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RESEARCH ARTICLE

Gender differences in game activity preferences of middle school children: implications for educational game design

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Abstract Educators and learning theorists suggest that play is one of the most important venues for learning, and games a useful educational tool. This study considers game activity preferences of middle school-aged children, so that educational games might be made more appealing to them. Based on children's activity modes identified in our prior research, we developed the *Educational Game Preferences Survey*, which collects information on children's preferences for play activity modes, their attitudes about each activity mode, and their preferences for game characters, settings, and forms of help. Survey results suggest the appeal of the *Explorative* mode of play for all children, especially girls. Gender differences in children's preferences and attitudes for *Active, Strategic, and Creative* play modes were also found. We close with recommendations for game design to appeal to both boys and girls, as well as for boys and girls individually, to build engagement and hopefully lead to learning.

Keywords Educational games · Game design · Gender differences · Activity modes · Game play preferences

Children love to play games and are highly motivated to engage with them. As so clearly described by Rieber a decade ago, "games are not just a diversion to children, but an integral part of their social and cultural lives" (Rieber 1996). But, if a game is labeled as "educational," many children automatically assume it is boring. While perhaps preferable to other classroom-based activities available to them, children frequently avoid educational games for out-of-school play. As a result, opportunities to gain useful knowledge and skills may be missed. This study was undertaken to examine the game activity preferences of middle school-aged children, so that educational games might be made more appealing to them.

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In our previous qualitative research (Joseph and Kinzie 2005), we identified six activity modes that reflect middle school children's game play preferences: *Active, Explorative, Problem-solving, Strategic, Social*, and *Creative*. These modes describe different types of activity that children can engage in during game play, and the aspects of the game that make these activities possible. We suggest these modes may be a more useful framework for considering game design than that provided by game genres (e.g., role-playing games, simulation games, shooters, etc.). Besides the fact that game genres are not clearly defined by the game design community (Dickey 2006), describing a game by its genre indicates only its similarities to previous forms of games, providing the "representation" of a game rather than identifying the "crucial defining features" of the game and the interactive experiences it provides (Apperley 2006). Evaluation and description of a game using activity modes can help educators and designers identify the elements of play that are most important to children, and how that these elements will appeal to different individuals.

Building on our previous research, we developed the *Educational Game Preferences Survey*, to explore the prevalence of activity mode preferences and attitudes among children, along with children's game play habits and preferences for character types, game aesthetics, and game settings. For this research, we administered this survey to a sample of middle school-aged children of mixed achievement levels and socio-economic status, paying special attention to any potential gender differences. In this paper, we present the results of this inquiry, and explore the implications for the design of educational games.

Background

Play, games, and learning

In his landmark work, *Homo Ludens*, Huizinga (1955) argued that some of the most important human activities can be considered as forms of play, but that play itself takes place within its own time and space apart from "ordinary life" in an utterly absorbing fashion. This conceptualization mirrors that offered by Csikszentmihalyi in his *flow* theory: Flow denotes an experience of total involvement, in which one employs his or her own skills to meet challenges that are presented, and results in a transcendence of ego boundaries and perceptions of time. While *flow* can be experienced in many contexts, "the most typical kind of flow experience is play, and games are the most common forms of play activity" (Csikszentmihalyi 1975).

Games can be thought of as a sub-set of play, with a key distinction being that play is considered to be looser and less organized, while games are almost always defined as having specific rules and goals (Salen and Zimmerman 2004). After considering Salen and Zimmerman's definition of play and their review of nine others, we offer our own version, reflecting our personal and theoretical perspectives:

> A game is an immersive, voluntary and enjoyable activity in which a challenging goal is pursued according to agreed-upon rules. The game provides a safe environment for taking chances and the opportunity to develop the knowledge and refine the skills required to succeed.

The active engagement with a challenging task, sense of control, confidence, and personal efficacy that can result from immersive game play can also support task persistence and learning from the experience (Bandura 1977; Kinzie 1990; Malone and Lepper 1987; Piaget 1952). Learning is thought to be more likely to occur if the game play is coupled

with instructional scaffolds and de-briefing (Garris et al. 2002; Peters and Vissert 2004); as Kriz succinctly observes, debriefing allows for a "consolidation of the experiences made and therefore a chance to acquire important knowledge that has theoretical as well as practical value" (Kriz 2004).

Games have been used to help encourage a range of cognitive and psychomotor skills as well as to influence affect (Dempsey et al. 1996); positive effects of game play have been noted in learning across age groups and content domains. Din and Calao (2001) found that 40 min a day spent on educational games across 11 weeks led to significant increases in kindergarten students' spelling and decoding performance, while in Schwarz's research (1988), game play offered special advantages for poor readers in the primary grades. Herselman (1999) found language proficiency to be increased for sixth-grade "resource deprived" ESL students who played educational computer games.

Within adult education, research reviewed by Gosen and Washbush (2004) suggests the efficacy of games and simulations across many different types of business-related learning (however, the authors observe that few of the studies conducted meet the highest standards for research design and measurement.) It's been argued that even games designed strictly for entertainment purposes can have important learning outcomes in this domain: Brown and Thomas (2006) suggest that the skills important for business leadership can be earned in the course of becoming a "guild master" in *World of Warcraft*.

In their review of 67 studies from 1984 to 1991, Randel and colleagues (1992) reviewed research on the use of educational games within social sciences, math, language arts, logic, physics, and biology. They found that games were at least as effective as conventional instruction in over half of the studies, with one-third of the studies suggesting significant advantage for educational games.

Within the domain of health applications, research findings summarized by Griffiths (2005) support the use of games to help children undergoing chemotherapy or psychotherapy, children who are dealing with emotional and behavioral problems such as attention-deficit disorder and autism, and individuals with a wide range of medical problems, including muscular dystrophy, burns, strokes, and movement impairments. To these we add research by Kato and colleagues (2006), who studied cancer patients' use of a "shooter" game in which players destroy cancer cells. These researchers found that not only was game play motivating but that patients adhered to cancer therapy at greater rates, and reported increased quality of life, cancer knowledge, and self-efficacy.

Games have been found useful for developing highly specific skills. Green and Bavelier (2003) found that non-playing university students could be trained in visual attention skills through use of action games, while significant effects have been found for computer game play on the mental rotation skills of third-grade students (de Lisi and Wolford 2002) and college students (Okagaki and Frensch 1996).

However, research suggests that children, particularly boys, tend to find educational games uninteresting. Chu (2004) reports that fifth- and eighth-grade boys found even "edutainment" games boring, while girls rarely used the term "educational" in the same negative way to describe a game. This finding may reflect boys' general tendency to find classroom activities less interesting and enjoyable than girls (Gentry et al. 2002), but it may also reflect the differing appeal of educational games' design (or both). Heeter and colleagues undertook a comparison of commercial and educational space games, and found that educational games are "less complex, shorter, and less challenging," in part because of the limited time available in a school setting. They also found that educational games also offered 30% fewer forms of fun for the player, using an adaptation of Garneau's 14 forms of fun (Heeter et al. 2003).

Gender differences in computer and game use

"Girls need to recognize themselves in the culture of computing," asserts the panel of technology commissioners convened by the American Association of University Women, and appealing digital play experiences can help girls approach new technologies in the same comfortable, playful way that boys do (AAUW Commission on Technology Gender and Teacher Education 2000). And, while computer game designs are rapidly evolving, there is a way to go before they achieve this potential.

While increasing numbers of girls report weekly game play [and among adults, women report playing on-line games as frequently as men (Fallows 2005)], computer technologies such as games still tend to be perceived as "masculine activity" that more boys than girls prefer (Colley 2003) and spend time on (Gilmour 2000; Kaiser Family Foundation 2002). This discrepancy may be, in part, a function of stereotypical presentation within games (e.g., passively waiting for male rescue or serving as the subject of male gaze) and general lack of female characters (Bryce and Rutter 2003). For instance, an analysis of 47 randomly selected console games indicated that only about one in four game characters were female, and that these characters were clothed in a way that exposed significantly more skin than male characters (Beasley and Standley 2002). Even elementary students perceive that software is "gendered by design" and express related preferences (Pinkard 2005). The resulting effects are more substantial than just girls' attitudes toward games, as there are implications for gender differences in confidence and comfort with computers, limitations in technological literacy, attrition in fields such as engineering and computer science, and future employment (Cassell and Jenkins 1998; Colley 2003; Culp and Honey 2002; Fallows 2005).

Designing games to encourage multiple perspectives and varying themes can avoid reinforcing gender stereotypes (Brunner et al. 1998) and can yield more appealing games for girls *and* boys. In their evaluation of the *Phoenix Quest* game (a game designed to appeal to girls and encourage interest in language and mathematics), De Jean et al. (1999) found that boys as well as girls enjoyed the game's cooperative play and group problem-solving. Based on their research on girls' game and software design preferences, the AAUW (2000) concludes that the attributes that would make these products more appealing to girls would enrich the experience of both boys and girls. Interestingly, many of the AAUW-recommended game activities parallel those described by the activity modes we have found to be motivational in children's game play. These activity modes are described next.

Game activity modes

In the paragraphs that follow, we briefly describe the six game play activity modes that emerged from our earlier research on middle school children's game play preferences (Joseph and Kinzie 2005). In this study, we recruited ten middle school-aged students for each of two, 2-week summer camps on computer game design. To help ensure broader applicability of our findings, one camp drew from a low-income, inner-city population, and the other from a predominantly middle-class suburban population. The 20 participants played, critiqued, and proposed their own modifications to improve commercial and educational games for science learning.

During analysis of the participants' game play preferences, certain patterns emerged. When children played complex games, there were differences in the types of activity upon

which each would focus. When one child's play behavior was followed across a number of complex games, that child was observed across the games choosing the same types of activities in which to engage. Preferences for these activity types were pronounced, and we found that standard game classification systems focused on the game attributes such as setting or genre, while not addressing the type of play in which the user was engaged. As a result, we sought a better way to discuss the varied play experiences that our participants engaged in across a variety of games.

Through case analysis techniques, we analyzed the play preferences of four participants purposively selected based upon the strategies of *intensity sampling* and *stratified purposeful sampling* in order to select information-rich cases that represented intense, yet not extreme manifestations of the phenomena and characteristics of interest. In this process we drew upon data generated from observation of participant game play, group discussions, interviews, and other qualitative data sources. This procedure enabled identification of distinct activity types that were then used as a frame though which to consider the play preferences of the other 16 participants in our camps. The resulting analysis allowed us to refine the definitions of each activity type and to confirm that other types of game play activity had not been left out. Preferences for these activity types were further considered through the administration of a follow-up survey to 17 of these 20 children. Results from this survey confirmed the results of our earlier analysis and allowed a few modest refinements in activity mode definitions. The resulting activity modes describe a range of different activities in which middle school-aged children like to engage as they play computer games. Any game can involve multiple activity modes, and in fact we argue that the more different types of activity a game can provide, the more it will appeal to a broad game-playing audience.

Active play

The game play mode most often thought of in connection with computer and video games is the *Active* mode. In this "intensively performative" (Apperley 2006) mode, the player must respond quickly, using rapid-fire techniques, "twitch" speed, and combinations of keys or buttons to achieve the goals of the game. The game clock and/or threat of character "death" often provide structure and consequences. In games that shape play around action, the story lines frequently emphasize dichotomous conflict where the player embodies good against an evil opponent. Many of the most popular commercial games, including "shooters", arcade-style games, and puzzles incorporate active modes into their game play.

Explorative play

Another activity mode widely experienced in games is *Explorative* play, where physical space and travel are simulated through the layout of the game arena. By hiding certain areas from view, the player is allowed to discover new areas and challenges in turn. *Explorative* play can be easily modified by the addition of other activity modes. Many three-dimensional shooters combine active and explorative play, where players find their way through virtual buildings or cities while dodging bullets and shooting enemies. Slower-paced educational games often pair exploration of an area with problem-solving activities.

Problem-solving play

The *Problem-solving* mode is commonly encouraged via puzzles and other types of challenges, both in educational games and in commercial titles such as *Myst, Contraptions, and Bejeweled*. Here, there are specific rules for the activity sequence and the solution to the challenges. Even if there are a number of problems within a given game, they are generally well defined, and undertaken independently. They may be hierarchical, requiring one problem to be solved before moving on to another, or parallel and unrelated. *Problem-solving* play may be fast-paced and reliant upon hand-eye coordination, or it can take a slower form where logic influences play.

Strategic play

In *Strategic* play, the emphasis is on manipulating resources over the longer term, for instance military, financial, or "human" resources. Games that encourage a strategic mode of play enable players to select their own goals *or* to meet goals presented by the game itself. In either case, there is often significant freedom provided in how the player can attempt to achieve the goals, and players strive to meet them as part of a continuous process of observation, analysis, and resource gathering and allocation during game play (compared to the smaller, discrete goals presented in problem-solving play). Games that can include *Strategic* activities include *The Sims*, titles in the *Tycoon* series, *Civilization*, and the *Age of Empires*. Few educational titles have incorporated this play mode into their games.

Social play

Social play can be thought of as taking place both within a game's design and external to it. It involves interactions between players and game characters and among players themselves as they interact or collaborate. This mode often provides the opportunity to manipulate the behavior of game characters, providing a god-like level of power. Interacting in a multi-player mode provides interaction between players in whatever manner the game allows, be it fighting, cooperating, or romancing. Another form of player interaction takes place when two individuals use the same computer or console to control characters or action, when they must cooperate to some degree. This activity provides players with support, camaraderie, and/or help. Research indicates that females are more interested than males in technology-assisted social interaction (Igarashi et al. 2005; Jackson et al. 2001), and research on game preferences suggests that these gender preferences extend to various aspects of *Social* play, including a greater focus among girls and women on game characters, storylines, and interaction with other players (Inkpen et al. 1994; Yee 2001).

Creative play

The final activity mode we have identified through our qualitative research is *Creative* play, which offers the opportunity to create elements during play. Some games provide opportunities to develop characters' skills or appearance or to build or modify aspects of the environment. *SimCity* and the *Tycoon* games allow players to determine the

components, layout, and palette of cities, golf courses, amusement parks, zoos, restaurants, etc. Other games featuring creative play allow selection of character powers and appearance, or include free form drawing and use of stamps to design printable or email-able documents used during or outside of game play.

In the current inquiry, we used this framework as the basis from which to explore children's game play preferences. We were interested in determining the characteristics of games that children find most appealing, so that instructional and game designers would be able to build upon these in the design of educational games. We selected science learning as the venue of interest, and inquired about the most appealing characters, settings, and focal areas for science-related game play. We also examined the data for possible differences in play preferences between girls and boys and between children of different ethnicities, so that designers would be able to produce games appealing to all children.

Method

Survey development

Based on the game activity modes detailed above, we developed the *Educational Game Preferences Survey* for middle school-aged children. We used the activity modes as our key constructs and starting point for item generation. We tested and revised the survey with 17 children as part of a previous study (Joseph and Kinzie 2005). Our goal was to devise a survey capable of determining the play preferences of larger numbers of students.

The survey elicits information across four categories. In order of presentation within the survey, they are: (1) Demographics and Game Play Experiences; (2) Character, Setting, and Help Preferences; (3) Primary Preference for Activity Mode; and (4) Activity Mode Attitudes. Each is described below.

Demographics and game play behavior

Demographic items on the survey collect data for age, gender, grade in school, and ethnicity. The survey also elicits information on frequency of computer game play (five-point scale, from never to daily), length of play sessions (four-point scale, from 0 min to 30 min to more than 2 h), game hardware used (game console [XBox, PS2, GameCube, etc.] or computer), existence of Internet access at home (yes/no), and whether games are played most often alone or with others.

Character, setting, and help preferences

Five survey items ask children to indicate their preferences for their game character: Gender (boy/girl/genderless alien), Age (four point scale: under 13 years of age, 13–20 years, 20–30 years, and over 30 years old), Character build for both male and female characters (illustration and text label for slight, fit, muscular, or heavy builds; see Fig. 1), and ethnicity (Black, Asian, White, Hispanic, Native American, or Inter-racial).

Preferred opponents in a game setting are also identified (powerful government, evil warlord, neighborhood bully, or a rival group of kids). Two items asked about proposed beneficiaries of respondents' game play activities. One of these items asks children to

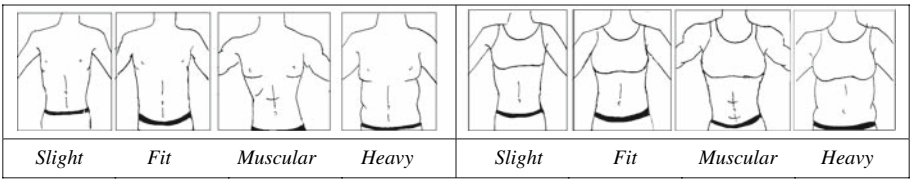

Fig. 1 Response options for preferred build for male and female characters

indicate the age group of the person to be saved, while the other asks children to choose between saving individual animals, individual people, all people in a city, or all living things on a planet.

Preferred game settings are identified in one item (large meadow with pond, street scene, shopping mall, or sports playing field). To determine help preferences, children were asked how they like to solve the problem of being "stuck" during game play (discovering the answer through random trial and error, methodically trying different ways until I solve the problem, receiving hints from a guide, or being given the answer).

Primary preferences for activity mode

We were desirous of eliciting children's primary preferences for activity mode (*Active, Explorative, Problem-solving, Strategic, Social, and Creative*) across different types of game topics/settings. In developing the survey items, we found that crafting a response option for each of the six modes for every game topic was not always feasible (some modes of play were less well-suited to a particular topic). In addition, we were concerned about the potential difficulty that might be associated with reading and selecting from six response options in each question, and the potential error that might be contributed as a result. To address these issues, we developed a set of nine activity mode preference items that offer four response options each. We varied the activity modes offered in the item responses, and across the nine items, there are six opportunities to select each of the activity modes as the most preferred. As a result, preference scores for each mode range from 0 (not selected as preferred for any game topic) to 6 (highly preferred, selected across all game topics). See Table 1 for several examples.

Table 1 Activity mode preferences—sample items

Item stem	Response options	Activity mode
Most of the time in a game, I like to:	(a) Explore a setting	*Explorative*
	(b) Solve a problem	*Problem-solving*
	(c) Conquer the world	*Strategic*
	(d) Manipulate behavior	*Social*
In a game, I would most want to:	(a) Fight an enemy	*Active*
	(b) Design objects like cars or clothes	*Creative*
	(c) Control individuals	*Social*
	(d) Work out puzzles	*Problem-solving*

Activity mode attitudes

Children may enjoy multiple activity modes, and items requiring a choice between modes (as in the previous preference items) will only indicate *primary* preferences. To capture children's attitudes about each of the activity modes in turn, we developed item stems from 24 of the 36 *Activity Mode Preference* response options, to craft stand-alone *Attitude* items eliciting agreement with statements about those preferences (responses ranged from 1 [strongly disagree] to 4 [strongly agree]). Children's attitudes toward each of the six activity modes were measured with four items each; each item describes a different game application of that activity mode. Table 2 contains sample attitude items and the activity mode to which each corresponds.

Participants and procedures

Data for this study were collected at a middle school drawing from a suburban and rural population, outside of a small mid-Atlantic city. At this school, 16% of the students receive free or reduced-price lunch, 18% participate in Special Education programs, and 26% have been identified as gifted. Parental and child consent forms, together with the *Educational Game Preferences Survey*, were distributed to a convenience sample of students in two middle school (grade 6–8) homerooms, each containing 22 students of mixed achievement levels and abilities.

Of the 44 students receiving consent forms and surveys, 42 (18 girls and 24 boys) returned signed consents and completed surveys, for a 95% response rate. The average age of our respondents was 12 years old; 60% were in the sixth grade, 14% in the seventh grade, and 21% were in the eighth grade. Nearly two thirds of the children were white (64%). The other one-third (36%) of respondents were from Asian/Pacific Islander (12%), African American (10%), Hispanic (2%), and "Other" (12%) ethic groups.

Data analysis

Descriptive statistics are presented to summarize respondent demographics and overall game play experiences, preferences, and attitudes. When the response options for these items were categorical in nature, non-parametric tests were undertaken to examine possible gender differences in character, setting, and help preferences: χ^2 analyses, which enable comparisons between categories of response, were used to examine gender differences, with two exceptions. Cramer's V was used to determine if gender was associated with

Table 2 Activity mode attitudes—sample items using same item stem

Item	Activity mode
If I had a telescope in a game I would like to search for unexplored territory.	*Explorative*
If I had a telescope in a game I would like to scan for an approaching enemy.	*Active*
If I had a telescope in a game I would like to watch the neighbors.	*Social*
If I had a telescope in a game I would like to decide on the best place for a settlement.	*Strategic*

Responses were made on a 1 (Strongly Disagree) to 4 (Strongly Agree) scale

Items sharing the same item stem were dispersed throughout the measure

choice of opponent, as in this case the expected cell counts were less than five and more than two response options were provided. The Mann-Whitney U was computed for preferences on physical build of characters (from slight to heavy) and for age of character to be saved (from young to senior citizen) as the response options differed ordinally.

Analysis of variance tests were conducted to identify any gender differences in the continuous variables of *Primary Preference for Activity Mode* and *Activity Mode Attitudes*. Because sub-scores for each of the six activity modes were likely to be correlated with one another on these measures, statistical tests for gender differences were undertaken first at the multivariate level, followed by univariate tests where indicated by significant multivariate results. Cohen's d was used to calculate effect size (boys > girls) where significance was obtained at the univariate level. Alpha reliability estimates are also reported for the attitudes sub-scales.

Results

We first present data which describe respondents' game play behavior, and their character, setting, and help preferences. Next we explore the children's primary preferences for activity modes during game play, and their attitudes toward the six activity modes. Analyses were undertaken to identify any significant gender differences, and are reported where they exist. There were no significant differences between students of differing ethnicities.

Game play behavior

The children reported a range of computer game play frequency. Nearly two-thirds reported regular play: several times a month (14%, $n = 6$ of 42), several times a week (31%, $n = 13$) and even daily (17%, $n = 7$). There were also children who reported playing only several times a year (21%, $n = 9$) or never having played (15%, $n = 7$). Despite the fact that some children reported infrequent or no game play experience, we decided to retain their data for the bulk of the analyses described here—certainly these children have played other games and their preferences are important—however we removed data supplied by these children from the two questions about duration of computer game play sessions and whether play was on a console or computer.

Of those with play experience, 43% ($n = 15$ of 35) reported playing less than 30 min each time, while 26% ($n = 9$) played between 30 and 60 min, and 26% ($n = 9$) played between 1 and 2 h. A smaller 6% ($n = 2$) reported playing for more than 2 h each time. Though most of the children overall reported having a computer and Internet access at home (88%, $n = 37$ of 42), they most often played on a game console (57%, $n = 20$ of 35) rather than on a computer (43%, $n = 15$). Boys (83%, $n = 20$) were much more likely than girls (28%, $n = 5$) to play games on a console ($\chi^2 = 13.176$, $p = .0001$).

Character preferences

When asked about their game character, all but three children indicated they wanted their characters to be of their same gender (two boys and one girl selected a preference for

playing a "genderless alien"). There was strong agreement on character age, with most (64%, $n = 27$ of 42) preferring slightly older teenaged characters (between 13 and 20 years of age), or 20–30-year-old characters (30%, $n = 12$). *No* children desired a character over 30 years old and only a few (8%, $n = 3$) found characters under 13 years old appealing.

Where the physical build of *male* game characters was concerned, most children selected a *muscular* build (61%, $n = 25$ of 41), with a third selecting a *fit* build (34%, $n = 14$). Only two (5%) indicated preferences for a *slight* build for male characters, and none preferred a *heavy* male build. For *female* characters, a different standard was endorsed, with most children preferring a *fit* build (61%, $n = 25$ of 41), and one-fourth (24%, $n = 10$) preferring a *slight* build. Only 14% ($n = 6$) of respondents desired a muscular female character, and once again, none desired a heavy female build. While there was a greater tendency for boys than girls to want male characters to be muscular, this difference was not significant. What was significant was the preference for the build of female characters, with more girls than boys desiring females of slighter build, (Mann-Whitney $U = 136$, $p = .032$).

A total of 21 of the 26 Caucasian students (81%) indicated they would prefer a white character. While students of other ethnicities were too limited in number to determine the significance of their response, they tended to show more variability in the preferences for their game character's ethnicity. No students reported preferring a Native American game character, however (and there were no Native American students among the respondents).

Calculation of Cramer's V suggests that the respondent gender is significantly associated with choice of opponent ($V = .444$, $p = .041$): When selecting a desirable character for an opponent in game play, half of the children overall ($n = 21$ of 42) and two-thirds of the boys ($n = 16$ of 24) selected *evil warlord*, but a *rival group of kids* was popular overall (29%, $n = 12$ of 42) and especially with the girls (50%, $n = 9$ of 18). Neither a *powerful government* nor *neighborhood bully* appeared to be very appealing opponents to these children.

If given the opportunity in a game to save a group of people, a few of our respondents would target adults (14%, $n = 6$ of 42) and senior citizens (10%, $n = 4$), but many of our respondents overall (43%, $n = 18$) wanted to focus on people their own age, including nearly half of the boys (46%, $n = 11$ of 24). Young children were also appealing beneficiaries overall (33%, $n = 14$ of 42) and especially among the girls (56%, $n = 10$ of 18). The gender difference on this preference was significant (Mann-Whitney $U = 104.000$, $p = .002$), with boys' expressing a greater preferences than girls for all beneficiaries except young children.

In choosing between saving individual animals, individual people, all the people in a city, or all living things on the planet, half of our respondents (51%, $n = 21$ of 41) and most of the boys (63%, $n = 15$ of 24) set their sights on saving all living things during their game play. Girls' attentions were more evenly distributed across the beneficiary choices, but this gender difference was not significant.

Setting and help preferences

Many of the children indicated that they would prefer a game set in a *street scene* (48%, $n = 20$ of 42), as opposed to a *large meadow with pond* (14%, $n = 6$), *shopping mall* (17%, $n = 7$), or *sports playing field* (21%, $n = 9$). No significant gender differences were found in this response.

Nearly two-thirds of our respondent group prefers self-help when stuck in a game; with half ($n = 21$ of 42) preferring to *methodically try different ways to solve the problem*, but some also liking *discovering the answer through trial and error* (14%, $n = 6$). The remaining one-third of students desire help, with some preferring *hints from a guide* (21%, $n = 9$), and others *being given the answer* (14%, $n = 6$). There were no significant gender differences in help preferences.

Primary preferences for activity mode

Overall preferences

As previously described (see Method), children were asked to indicate their primary preferences for activity mode, with up to six opportunities to select the most favored activity mode across nine survey items. Mean preferences for primary game activity modes are depicted in Table 3.

If activity preferences were evenly distributed across all six modes, each respondent would have selected each activity mode 1.5 times. *T*-test analyses were undertaken to determine if overall preferences departed significantly from this expected value. As a group, students expressed greater preference than might be expected for game activities in the *Explorative* mode ($t[42] = 3.276$, $p = .002$), and lesser desire for game play involving the *Strategic* ($t[42] = -2.785$, $p = .008$) and *Social* ($t[42] = -2.912$, $p = .034$) modes. Preferences for *Problem-solving*, *Active*, and *Creative* play did not significantly differ from those expected.

Table 3 Means for activity mode preferences, by gender

Activity mode preference		Mean	*SD*
Active***	Boys	2.75	1.36
	Girls	.61	.98
	Total	1.83	1.61
Explorative*	Boys	1.79	1.29
	Girls	2.72	1.32
	Total	2.19	1.37
Problem solving	Boys	1.12	1.26
	Girls	1.78	1.59
	Total	1.40	1.43
Strategic**	Boys	1.42	1.06
	Girls	.61	.70
	Total	1.07	1.00
Social	Boys	1.08	.93
	Girls	1.28	1.07
	Total	1.17	.99
Creative**	Boys	.67	.87
	Girls	1.83	1.58
	Total	1.17	1.34

* $p = .05$, ** $p = .01$, *** $p = .001$

Mean range = 0–6

Boys $n = 24$; Girls $n = 18$

Gender differences in primary activity mode preferences

The possible presence of a significant gender effect was evaluated with a multivariate analysis of variance, which indicated significance (Wilks' Lambda = .003, $F[6, 35] = 1948.854$, $p < .0001$). Univariate analyses were performed on preferences, and significant gender effects were found for four of the six activity modes. (Note that because the univariate contrasts are interdependent, it is probable that an increased preference for boys or girls on one activity mode resulted in a decreased preference for other modes.)

The largest between-gender difference appeared in preferences for *Active* play, with boys selecting this form of play substantially more often than girls (F [1, 40] = 32.023, $p = .0001$); Cohen's d is +1.81, indicating a very large effect size. Boys also indicated a greater preference for *Strategic* play than did girls (F [1, 40] = 7.827, $p = .008$), a difference with a large effect size ($d = +.89$).

When considering *Creative* play, however, girls reported greater preferences than did boys ($F[1, 40] = 9.359$, $p = .004$); the effect size again was large ($d = -.98$). *Explorative* play was also favored by girls over boys (F [1, 40] = 5.273, $p = .027$); this difference was of a large effect size ($d = -.73$). There were no between-gender differences in preferences for *Problem-solving* or *Social* play modes.

Activity mode attitudes

Scale attributes

Alpha reliability statistics on children's responses to the 24 attitude items suggest that, overall, the attitude items function as an internally consistent measure of children's attitudes about game play activities ($\alpha = .74$). When considering the four-item sets for each of the six activity modes, however, lower reliability estimates were obtained, perhaps in part a function of the small number of items in each set and the modest number of respondents. The highest alpha reliability estimates were obtained for items reflecting attitudes about *Problem-solving* and *Creative* play ($\alpha = .71$ for each). *Active* and *Social* play item sets yield internal consistency estimates of .63 and .62, respectively. However, survey items for *Strategic* ($\alpha = .29$) and *Explorative* ($\alpha = .24$) modes were found to be less internally consistent.

Overall attitudes and gender differences

Overall, the children responded to the attitudinal statements in a neutral fashion, with totals for each activity mode falling in the middle of the possible response range, as shown in Table 4. A multivariate analysis of variance indicated significant gender differences (Wilks' Lambda = .516, $F[6, 31] = 4.840$, $p < .001$). To determine which activity modes might account for the gender differences in attitudes, univariate analyses were then performed.

Significant gender differences were found on attitudes related to the *Active* (F [1, 39] = 7.783, $p = .008$, $d = +.91$), *Strategic* (F [1, 38] = 5.636, $p = .023$, $d = +.77$) and *Creative* (F [1, 38] = 11.101, $p = .002$, $d = -1.10$) activity modes. Boys felt substantially more positive about games involving the *Active* mode and the *Strategic* mode. Girls, on the other hand, responded much more positively to the *Creative* mode.

Table 4 Means for activity mode attitudes

Activity mode attitude		Mean	*SD*
Active**	Boys	11.88	2.51
	Girls	9.59	2.69
	Total	10.93	2.79
Explorative	Boys	11.25	2.07
	Girls	11.82	2.21
	Total	11.49	2.12
Problem-solving	Boys	9.30	2.70
	Girls	11.06	3.49
	Total	10.03	3.13
Strategic*	Boys	10.30	2.34
	Girls	8.71	1.72
	Total	9.62	2.23
Social	Boys	9.02	2.82
	Girls	9.82	3.47
	Total	9.35	3.09
Creative**	Boys	8.12	2.54
	Girls	11.06	3.00
	Total	9.30	3.07
Total-all modes	Boys	59.16	8.85
	Girls	63.31	9.78
	Total	60.91	9.35

* $p = .05$, ** $p = .01$

Category range = 4–16; Total range = 24–96

Boys $n = 23$–24; Girls $n = 16$–17

While girls also seemed to express more positive attitudes about the *Problem-solving* activity mode, this difference was not significant. Girls responded slightly more positively than boys to *Explorative* play—the *Explorative* mode was the activity mode that girls liked the best but about which both boys and girls were positive. Similarly, girls expressed somewhat more positive attitudes about *Social* play than boys, but neither difference was significant.

Discussion

The 42 children participating in this research were in their early adolescence, from grades six to eight and of mixed achievement levels and abilities. Nearly two-thirds reported regular play of computer games and moderation in the length of play sessions seemed to be the norm. Most reported having a computer and Internet access at home, but over half of our respondents and most of the boys were more likely to play games on a console than a computer. We begin this discussion by summarizing these children's game-related preferences and attitudes, and provide related recommendations for the design of educational games. We go on to consider limitations of this study, and offer recommendations for future research.

Summary of research findings and recommendations for game design

Activity mode preferences and attitudes

Table 5 offers a summary of the preferences and attitudes expressed by our participants. When making a choice between activity modes, children expressed a significantly greater preference for the *Explorative* mode, with this mode especially popular for girls. Although lesser preferences were found for *Strategic* play than might be expected overall, boys did select this mode of play more often than girls, and felt more positively about it. While children's preferences for *Active* and *Creative* modes did not differ from what was expected, boys preferred and felt more positive about *Active* play than girls (mirroring findings reported by Chu [2004] and Gorriz and Medina [2000]), and girls preferred and felt more positive about *Creative* play than boys.

These study findings suggest the following recommendations to educators and game designers interested in appealing to a middle school-aged (early adolescent) population.

- To appeal to both girls and boys, and encourage their interest in the underlying educational content and skills:

– Emphasize *Explorative* play. *Explorative* activities are more highly preferred by children overall, and by more girls than boys. Activities of this type involve simulation of travel through space and time, with gradual discovery of new areas and challenges keeping play exciting for children. *Explorative* play is an example of the type of game element that will draw girls in but also serve to enrich play for both boys and girls, as suggested by the AAUW (2000).
– Consider opportunities for *Problem-solving* play. While preferences for this mode were not significantly high or low, there were also no significant gender differences in preference or attitude, suggesting that this mode may appeal equally to children of both genders, as found in previous research (De Jean et al. 1999). *Problem-solving* play offers a series of discrete puzzles or challenges that are undertaken hierarchically, with

Table 5 Summary of findings: activity model preferences & attitudes

	Overall preferences	Gender differences in preferences	Gender differences in attitudes
Active		Boys > Girls $p = .0001$, $d = +1.81$	Boys > Girls $p = .008$, $d = +.91$
Explorative	Greater preference[a] $p = .002$	Girls > Boys $p = .027$, $d = -.73$	
Problem-solving			
Strategic	Lesser preference[a] $p = .008$	Boys > Girls $p = .008$, $d = +.89$	Boys > Girls $p = .023$, $d = +.77$
Social	Lesser preference[a] $p = .034$		
Creative		Girls > Boys $p = .004$, $d = -.98$	Girls > Boys $p = .002$, $d = -1.10$

[a] Relative to that expected by chance (equal preference for all modes)

the solving of one problem making it possible to address another, or in parallel, as unrelated problems are solved. With problem-solving play, it would also be relatively easy to incorporate scaffolds and de-briefing for the player (much as suggested by Garris et al [2002] and Peters and Vissert [2004]), but within the game itself, making it explicit what he or she is learning and calling forth prior knowledge and skill to solve new challenges.

- To especially appeal to girls, for instance in the design of games to encourage interest in Mathematics and Science:

– Offer activities that encourage *Creative* play, for which girls expressed a greater preference and more positive attitudes. Offer opportunities to create or modify character appearance, to build elements of the game, or to create artwork for use within or outside the game. Our findings in this regard parallel those of the AAUW: girls want to design and create in games (AAUW Commission on Technology Gender and Teacher Education 2000).

- To build boys' interest and satisfaction:

– Incorporate opportunities for *Active* play, for which boys expressed greater preferences and more positive attitudes. This mode requires quick response and rapid-fire technique, with limits and consequences set by game clocks or character death.
– Integrate *Strategic* play activities, for which boys expressed both greater preferences and more positive attitudes. In *Strategic* play, individuals actively manipulate resources (military, financial, and human) to achieve longer-term goals. Similar opportunities are obvious here for the kinds of in-game scaffolding and de-briefing described for *Problem-solving* play above.

In addition, educators and game developers may be well advised to offer boys and girls opportunities to develop skills in less-favored areas. Girls may come to appreciate *Active* and *Strategic* play if offered appealing opportunities to develop related skills and comfort. Similarly, boys' may find greater satisfactions in *Creative* activities if provided with well-designed, targeted experiences.

Character, setting, and help preferences

Game and instructional designs may also benefit from consideration of the preferences children expressed for game characters, settings, and help. These are described below.

Children seem to want the characters they play to be like them in some ways, but perhaps a bit older. A preference for game characters "like me" has been expressed by children participating in other research inquiries (Chu 2004; Denner et al. 2005). Cultural preferences for body build may influence children's preferences for the characters they play: Children tend to want their male characters to be muscular and their female characters to be fit or slight in build. More girls than boys reported a preference for females of slighter build, perhaps reflecting the cultural emphasis girls perceive on being more

slender. No children were interested in a character that was fat and only a few in a male character that was slight. Acceptable body shape can be thought of as a learned concept, just as are attitudes about acceptable behavior and clothing (Beasley and Standley 2002), so it is possible that thoughtfully designed game materials may expose players to characters with a range of body types, and provide the social learning necessary to develop greater acceptance.

In their game opponents, children overall (and especially boys) like to see *evil warlords* (a common element of games designed for and played by boys), with a *rival group of kids* a popular opponent, especially with girls. Boys tended to want to save people their own age more than girls, while girls want to save young children more often. Half of the children wanted to save all living things on the planet (51%). In terms of game setting, nearly half of the children preferred a *street scene* to the other game venues offered.

Nearly two-thirds of our respondent group preferred self-help when stuck in a game, either methodically attempting to solve the problem or discovering the answer through trial and error, the latter of which has been observed to be a dominant game play strategy among adults (Dempsey 2002). We did not see gender differences in help preferences, though previous research suggests that girls may rely heavily on help, perhaps as a function of lesser game play experience, while boys tend to ignore instructions altogether (Chu 2004). Of the one-third of students desiring help, most selected *hints from a guide* rather than *being given the answer*.

Research limitations and recommendations for future research

There are a number of possible limitations in this research, related to the study sample, reliance on self-report rather than actual behavior, the influence of past experience, and measurement issues. Each will be discussed and related opportunities for future research described.

Study sample

We examined the preferences and attitudes of 42 individuals from one middle school; different findings may be obtained with a larger or more diverse sample. For instance, study of a larger sample may indicate that girls like Problem-solving play more than boys, even if neither prefers this as a primary mode of play. The data we obtained suggests that this difference may exist, and previous research has validated this preference (Chu 2004; Gorriz and Medina 2000). In addition to answering this question, administration to a larger sample, one drawn from multiple schools and locations, and specifically sampling a more disadvantaged population, would all enable better generalization of our overall findings to a larger population of children.

Reliance on self-report

The results are a function of respondents' self-report of preferences, as opposed to their actual game play choices. While preferences and attitudes are thought to predict future behavior (Ajzen and Fishbein 1980; Bandura 1977), it may also be most useful to examine what individuals actually choose to do and not just what they say they prefer. Carr (2005)

conducted research in a girls' computer club and found that initial game preferences may not always be consistent indicators of future game choices. While the kinds of experiences offered by a game affected the games choices girls made, other factors were also influential: context and setting of play, available hardware and software, and mood of the player (Carr 2005). Our previous research led to definition of these activity modes based on children's play behaviors, but it would be beneficial to examine the relationship of initial preferences and attitudes to subsequent play behaviors. This could be done by following administration of the *Educational Game Preferences Survey* with observation of free-play choices and behaviors. In this way we could determine the extent to which survey methods can predict children's *continuing motivation* (Kinzie 1990; Maehr 1976) to engage with different types of game play activity.

Influence of past experience

It has been shown that an individual's affect is influenced by his/her past experiences and cultural influences. For instance, the research of McRobbie (1991) and of Willis (1991, both summarized by Cassell and Jenkins [1998]) suggests that magazines reinforce gender-related interests beginning at an early age and that toys are deeply divided by gender traits. As a result of these and other influences, it may be difficult for children to imagine non-stereotypical preferences (Culp and Honey 2002). In this case, girls may not like *Active* or *Strategic* game play activity in part because they have not experienced play of this type that they have enjoyed. In our survey design, however, we did attempt to design items for each activity mode that describe a range of activities that would be possible within that mode, and we employed gender neutral language throughout.

Despite the fact that seven of the 42 children reported no game play experience, we decided to retain their data except when calculating the length of computer game play sessions and whether play was on a console or computer. It could be argued that these children had no computer game experience on which to draw, but we were not asking them about prior play experience (with the two exceptions noted). Instead, we were asking them to imagine participation in the activities described and indicate their preference or degree of liking.

Measurement issues

The internal consistency estimates for the four-item *Activity Mode Attitude* subscales were lower than might be desired, particularly for *Explorative* and *Strategic* play modes. Subscales with lower reliability are not necessarily "invalid," but lower reliability estimates may indicate that more than one dimension of play is reflected in these sub-scales or that certain survey items are ambiguously worded or unrelated to the intended activity modes, deflating the alpha estimates (Yu 2001). We therefore will devote future attention to item and subscale revision.

Our conceptualization of *Social* play was based on our previous qualitative research, and included social activity both *within* a game's design (interacting with and manipulating game characters) and *external* to the game's design (cooperating, fighting, socializing with other players). The preference and attitude items on our survey, however, reflected only those aspects of *Social* play that were internal to the design of a game. This factor may help to explain, in part, the lesser preference found for *Social* play across our respondents. In

future versions of the survey we will specifically solicit children's preferences and attitudes for different aspects of *Social* play, including the interactions among players. This is important to do, as past research suggests that girls prefer *Social* play (AAUW Commission on Technology Gender and Teacher Education 2000; Chu 2004; Gorriz and Medina 2000). In addition, opportunities for social interaction during game play are on the increase, with the rapidly expanding popularity of multi-player and hybrid reality games that unlink game play from a console or computer and reconnect with everyday life (de Souza e Silva and Delacruz 2006).

With an active program of research on game design such as that described above and in the recent *Summit on Educational Games* (Federation of American Scientists 2006), we will be able to answer these and other questions. The goal is one worth pursuing: The design of educational games that children will choose to play during their free time.

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