Exploring Video Game's Relationship to CS Interest

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ABSTRACT
The possible causal relationship between playing digital games and interest in computer science has been explored by researchers and outreach programs working on broadening participation in CS. This paper reviews empirical data from over 1,000 students at a technical university regarding their interest in CS and their frequency of game play. The data suggest that gaming is a significant, but small factor in students' interest in CS.

Categories and Subject Descriptors
K.3.2 Computer and Information Science Education

General Terms
Human Factors

Keywords
Games, Informal Education

1. INTRODUCTION
"I suppose my lack of playing video games reduced the probability of me being interested in anything to do with computer programming."

Computer Science (CS) departments are currently faced with dropping enrollment numbers. Within the population of students at technical universities, over time fewer and fewer have been choosing to major in computer science [3]. The lack of diversity among CS professionals is also of concern to the CS field [1, 2].

One of the first factors that many computer scientists recall in influencing their choice to study computing is early and frequent exposure to video games [4, 5]. The possible causal relationship between playing computer games and an interest in CS has been of interest to researchers looking at gender inequities in CS [6-11]. Research shows that males are more likely to frequently play video games than females. This has lead a number of outreach and research projects to focus on developing an interest in gaming and making games. However, when factors besides gender are examined, such as race, a positive influence from playing games on interest in CS does not appear. The demographic groups identified as playing most frequently, African American and Hispanic males [12-14], have poor representation in CS and other technology related fields [15, 16].

Does playing games have a relationship to an interest to CS? This paper looks at that relationship across a large, technically competent population. In the fall of 2007, undergraduate students at a technical university were invited to complete a survey during a required course. Over 1,000 students chose to participate in this research. At this institution students are admitted without an indication of the program of study they are interested in, and all are considered competent to complete a course of study in any major, including CS.

The data suggests that students who have played games more frequently have a greater likelihood of choosing CS as a major. However, the great variations in how frequently students played across all majors indicated that other variables had significant roles in students' choice of major. Additional qualitative data gathered provides understanding on instances where games influenced a positive interest in CS.

2. RESEARCH METHOD
In the fall of 2007, 1,872 undergraduate students at a highly selective, public, technical university took a required introductory CS course. At the end of the term students were offered options to earn extra credit, including completing an online survey.

The survey primarily consisted of questions to help researchers and faculty better understand student perspectives on the vision and image of computing. In addition, questions regarding the students' use of digital media, particularly video games and their influence on student interest in computing, were included.

The survey was specifically designed to explore the extent to which responses compare for four student sub-groups in the study: 1) students in the CS major; 2) students considering a CS major; 3) students feeling neutral about CS, and 4) students who indicate no interest in CS. These sub-groups are examined to provide insight into the influence of video games on students' interest in computer science.

2.1 The Survey Instrument
The online survey was administered by SurveyMonkey.com, and collected demographic information regarding race, gender, citizenship, and major. Students were also asked to rate their frequency of computer game play at four ages (0 – 5 years, 6 – 10 years, 11 – 15 years, and 16 – 20 years of age).

The frequency ratings were scored from 0 – 5 for each age reported:

Score	Response
0	Never
1	Almost never, less than once a week
2	Rarely, 0 – 1 hours per week
3	Sometimes, 1 – 3 hours per week
4	Frequently, 4 – 6 hours per week
5	Very Frequently, 7+ hours per week

These scores were added for each age resulting in a *Scale of Game Play Frequency* between 0 – 20 for each subject.

The survey also consisted of the following series of questions regarding the use of different digital media, "What technologies do you use regularly (at least once a week?). Check all that apply", and included the following 16 options:

- MP3 Player (IPod, Zune, etc)
- Cell Phone for Calls
- Cell Phone for Text Messaging
- Cell Phone for Browsing the Internet
- Email
- Instant messaging
- Social Networking (Facebook, MySpace, etc)
- Blogging
- Photo Sites (Flickr, Piccasa, Yahoo Photos)
- Video Sites (YouTube, Yahoo)
- Rss Readers (Bloglines, Google Reader, Yahoo Headlines)
- Other (please specify)
- Console Video Games (Wii, Xbox, Playstation, etc.)
- Computer Games, (free i.e. solitaire or Yahoo Games)
- Computer Games, (single player, i.e. Half Life, Civilization)
- Computer Games (multiplayer games, i.e. WOW, Everquest)

The data analysis strategy for the closed-ended question items involved conducting a one-way ANOVA with category of considering CS as a major as the independent variable (category = 'is major', 'possible', 'neutral', and 'no plans') and each item as the dependent variable.

In addition to these items, students were asked one open-ended question regarding the influence that video or computer games had on their interest in computer science. Coders independently categorized responses by the presence and effect of games' influences on computing. Those that were coded for a positive influence were then analyzed and coded by themes according to the type of influence reported. A primary rater coded all of the questions and a secondary rater coded a sample of 25% with >90% agreement on the *"presence of influence"* and >87% agreement for the "*type of influence*" item [17]. The primary rater's coding was used.

3 RESULTS

A total of 1,116 students completed the survey for a 60% response rate of 793 males and 288 females. The majority of surveys received were completed by Engineering majors (887 = 79%), though all departments are represented.

3.1 Considering CS as your academic major

Table 1 provides a summary of student responses to the question: "To what extent are you considering computer science as your academic major?" This item had five response categories including: "It is my major"; "I am very strongly considering it"; "It is possible"; "Am feeling neutral"; and "I have no plans to consider it." For data analysis, two of the categories, "I am very strongly considering it" (N = 32) and "It is possible" (N = 176), were combined into one category: "Possible" (N=208).

Table 1. Self-report of considering CS as a major.

Measure	Major	Possible	Neutral	No Plans	Total
Frequency	77	208	180	648	1113
Percentage of total sample	6.9%	18.6%	16.1%	58.2%	99.7%

Note. Three participants (0.3%) did not answer this item.

3.1.1 Gaming Frequency and CS Major

1,110 students reported their frequency of computer game play at four different ages (0–5 years, 6–10 years, 11–15 years, and 16–20 years of age). As expected, students played less at younger ages, 0-5 years averaged a score of 1.02, 6–10 averaged a score of 2.36, and 11-15 years averaged a score of 3.37 (N = 1,110). As students entered high school and college, the average score for gaming frequency dropped to 2.94 (Figure 1).

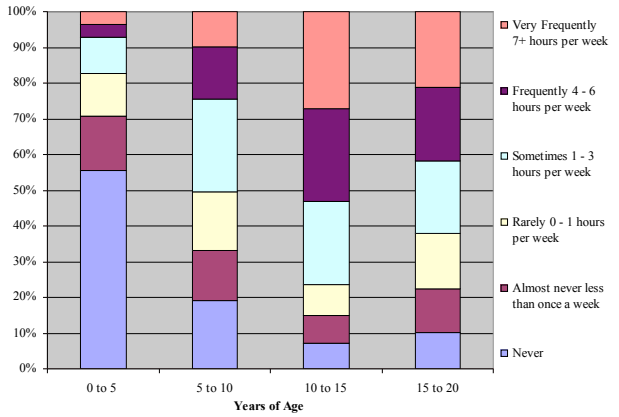


Figure 1. Self-Reporting of Gaming Frequency by Age.

To analyze the effect of a lifetime of game play on computer science interest, a cumulative score for each subject was calculated. These scores ranged from 0, indicating no experience with video games to 20, indicating playing 7+ hours per week for most of their lives.

These scores were then analyzed using the independent variable of student sub-groups in the study. 1,007 students fully answered both questions. The ANOVA results suggest a relationship between the amount of gaming experience students have had over their life time and their interest in CS as a major. Those that reported CS as their major had the highest mean score for game-play experience at 12.65. Those who reported CS as a possible major had a mean score of 11.19. Those who felt neutral about CS as a major had a mean score of 10.04, and those that had no interest had a mean score of 8.7 (Figure 2).

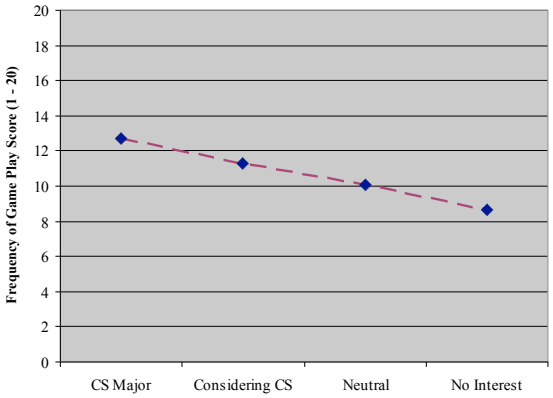


Figure 2. Mean Frequency of Game Play by CS Interest.

While this proved to be a statistically significant relationship between the frequency of gaming and an interest in CS, the proportion of the total responses accounted for by the relationship is only 8% (Table 2). This suggests that while gaming may be correlated to an interest in CS, additional variables must be considered more influential.

Table 2. ANOVA Table, Gaming Frequency by CS Interest.

Source	df	SS	MS	F-Stat	P-value	r^2
Treatments	3	1774	591	29	<0.01	0.08
Error	1030	20532	19			
Total	1033	22306				

3.1.2 Comparing Technologies and CS Major

To control for a possible correlation between game play and general technology use, we analyzed a survey question that asked, "What technologies do you use regularly (at least once a week)? Check all that apply". Each subject was given a score of 1 for the number of items they reported using weekly. We split these technologies in two different categories, gaming technologies and non-gaming technologies.

The gaming technologies consisted of 4 items: Console Video Games, Free Computer Games, Single Player Computer Games, and Multi Player Computer Games. Subjects received scores between 0 – 4; with 0 indicating they did not use any gaming technologies on a weekly base and 4 indicating they used all four on a weekly base.

CS majors had a mean of 2.45, possible CS majors, 2.30, those feeling neutral 1.98, and those with no plans to major in CS 1.45 (Table 3). The mean for each group shows a relationship between the weekly use of gaming technologies and CS interest (Figure 3). The relationship is similar to the frequency score (Figure 2), and the high number of outliers for each group indicates other variables influenced interest.

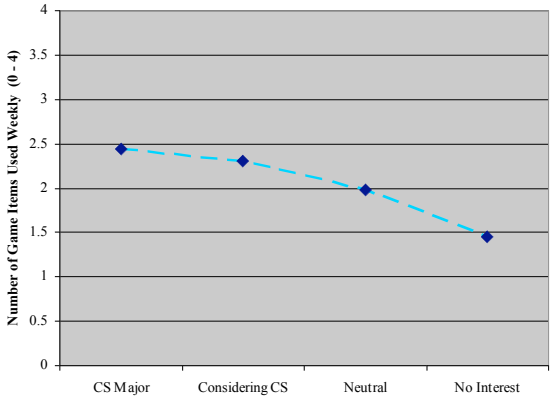


Figure 3. Mean use of game technologies by CS Interest.

Table 3. ANOVA Table, use of games by CS interest.

Source	df	SS	MS	F-Stat	P-value	r^2
Treatments	3	155	52	29	<0.01	0.08
Error	1030	1824	2			
Total	1033	1979				

The non-gaming technologies consisted of 12 items: MP3 Player, Cell Phone for Calls, Cell Phone for Text, Cell Phone for Internet, Email, Instant messaging, Social Networking, Blogging, Photo Sites, Video Sites, RSS Readers, Other. Subject received scores between 1 – 12, 1 indicating they only used one of these technologies weekly, and 12 indicating that they used all twelve weekly.

Table 4. ANOVA Table, use of technology by CS interest.

Source	df	SS	MS	F-Stat	P-value	r^2
Treatments	3	76	25	8	<0.01	0.02
Error	1030	3454	3			

CS Majors' mean score for weekly use of non-gaming technologies was 7; Possible CS major 7.08, Neutral to CS 6.69, and No plans for CS 6.42. While the data shows significance between CS Major and those with no interest in CS (of less than 1 additional item per week) (Table 4), it is not a consistent trajectory (Figure 4). There is no significant pattern in the relationship between weekly use of non-gaming technologies and interest in CS.

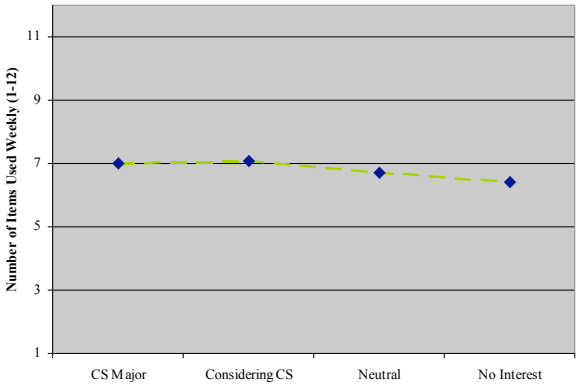


Figure 4. Mean use of other technologies by CS Interest

3.2 Qualitative Findings

The survey asked an open-ended question regarding gaming and computing, "How did playing video or computer games affect your interest in computing?". Responses were coded in two separate analyses: To quantify the self-reported influence that games had on students' interest in computing, and to find common themes in the ways that games influenced students' interest in computing.

To help us quantify the self-reported influence of games on CS answers were coded for *Positive Influence* on computing interest, *No Influence* on computing interest, *Did Not Play*, *Neutral*, or *Other*. Of the 1,056 subjects that answered the question, 43% indicated that computing did have a positive influence on their interest in computing (N = 459). The remaining 57% did not feel that games influenced their interest in computing (N = 472, 45%), did not play or gave answers that were neutral or unintelligible (N = 125, 12%) (Figure 5).

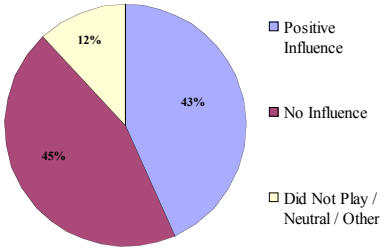


Figure 5. Self-Reported influence of games on computing.

Of those who provided more in-depth answers to the question "How did playing video or computer games affect your interest in computing?" raters noted major themes including increasing:

- Curiosity about "*How things work*" in computing (118)
- *Appreciation* of and comfort with computing (106)
- Desire to *Make games* (92)
- Knowledge and interest in *Programming* (71), Graphics (29) and Hardware (36)
- Development of game *Community* (10)
- *Math* and problem solving (21)
- *Hacking*, modding and cheating games (14)

The variables in the data between gaming frequency and CS interest suggest that while some people are lifetime gamers, they do not become part of the CS subculture. As one student responded:

"I just liked to kill things; I never cared how the game worked."

Others gained appreciation for what computation could do:

"It made me wonder how the games were created and gave me a greater respect for computing/computer graphics. "

Others claimed that games made them more comfortable with technology. A higher frequency of responses that were identified as comfort and appreciation of computing were found in groups that had no interest or felt neutral about CS (Figure 6).

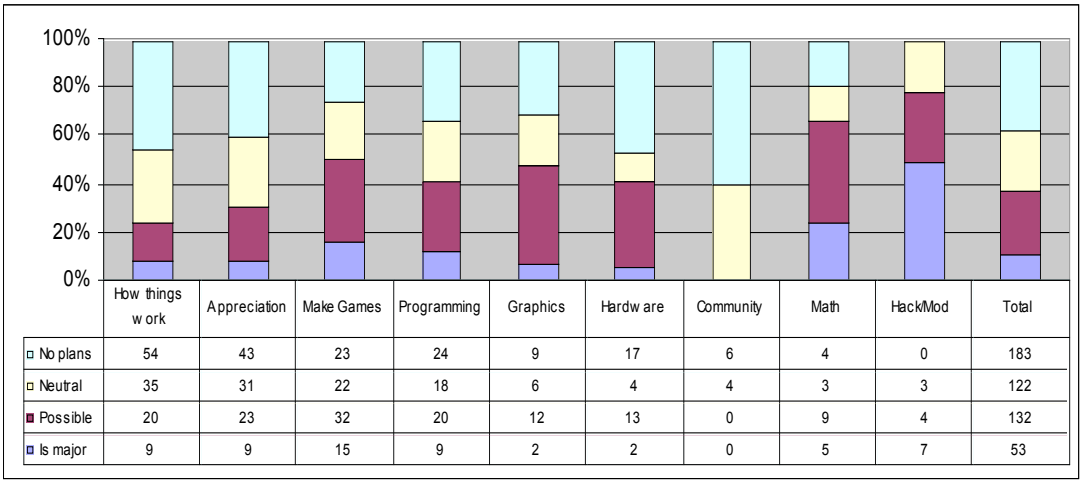
While the number of possible or current CS majors is limited (18.6% and 6.9% respectively), their responses provided the majority of occurrences in several categories: Make Games, Graphics, Math, and Hacking. In particular we see little to no occurrences of Math or Hacking in the groups that have no plans or are neutral to considering a CS major.

The similarity of interest among the students surveyed may have lead to less variation of the data. For example several students reported that games increased their interest in other technology related fields:

> *"One of the main reasons I decided to go into my major of Electrical Engineering is because I enjoy console video games (Xbox, Nintendo, etc.). I have no desire to be a computer programmer for games, but I would like to design new video game technology and consoles."*

Most negative responses were succinct, "It didn't" or "No Influence". There were 15 responses that elaborated on why games did not positively influence their interest in CS. These responses showed an initial interest in CS, but then felt it became "too hard" or "tedious" or because the game industry was unwelcoming.

> *"Greatly influenced (an interest in computing), until I found out how much coding was involved and how much working at a videogame company sucks."*



	How things work	Appreciation	Make Games	Programming	Graphics	Hardware	Community	Math	Hack/Mod	Total
No plans	54	43	23	24	9	17	6	4	0	183
Neutral	35	31	22	18	6	4	4	3	3	122
Possible	20	23	32	20	12	13	0	9	4	132
Is major	9	9	15	9	2	2	0	5	7	53

Figure 6. Reasons for games influencing computing interest by consideration of CS major.

4. CONCLUSION

Research in broadening participation in computing (BPC) aims to increase the diversity of computer science, and to simply increase the number of students being prepared for field. Ethnographic studies [4], research on computer scientists' relationships with computers [5], and accounts of biases and cultural preparation for computing [18] provide self-reported relationships between gaming and interest in computing. The self-reporting from students in this survey seems to complement this research, supporting the theory that computer scientists have played more frequently, or differently than non-computer scientists. But when we look at this qualitative data in relationship to the quantitative data on students' interest in CS, things become more complicated.

Many research and outreach projects are based upon the premise that video games can help develop an interest in computing [19-25]. The evidence used to explain this relationship has been based upon gender ratios of gaming and computing interest [6] and self-reporting from individual in computing careers. But this research does not take into account differences in race and culture. Young African American and Hispanic males game more frequently than any other group, yet their representation in computing fields are low and not growing in proportion to their frequent game play.

The survey data supports a small relationship between gaming more frequently and one's likelihood to become a CS major. We found students from all majors are gaming. Why do games contribute to an interest in CS for some, while others see no connection? A whole host of factors can affect the influence of games on CS interest; how and what they play, race and gender, or other issues. The question is: How can we understand more about the factors we can influence?

This study is a first effort to provide empirical evidence on the nature of the relationship between CS and games. In this study we considered students in a technology focused institution, because we wanted to understand why that population was choosing CS less frequently. In future studies we will focus on students representative of a general population. As we understand what factors like gaming play in influencing interest in CS, we can use them to shape interventions such as BPC efforts.

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