier because she liked skiing; Gloria and Sina cast a teacher in their games. Another possibility is that the small number of supporting characters reflected preferred social groupings—girls have been known to play in smaller groups than boys (Moller, Hymel, and Rubin 1992).



On the other hand, we find in the SGDP that the boys designed as few characters as the girls did. There are several interpretations possible here. One could be that students drew only a small cast of characters because space missions are not known to involve many people, due to restricted living space on space ships. On the other hand, many commercial films and popular television programs feature large casts of characters. It is unclear what generated the differences between the science and mathematics contexts.

### Design of Game Feedback

The design of feedback to the player was a central feature in the games and was linked to the quality of answers given by the player. The feedback modalities were either violent or nonviolent. "Game Over" by itself would not constitute a violent feedback if it were not connected with losing one's life or suffering harm by insulting the player's intelligence. Game actors die in the course of the game. In the SGDP, no designer included violent feedback for those instances when players answer questions incorrectly; in the MGDP, only girls did not use violent feedback. The nonviolent feedback options were "sending the player back to another planet" (SGDP, girl), or "not receiving a piece of the map" (MGDP, girl), or "having to start again from the top of the ski slope" (MGDP, girl).

The MGDP designers who incorporated violent feedback (all but one of whom were boys) developed a variety of violent-feedback modalities. For example, game actors were "kicked to the moon," "turned into an ice cube," "sent frying to the underworld," and "mentally transformed." One boy made his surfer character insult the players' intelligence ("Let me see how smart you are, Dude or Dudette," and "So you are telling me you're dumb,") when they gave a wrong answer. The harm here is psychological rather than physical, but it is still a harm. Only one girl chose to use violent feedback, ending her game with a helicopter crash if the player did not give the right answer.

Violent feedback is probably one of the most discussed features of video game play. (See, for example, Provenzo 1991; Silvern and Williamson 1987.)

Many commercial video games such as "Mortal Kombat" or "Streethghter" indulge in explicit images of violence and combat activities as markers of progress through the game. It is difficult to explain why violent feedback was absent from the SGDP, while it was such a prominent feature in the MGDP. One of my explanations is that the space theme provided a context that focused on overcoming physical limitations rather than on overcoming people. As noted before, only three students included aliens that could serve the role of an adversary.

*Design of Game Narrative*

As students continued to develope their games, defining characters and outlining scenes, they also created stories that situated the actors, often in a fantasy yet meaningful context. In many instances, they were established in the introduction and provided the player with a context, as in this boy's game in the MGDP:

> You are Jose, a third grade kid who gets lost and must find his way home. You will go on many different adventures. Along the way, people (or beasts, creatures, etc.) will ask you questions about fractions, (you will type A, B or C, remember to press enter.) If you get the question right, you will go on safely, but beware! Danger lurks if you get the question wrong. Have fun if you dare! Type play and press enter. "Where am I?" "I have to get home!" A mysterious man approaches you. "Hey kid, I'm Marley the Magician and I'm going to make you disappear if you don't tell me how much of this square is colored!", says the man . . .

Another example is from a girl in the SGDP, whose game involves a player that gets kidnapped into space:

> One morning you wake up to find you are in a strange room like nothing you've ever seen. Suddenly three weird creatures come into your room. You ask where you are and why it's so hot. They reply in a strange accent, "Sunspin or your Sun." Then you yell out: "The Sun! How can I be on the Sun?" One of the creatures answers, "Technolegy [sic]. We are intelligent creatures. We originally come from Gokk but you don't know about this planet yet. You will some . . ." "But why am I here?" You interrupt. The creatures just look at you and then walk out of the room closing the door and locking it behind them. Then a terrifying thought strikes you—you have been kidnapped into space. . .



While narratives were not always included in the beginning of the design process, many students opted to include stories later on. However, there was a substantial difference between the two game design contexts: whereas many students chose to have some form of narrative in their fraction games, explicit narrative was mostly absent in the SGDP, with the exception of a few games that used a story context to introduce the player to the game.

The popularity of the narrative in the MGDP could be explained by seeing narrative as a form of problem solving. It reconciled two seemingly adverse domains in a more coherent framework. In the fraction games, the narrative provides the glue that holds together different scenes or places as well as the instructional content. Furthermore, it allowed students to incorporate fantasy and to decorate their worlds in a more appealing way. This was also one of the features that the children in Malone and Lepper's study (1987) identified as appealing in playing games.

But this is not a sufficient explanation for the infrequent use of narrative in the SGDP. It is possible, however, that the science context itself provided a narrative. In all the science games, the solar system or planets served as the starting point for the game designs and the players' explorations and adventures. One could argue that in the science games the content was intrinsically integrated with the game ideas, something that could not be said for most fraction games. All of the fraction games, with the exception of one in which the player assembled fraction pieces of a map that had been ripped apart, had an extrinsic integration of content and game idea. Consequently, the designer had to work in the narrative to provide some connection between the game and the content to be learned.

## Discussion

The comparative analyses of these two game design contexts presented a complex picture of the ways in which gender differences are simultaneously consistent and variable. The comparison of the different contexts, MGDP and SGDP, foregrounded observable shifts in preference for game format, realism of designed game worlds, gender and number of characters, quality of feedback, and presence of narrative. From the analysis of context differences by gender, it

became clear that these shifts were mostly due to boys' change of game design features. Looking over the girls' games, we observed a remarkable consistency in design features across contexts. These results offer a first indicator of variations of game preferences within one gender.

This result may be a consequence of the research methodology used for assessing gender differences. Traditionally, researchers have observed children's game-playing performance in natural or experimental settings or have asked children about their play interests in relation to and choices from among existing commercial toys and games. By asking children to create their own video games, some game features emerged that were clearly found in commercial games. The influence of commercially available games was especially strong in the case of boys' games in the MGDP. Many game designers took as their starting point ideas borrowed from popular video games such as "Super Mario Brothers" or "Pacman." Or, students referred to existing commercial games in their interpretations of their own games, as did this MGDP boy:

> Because you are playing the role of the character and you want to type in your things. Everything is you. And if you are, say, role playing for—I mean, in arcades it is someone else and in arcade games, you don't—role playing isn't like, you don't play the role, you just like someone, like the space ship or the gun plays the role. . . . Role playing is when . . . actually Dungeons and Dragons is kind of role playing for, that is kind of, a play on words because you roll with dice to see if you shoot something, and you're also playing the role of the character. You see, in role playing in Dungeons and Dragons you have the character sheet. You write down your name, what you want your character to be, write down all his abilities and all his strengths. See you are playing his role, you try to kill monsters and get treasures. You are playing his role.

Many of the boys' game implementations include violent aspects, documented in the design of their feedback to player interactions. Violence is one of the most prominent features in commercial video games (Provenzo 1991). Hence, popular media offer paradigms for the organization of the game design (at least for the boys).

Yet popular media do not provide similar models for girls. Rarely are female game figures cast in the main role. The thematic embedding of video games in hunts and adventures is not necessarily suited to girls' tastes. In the interviews, many girls also stated that they had no particular interest in pursuing video game playing because they did not like the games, their content, and their violent aspects. Because of this lack of popular models, girls choose as the starting point of their narrative a familiar and likable figure (such as Rosy's cat) or a familiar place (such as Sina's classroom or Miriam's ski slope). In many ways, girls created their own worlds and characters, compensating for the sexism and violence found in many video games (Gailey 1993).

This research approach allowed for the articulation of gender differences in alternative forms from those readily available through the commercial market at the time these studies were conducted. It also allowed for variability across contexts, and this was particularly true for boys. Some researchers have argued that

> girls are moving closer to boys in their identification with heroic figures, adventurous achievement, and pretend aggression than previous data claimed. This appears to reflect changes in television action programs, where more female heroines now appear, as well as the increased willingness of parents to tolerate adventure themes in girls' play. . . . We do not see a comparable trend among boys—that is, a move toward playing female games and using traditionally female toys. (Singer and Singer, 1990, p. 80)

The convergence of game preferences observed in this study seems to suggest otherwise: one could say, it was the boys who adopted more "female" design features in their games. But these conclusions have to be drawn with care. Singer and Singer (1991) noted the increasing presence of female role models in television programs as one reason for the observable transformations in girls' play. The appearance of pink software on the market is too recent and probably not pervasive enough to argue for a similar situation in the programming of interactive software. Furthermore, the current titles seem to affiliate content more closely with traditional play arenas of girls. "Barbie Fashion Designer," which allows users to dress Barbie in different clothes, integrates smoothly within the existing play activities of girls. "The Babysitter Club" draws inspiration from a popular book series and provides a diary and schedules, in addition to letter-paper printing designs. More recently, video game productions have placed girls and women in the role of protagonists (Goodfellow 1996). It remains to be seen what impact these development will have on girls' interest in video games and software and whether similar trends can be observed in the interactive domain.

There is still an explanation required for why girls, in contrast to boys, were so consistent in their design choices. The choice of the two comparative contexts, mathematics and science, could be one explanation. Girls' lesser interest in these subject areas is well documented (Sadker and Sadker 1994). One could speculate on the variations that would be seen if the chosen contexts resonated better with girls' choices and interests such as history and social sciences. Future studies would need to investigate this issue more closely.

## Conclusions

The results of this research made visible the variability in gender differences. In particular, these results suggest that boys have more variability in their game design preferences than formerly understood. These results also pointed out the consistency in gender differences. Girls are not uninterested in video games or interactive technologies; they are simply interested in other features. The success of pink software is testament to this potential. Taken together these results open the possibility to consider other video game designs not currently available on the market.

But if the trend of casting more women in protagonist roles in television programming is an indicator of what might happen in interactive programming, then games with other features will also appeal to girls. The potential confluence of girls' and boys' game interests might create contexts in which boys and girls play and interact together. Preliminary results from networked multi-user environments are a first indicator of this trend (Turkle 1996). One such example is MOOSE (Multi Object Oriented Scripting Environment), a multi-user environment that has been developed for children (Bruckman 1997). In this environment, girls and boys created their own worlds with different places, objects, features, and activities. Ultimately, we need play environments that support children's versatility in expressing themselves—environments open to the unbounded limits of their imagination rather than confined by boundaries of gender stereotypes.

## Notes

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2. One of the primary purposes of these projects was to investigate game making as a context for learning Logo programming and fractions, among other things (see also Harel 1991). For that reason, the games designed by the students are a special breed, called educational games. Yet, as my analyses will indicate, it was this particular constellation that emphasized game aspects, as students had to think about how to create games that were both educational and entertaining. In the following analysis, I focus more on the game aspects than on the learning aspects, which are discussed more extensively in other publications (e.g., Kafai 1995).

## References


Bruckman, A. 1997. "MOOSE for Children." Doctoral dissertation, The Media Laboratory, Massachusetts Institute of Technology.

Bruner, J., Jolly, A. and Sylva, K. eds., 1976. *Play: Its Role in Development and Evolution*. New York: Basic Books.

Brunner, C., Bennet, D., Clements, M., Hawkins, J., Honey, M. and Moeller, B. 1990. "Gender and Technological Imagination." Paper presented at the annual meeting of the American Educational Research Association, Boston.

Gailey, C. 1993. "Mediated Messages: Gender, Class, and Cosmos in Home Video Games." *Journal of Popular Culture*, 27(1): 81-97.

Garvey, C. 1990. *Play*. Cambridge: Harvard University Press.

Goldstein, J. 1994. "Sex Differences in Toy Use and Video Game Play." In J. H. Goldstein, ed., *Toys, Play and Child Development*. New York: Cambridge University Press, 110-129.

Goodfellow, K. 1996. "Beyond Barbie: Games by Women." *New York Times*, 11 November.

Greenfield, P. M. 1984. *Mind and Media: The Effects of Television, Video Games, and Computers*. Cambridge: Harvard University Press.

Greenfield, P. M. 1994. "Video Games as Cultural Artifacts." *Journal of Applied Developmental Psychology* 15(1): 3-12.

Greenfield, P. M. and Cocking, R. R. 1994. "Effects of Interactive Entertainment Technology on Development." *Journal of Applied Developmental Psychology* 15(1): 1-2.

Greenfied, P. M., Brannon, G. and Lohr, D. 1994. "Two-Dimensional Representation of Movement through Three-Dimensional Space: The Role of Video Game Expertise." *Journal of Applied Developmental Psychology* 15(1): 87-104.

Greenfield, P. M., deWinstanley, P., Kilpatrick, and D. Kaye, D. 1994. "Action Video Games and Informal Education: Effects on Strategies for Dividing Visual Attention." *Journal of Applied Developmental Psychology* 15(1): 105-124.

Greenfield, P. M., Camaioni, L., Ercolani, P., Weiss, L., Lauber, B. A. and Perucchini, P. 1994.





"Cognitive Socialization by Computer Games in Two Cultures: Inductive Discovery or Mastery of an Iconic Code?" *Journal of Applied Developmental Psychology* 15(1): 59-86.

Harel, I. 1991. *Children Designers*. Norwood, N.J.: Ablex Publishing.

Huff and Cooper. 1987. "Sex Bias in Educational Software: The Effects of Designers' Stereotypes on the Software They Design." *Journal of Applied Social Psychology* 17: 519-532.

Inkpen, K., Upitis, R., Klawe, M., Anderson, A., Ndunda, M., Sedighian, K., Leroux, S. and Hsu, D. 1993. "'We Have Never-forgetful Flowers in Our Garden': Girls' Responses to Electronic Games." Technical Report 93-47 (December) Department of Computer Science, University of British Columbia.

Kafai, Y. 1995. *Minds in Play: Computer Game Design as a Context for Children's Learning*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Kafai, Y. 1996. "Gender Differences in Children's Constructions of Video Games." In P. M. Greenfield and R. R. Cocking, eds., *Interacting with Video*. Norwood, N.J.: Ablex Publishing.

Karpoe, K. and Olney, R. 1983. "The Effect of Boys' or Girls' Toys on Sex-Typed Play in Pre-Adolescents." *Sex Roles* 9: 507-518.

Kubey, R. and Larson, R. 1990. "The Use and Experience of the New Media among Children and Young Adolescents." *Communication Research* 17: 17-130.

Kinder, M. 1991. *Playing with Power*. Berkeley: University of California Press.

Linn, M. C. 1985. "Fostering Equitable Consequences from Computer Learning Environments." *Sex Roles* 13(3/4): 229-240.

Malone, T. W. and Lepper, M. R. 1987. "Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning." In R. E. Snow and M. J. Farr, eds., *Aptitude, Learning and Instruction*. Vol. 3: *Conative and Affective Process Analyses*. Hillsdale, N.J.: Lawrence Erlbaum Associates, 223-253.

Moller, L. C., Hymel, S., and Rubin, K. H. 1992. "Sex Typing in Play and Popularity in Middle Childhood." *Sex Roles* 26: 331-353.

Okagaki, L. and French, P. 1994. "Effects of Video Game Playing on Measures of Spatial Performance: Gender Effects in Late Adolescence." *Journal of Applied Developmental Psychology* 15(1): 33-58.

Papert, S. 1980. Mindstorms. New York: Basic Books.

Piaget, J. 1951. Play, Dreams, and Imitation in Childhood. New York: W. W. Norton.

Provenzo, E. F. 1991. Video Kids: Making Sense of Nintendo. Cambridge: Harvard University Press.

Ross, H. and Taylor, H. 1989. "Do Boys Prefer Daddy or his Physical Style of Play?" Sex Roles 20: 23-33.

Sadker, M., and Sadker, D. 1994. Failing at Fairness: How America's Schools Cheat Girls. New York: Scribner's.

Silvern, S. B. and Williamson, P. A. 1987. "The Effects of Videogame Play on Young Children's Aggression, Fantasy and Prosocial Behavior." Journal of Applied Developmental Psychology 8: 453-462.

Singer, D. G. and Singer, J. L. 1990. The House of Make-Believe: Play and the Developing Imagination. Cambridge: Harvard University Press.

Subrahmanyam, K. and Greenfield, P. M. 1994. "Effects of Video Game Practice on Spatial Skills in Girls and Boys." Journal of Applied Developmental Psychology 15(1): 13-32.

Sutton-Smith, B. 1986. Toys as Culture. New York: Garland Press.

Turkle, S. 1984. The Second Self: Computers and the Human Spirit. New York: Simon & Schuster.

Turkle, S. 1996. Life on the Screen. New York: Simon & Schuster. Part Two: Interviews.