Questioning Video Games' Influence on CS Interest

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ABSTRACT
In this paper, we examine the relationship between digital games and interest in computer science. When we undertook this research, our goal was to expand upon past work that explores video games as a positive influence on students' interest in CS. We utilized both quantitative and qualitative research methods with a large technically and academically competent subject pool. We hypothesized that subjects with more years and intensity of playing video games would have a stronger interest in computer science. While we did find a small relationship, the proportion of the total responses accounted for by the relationship is only 8%. This suggests that while gaming may be correlated to an interest in CS, it is a small correlation and other variables must be considered more influential.

Categories and Subject Descriptors
K.3.2. [**Computers and Education**]: Computer and Information Science Education– *computer science education.*

General Terms
Experimentation and Human Factors

Keywords
Games, Race, Informal Education.

1. INTRODUCTION
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 [15,16,21]. The lack of diversity among CS professionals is also of concern to the CS field [7,14] 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 [2,13,19]. Logically this has lead many researchers and educators to look at games for increasing students interest in Computer Science.

When we undertook this research, our goal was to expand upon past work that explores video games as a positive influence on students' interest in CS [1,8]. We utilized both quantitative and qualitative research methods with a large technically and academically competent subject pool. We hypothesized that subjects with more years and intensity of playing video games would have a stronger interest in computer science. While we did find a small relationship, the proportion of the total responses accounted for by the relationship is only 8%. This paper will explore our findings then develop theories on the discrepancy between the quantitative and qualitative findings.

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 the survey. At this institution students are admitted without indication of the major they are interested in, and all are considered competent to complete a course of study in any major, including CS.

The possible relationship between playing computer games and an interest in CS has been of particular interest to researchers looking at gender inequities in CS [1,3,8,11,20] . Research shows that males are more likely to frequently play video games than females. This has led a number of outreach and research projects to focus on developing girls' 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, Black and Hispanic males [18], have poor representation in CS and other technology related fields [10,15].

We anticipated that when our data was analyzed the findings would yield insights into differences between gender and race. However, the data showed no significant difference in the relationship between frequency of play and interest in CS, between genders or racial/ethnic groups among U.S. citizens.

The data does suggest that students who are CS majors are slightly more likely to have played games more frequently than those who are not considering CS as a major at all. However, the variation in how frequently students played across all majors indicates other variables have a more significant role in students' choice of major. Additional qualitative data provides understanding on instances where games influenced a positive interest in CS.

Past research showed a greater relationship between gaming and interest in CS, this difference may be related to the prevalence and availably of video games today. As video games have become pervasive in American homes, the first adaptor or cultural indicator of being a "gamer," and the status that it provides in technical communities of practice, may be waning.

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2. RESEARCH METHOD

In the fall of 2007, 1,872 undergraduate students at a highly selective public technical university took a required introduction to CS course. At the end of the term students were offered an option of earning extra credit for completing an online survey.

This 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 in the survey.

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 it; and 4) students who indicate no interest whatsoever. These sub-groups will be examined to help provide insight into the influence of video games on students' interest in computer science.

2.1 The Survey Instrument

The online survey, administered by SurveyMonkey.com, was much larger in scope than what is represented in the data we are presenting. The survey asked a number of questions regarding reasons for major, personal influences, technology use and 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 hour 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 question 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, Picassa, 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 on your computer or online, i.e. solitaire or Yahoo Games)
- Computer Games, (Purchased single player games, i.e. Half Life, Civilization)
- Computer Games (Multiplayer games, i.e. WOW, Everquest)

In general, 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 affected 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 [12]. Inter-rater reliability was >90% the *"presence of influence*" and >87% for the "*type of influence*" item.

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%), compared with 60% enrollment of engineering majors. Computing majors were consistent in enrolment and response at 6.5%. Other majors, Liberal Arts, Architecture and Business Management had smaller response rates compared with enrollment.

3.1 Considering CS as 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).

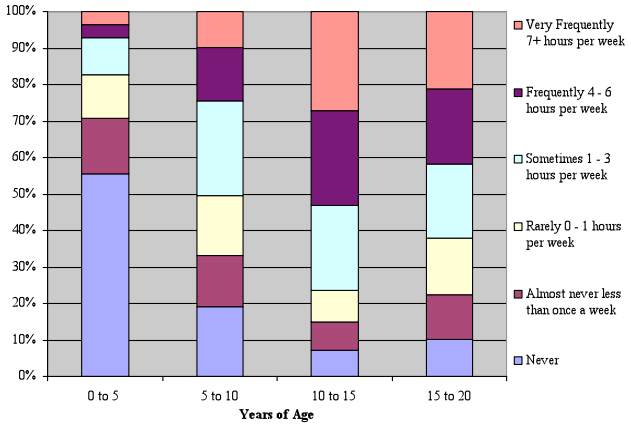


Figure 1. Self-Reporting of Gaming Frequency by Age.

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).

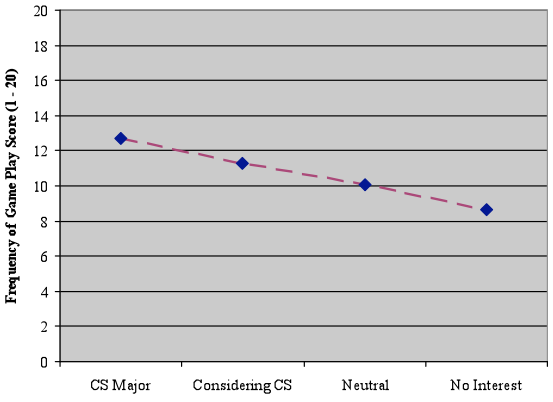


Figure 2. Mean Frequency of Game Play by CS Interest.

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.

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				

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), in that the high number of outliers for each group indicates other variables influenced interest.

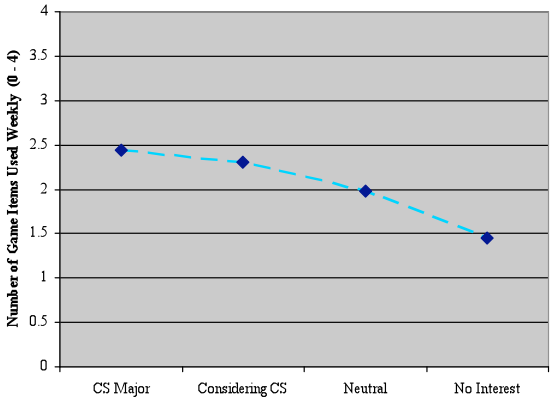


Figure 3. Mean use of game technologies by CS Interest.

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 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.

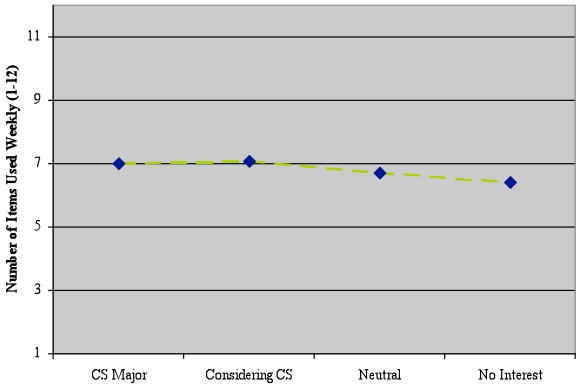


Figure 4. Mean use of other technologies by CS Interest

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 6).

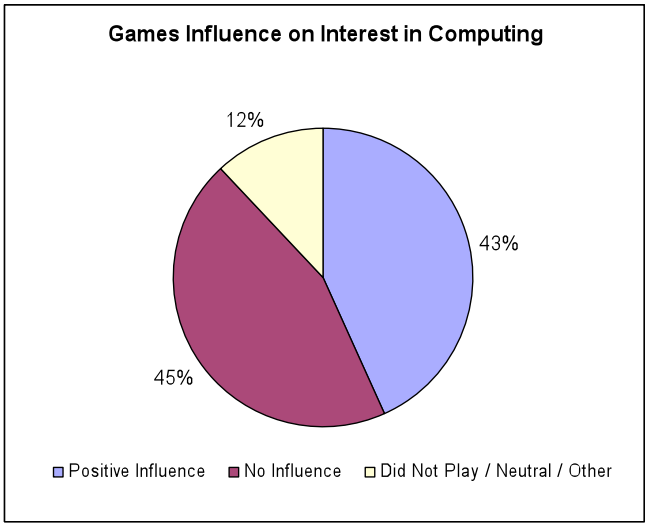


Figure 6. Self-Reported influence of games on computing.

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)
- *Hardware* (36)
- Development of game *Community* (10)
- *Math* and problem solving (21)
- *Hacking*, modding and cheating games (14)

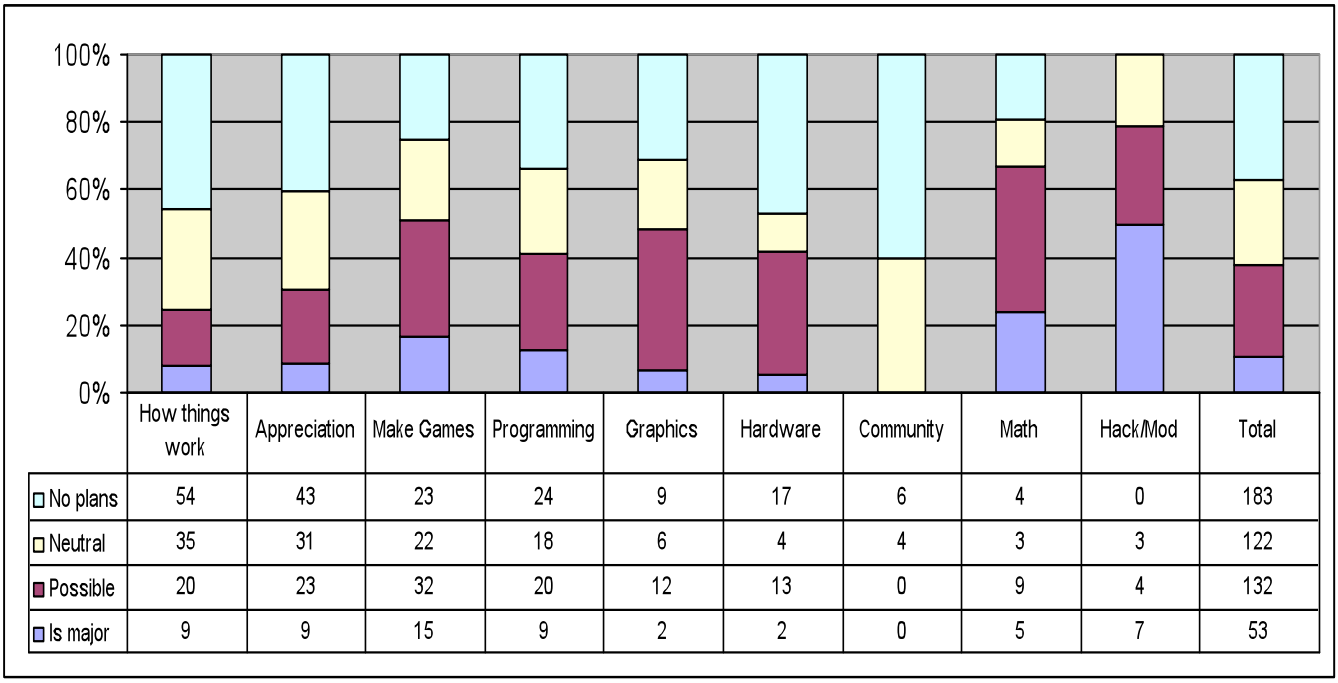
The variables in the data between gaming frequency and CS interest suggest that while some people are lifetime gamers, they do not become part of the CS subculture. As one student responded:

"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 7).



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

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."

4. CONCLUSION

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

The response rate of students who claim that games influenced their interest in computing is large, (43%). And, as the quote above suggest, it is common sense - video games are cool demonstrations of what computing can do and should spark an interest in computing. However, the number of students in our survey realizing that interest by becoming computer scientist is low (6.9%).

Ethnographic studies [2], research on computer scientists' relationships with computers [19],and accounts of biases and cultural preparation for computing [13] provide self-reported relationships between gaming and interest in computing. This research supports the theory that computer scientists played more frequently, or differently than non-computer scientists. But when we look at our data it is reflective of larger social changes. There has been substantial increase in game play among all young people while enrollment decreases in computer science. Obviously the relationship between gaming and interest in CS is less certain than common sense would suggest.

With the increase of video game use among all demographic groups, particularly among youth, it is not difficult to imagine what has impacted a diminishing relationship between gaming and CS. We suggest that it is not that CS majors have stopped gaming, but that now everyone is gaming. And that gaming has lost some of its cultural significance and its introduction into an exclusive community of practice that included computational practices.

The survey data supports a small relationship between gaming more frequently and one's likelihood to become a CS major. What is interesting is in this data is not the slight relationship, but why 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?

4.1 Future Work

As we have seen, many passionate gamers never develop an interest in computer science. This led us to ask, is there some way we could show teenagers that the games they love are computer programs, and encourage them to explore computing education? Can we leverage their personal connection to games to nurture an epistemological connection to computation [17]? Can we create learning opportunities that respect and utilize specific cultural and gaming practices of different groups; examining race, ethnicity, social cultural status, gender, and geography?

4.1.1 Glitch Game Testers

One example of work that attempts to do this is in our current project, Glitch Game Testers. Glitch will be a summer and after-school job program focusing on young black men from underserved urban high schools. In the program students will be trained as, and work as game testers while also receiving CS lessons that are contextualized to the game testing process. While young black men spend many hours playing games, they often do not look at the computation behind games. We seek to utilize affordances in games and our students culture and culture of play that could increase their knowledge and interest in CS. Those affordances include a highly competitive style of play, desire for external validation, and a need for legitimate after-school work [4]. The Glitch Game Testers will test real games, for real companies and for real money. The competitive nature of game testing, often requiring a minimum number of bugs found in a day and rewards for detail observations and communications, fits nicely with the competitive culture of play.

To utilize the game testing experience as a way to look at computation, we will be embedding CS course work similar to Computational Media, as developed at Georgia Institute of Technology [5,6,9]. These CS courses will tie directly into testing assignments.

For example, Glitch Game Testers will be assigned systematic testing of user interface elements. The testing assignments will be augmented with course work on graphical user interface (GUI) development. In our preliminary workshops, students were better motivated and able to understand the use of GUI's and (to our surprise) became better testers after understanding the ways that bugs occurred in the code. This early work is promising, Darniel[1], a high school student who completed a one-day game tester workshop reflected on what he learned:

"I really want to learn how to read stuff like that (computer programs), to understand what it means, not just letters and objects in a square, but to understand."

[1] The student's name has been changed.

4.1.2 Broadening Participation in Computing

This survey is an effort to provide empirical evidence on the nature of the relationship between CS and digital media. 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 hope to focus on students representative of a general population to provide more data on race and gender practices in the digital media and CS relationship. As we understand what factors within gaming and digital media practices play in influencing interest in CS, we can use them to shape interventions such as Broadening Participation in Computing efforts.

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