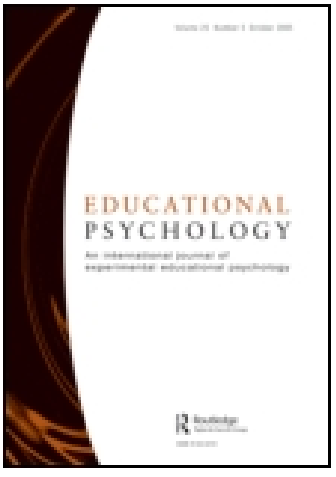

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Gender Differences and Styles in the Use of Digital Games

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This paper reports work in progress investigating gender differences and styles in the use of digital games amongst advanced level biology students. It is an elaboration on previous work exploring the relationship between cognitive style and academic performance in Maltese students taking biology at advanced level. In this previous work the cognitive style of 581 (212 male and 369 female) advanced biology students was correlated with their academic performance in five different subjects. Pearson's correlation showed that the wholist–analytic dimension, the verbal–imagery dimension, and gender were not correlated. Regression analysis showed that none of the style dimension combinations had a significant effect on performance in any of the subjects. However, gender proved to be a stronger determinant of performance. These results were interpreted from a cognitive neuroscience perspective. Numerous studies have consistently found gender differences in language and visuospatial skills. Female superiority is seen on tests of both receptive and productive language, and on more complex tasks such as making analogies and creative writing. Males have an advantage in visuospatial reasoning, being more adept at performing disembedding and internal spatial transformations. In view of these results and the constantly reported gender difference in the use of digital games, this paper describes the initial stage of an investigation about gender-determined propensities to digital media. Different studies claim that males dedicate more time than female students to playing digital games. A marked emphasis on the use of particular game genres by the different sexes is also reported. This reported phenomenon is investigated within the context of Maltese students taking advanced biology. Through a questionnaire, data were collected about the time students spend playing digital games, their preferred platform, and their preferred games. Data were analysed to establish gender differences in the time spent on playing digital games, the preferred platform, the most popular digital games amongst males and female students, and the preferred game genre. The results are interpreted from neurocognitve and psychosocial perspectives. Suggestions are made for possible integration of digital games in learning.

Theoretical Background and Research Rationale

This paper reports work in progress investigating gender differences and styles in the use of digital games amongst advanced level biology students. It is an elaboration on previous work that explored the relationship between cognitive style and academic

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performance in Maltese students (Bonanno, 2001). In the previous work, the cognitive style of 581 (212 male and 369 female) advanced biology students was determined using Cognitive Style Analysis (Riding, 1991). The different style dimensions were correlated with students' academic performance in five different subjects. Pearson's correlation showed that the wholist–analytic dimension, the verbal–imagery dimension, and gender were not correlated. Regression analysis showed that none of the style dimension combinations had a significant effect on performance in any of the subjects. However, gender proved to be a stronger determinant of performance.

The lack of correlation between cognitive style and performance demands a shift in focus from personal labels to situational characteristics and task demands. From a neurocognitive point of view, the human brain is so versatile and efficient in adapting to different situational demands that it can function efficiently under diverse constraints. Style typologies describe the task at hand rather than fixed learner characteristics (Gazzaniga, Ivry, & Mangun, 1998). Considering such a contextual perspective, the previous work concluded that typical classroom instruction and assessment procedures, for advanced level biology, are more conducive to female linguistic propensities. This is in line with Vlachos, Andreou, and Andreou's (2003) claim that gender and academic discipline may influence performance on visuospatial tasks. Classroom methodologies tend to downplay male visuospatial skills and orientation to kinaesthetic activity.

Such a position triggers a set of provocative questions. How can gender-oriented neurocognitive propensities be exploited and challenged for instructional purposes? Do males prefer tasks that exploit their visuospatial skills such as hands-on projects or tasks that exploit the computer's versatility with respect to these neurocognitive skills? Do females prefer school-based, collaborative activities, in contrast to males who are more inclined to work on "out-of-school", solitary problems? How can females be helped to develop visuospatial skills during instruction? Which activities, designed specifically to promote linguistic abilities, can be embedded in the curriculum? Is it possible to exploit the malleability of the computer as a medium to develop gender-challenging instruction?

Digital media propose a number of possible solutions. For example, virtual learning environments offer a very promising route through the various synchronous and asynchronous communication facilities. But since the major focus of this work is on metacognition and related intrapersonal affective processes rather than the transmission of domain knowledge and skills, a tool that can reveal such gender-based dynamics was chosen. Digital games, the emerging, powerful medium of today's culture, were chosen in a tentative bid to merge engagement with reflection, intuitive with conceptual knowledge, and personal interests with formal instruction.

Various aspects of games or gaming have been investigated. The following literature review will be limited to those aspects related to individual differences in gaming, especially gender-related neurocognitive skills. It also discusses research about educational and normative aspects of games focusing on playtime, user motivation, and game preferences.

Gender Differences in Neurocognitive Skills

In which neurocognitive processes and psychomotor skills relevant to the use of digital games do males differ from females? A review of the literature on cognitive sex differences shows that men and women differ systematically on tests of spatial cognition (Halpern, 1992; Kimura, 1996; Voyer, Voyer, & Bryden, 1995). On average men have an advantage on tasks of spatial cognition such as the Viewfinding Task (Watson & Kimura, 1991), localisation (Gordon & Lee, 1986), orientation (Gordon & Lee, 1986), and mental rotation (Gouchie & Kimura, 1991; Moffat & Hampson, 1996). Men also show an advantage on tasks that require both target-directed motor skills such as finger dexterity and spatial cognition involving three-dimensional object rotation, such as catching an object (Watson & Kimura, 1991), and guiding or intercepting projectiles such as throwing darts (Watson & Kimura, 1989, 1991). These cognitive and psychomotor skills are strongly influenced by early and current hormonal levels (Margolis & Fisher, 2002).

One of the largest between-sex differences favouring males, extremely exploited by digital games, concerns visuospatial tasks that require transformations in visuospatial working memory (Krikorian, Bartok, & Gay, (1996). Males have an advantage in visuospatial reasoning, being more adept at performing the disembedding and internal spatial transformations required by tasks such as mental rotation of shapes, shape recall, geometry, maze learning, and map reading (Coren, Ward, & Enns, 1994; Gazzaniga et al., 1998; Halpern, 1986; Wilson et al., 1975). The differences hold up whether one is dealing with simple or complex patterns (Bryden & George, 1990). Males are either more accurate in their responses or show greater speed when completing such tasks. Males also differ in increased aggression and greater risk taking. The male advantage in spatial reasoning may be one reason why they score higher on maths tests, why most chess masters are men, and why males use computers more than females as a medium for entertainment, learning, communication, and for expressing themselves.

On average, women have an advantage on tasks requiring perceptual speed and fine motor skills, such as identification of pictures (Watson & Kimura, 1991) or sequenced hand movements (Nicholson & Kimura, 1996). Numerous studies (Inglis & Lawson, 1982; MacCoby & Jacklin, 1974) consistently found gender differences in language and visuospatial skills. On average, girls begin to acquire language about one month prior to boys and, by age 11, they consistently perform better on tests of verbal abilities, with the gender gap growing at least until adulthood. Female superiority is seen on tests of both receptive and productive language, and on more complex tasks such as making analogies and creative writing. The gender difference is not large, showing extensive overlap between the two groups. But it is consistent. In general, women are reported to be more verbally fluent than men (Stumpf, 1995), although mixed results have also been obtained.

For instance, studies have shown a female advantage in quickly producing words from a particular semantic category (for example, foods; Gordon & Lee, 1986). Girls are much better than boys at generating sentences when given the initial letter

of each word but there is no sex difference for rapidly producing words beginning with a particular letter (Gordon & Lee, 1986), for either type of fluency measure (for example, Moffat & Hampson, 1996), or for rapid articulation (Gouchie & Kimura, 1991). Girls also show better interpretation of emotion cues, and a higher tendency to comply with parents and peers.

A very important suggestion, very relevant to this work on digital media, comes from Baenninger and Newcombe (1995). They claim that many gender differences may be decreasing in recent years, citing a number of meta-analyses showing this pattern. Crawford, Chaffin, and Fitton (1995) also stress a decline in gender differences in spatial visualization skill in the past 40 years. Stumpf (1995) acknowledges the reduction in some gender differences with time but points out that gender differences across a number of cognitive dimensions are still quite robust despite the reduction over time. Such studies point out the importance of psychosocial factors on sex differences in cognitive abilities. Finally, current models (Casey, 1996; Halpern & Tan, 2001) propose that the interaction between life experience and inherited biological propensities builds sex difference in spatial cognition. Sherry, de Souza, Greenberg, & Lachlan (2002) point to the importance of game playing in developing such skills, quoting Subrahmanyam and Greenfield (1994) who argue that children learn cognitive skills, such as how to orient things in space, by playing electronic games and that these skills differ between girls and boys because of differential exposure to electronic games.

Educational and Normative Aspects of Games

Video games have emerged as one of the most popular forms of mass mediated entertainment and edutainment worldwide, primarily among adolescents (12–17) and young adults (18–22). Much of the video game research has focused on potential social problems related to video game use such as the effects of violent video games on aggression (Anderson & Bushman, 2000; Sherry, 2001) or video game addiction (Fisher, 1994). Less research has focused on understanding more normative video game use among adolescents. Recent studies, such as Sherry et al. (2002b) and Media Analysis Laboratory (1988), focused on a number of normative factors related to digital game playing.

Playing time. A consistent finding in the above studies is that boys spend significantly more time per week than girls playing video games. The gender difference in time dedicated to game play can be attributed to the fact that boys find digital games much more attractive and conducive to their natural cognitive processing. For girls, games offer more challenge to their natural cognitive processing and to their preferred social comportment. Sherry et al. (2002a) relate time dedicated to playing digital games to the level of cognitive development. The cognitive difficulty college students experience in using the games may dissuade them from spending much time engaging in video game play. Thus they spend much less time playing video games because the challenge is beneath their cognitive abilities, because of different

affective needs, and as a result of increased social demands made on the young adult's time.

Motivations. Rosengren and Windahl (1989) assert that individuals use different media at different developmental stages in their lives, seeking out specific genres within any medium. While motivations for using media will vary across media, genre, and culture, uses and gratifications may offer the best hope of an etiological explanation about why people use the media that they do (Rubin, 1994; Sherry, 2001; Tannenbaum, 1996).

Wigand, Borstelmann, and Boster (1985) focused largely on understanding why adolescents used arcades, rather than games. Subsequent factor analysis revealed three factors: excitement; satisfaction; and tension reduction. A more recent survey conducted by Phillips, Rolls, Rouse, and Griffiths (1995) in the UK, focusing exclusively on the uses and gratifications of electronic game playing, used single item measures of electronic game play motivation including: "to pass time"; "to avoid doing other things"; "to cheer oneself up"; and "just for enjoyment." Furthermore, Griffiths' (1991) research on electronic game addicts proposed additional uses and gratifications, including arousal, social rewards, skill testing, displacement, and stress reduction. Using focus group sessions and structured interviews, Sherry, Lucas Rechtsteiner, Brooks, and Wilson (2001) revealed six major reasons why people play electronic games. The reasons are categorized as: *competition*—to be the best player of the game; *challenge*—to push oneself to beat the game or reach the next level; *Social Interaction*—to interact with friends and learn about the personalities of others; *diversion*—to pass time or alleviate boredom; fantasy—to do things that you cannot do in real life, such as driving race cars or flying; and arousal—to play because the game is exciting. This research also revealed patterns of game playing that suggest that sex differences exist in both electronic game preferences and usage.

Game preferences. The study by Sherry et al. (2002) has shown that teens use different video games for different reasons at various stages of development. Differences in game preferences were recorded between age groups. The effect sizes are small, with interest in imagination and physical enactment games declining with age, even as interest in traditional games increases. Considering leading theories of cognitive development such as Piaget's stage theory or Ackerman's PPIK theory (1996), one would expect college students to prefer strategy/imagination games the most because they are best able to conquer the challenges offered by these complex games. However, Sherry et al. (2002a) conclude that young adults show their strongest preference for traditional games while imagination games are the least liked. The researchers attribute this to the fact that traditional games are less time consuming and therefore may appeal more to college students who have less time to dedicate to gaming. Not only can these games be played for brief periods of time but, since they are traditional, there is the added advantage of already knowing the rules and conventions, hence time is not spent on deciphering the game. Such games evoke a feeling of nostalgia and familiarity that is constantly activated by having

these types of games on personal computers, where college students spend much of their time.

Sherry et al. (2002a) discuss the differences in motives between age groups for video game use. Children in the fifth grade play video games for the challenge and fantasy that the games provide. However, as these children develop into adolescents they begin to play for social interaction and competition and finally in college they are back to playing the games for challenge and fantasy. The change from the more personal motives (fantasy and challenge) to the more socially oriented motives (social interaction and competition) at the adolescent stage is consistent with social development theory. The period of adolescence is typified by the individual's declining dependence on family, the striving for independence, and increased importance of the peer group. As a result of these developmental changes, adolescents may look toward video games as a comfortable and non-threatening means of interacting with their peers. Motivations change again for the college student, as social interaction becomes the least popular motivation for game play. Playing digital games starts being considered as a childish, time-wasting, and socially-depriving activity; college students do not play much for social interaction.

Experimental Validation

Keeping in mind the different aspects and the rich dynamics involved in digital games, this work attempts to investigate these gender-related stylistic tendencies within the context of Maltese students taking advanced biology. Via a survey administered to college students, data regarding the time spent on playing digital games, preferred platform, and preferred games was analysed to establish gender differences within the identified factors and compared to the results obtained from previous works.

This work is part of a broader research project investigating the cognitive and metacognitive skills employed while playing different genres of digital games. The first objective is to determine possible gaming patterns present amongst Maltese students and compare these with results obtained from similar investigations carried out in other countries. Gaming patterns will be analysed through the following independent variables: time dedicated to playing games; preferred platform; preferred games; and related genres. Comparisons will be made between males and females within the same cohort and between different age groups. For this investigation, age will be a categorical predictor variable comprising first and second year university students. It is hypothesised that:

- there will be gender differences in the amount of time dedicated to playing games, the preferred games, and consequently the preferred genres;
- first years students dedicate more time to playing games than second year students; and
- only minor differences exist in game playing and preferences between Maltese students and foreign students of the same age cohort.

The research questions are as follows:

RQ1a: Which gaming device is mostly used by students?
RQ1b: Is there a difference in the time dedicated by male and female students to playing digital games?
RQ1c: Is there a difference in the time dedicated to playing digital games by male and female students within each age cohort?
RQ1d: Is there a difference in the time dedicated to playing digital games by male and female students across age cohorts?
RQ1e: Is there a difference in the type of games preferred by male and female students?
RQ1f: Is there a difference in game genre preferred by male and female students?

Method

Subjects

The investigation was carried out with 367 students in the 16–18-year-old range. The sample was made of two groups: 324 Maltese students, 186 first year and 126 second year students, attending a two year course at the GFA Junior College, University of Malta; and 43 Swedish students from Thorildsplans Gynasium, Stockholm. These were participating in a science exchange program.

The gender distribution of the respondents was 65.7% female ($n = 241$) and 34.3 % male ($n = 126$). Among the respondents 88.29% were Maltese students, while 11.72% were Swedes. The Maltese sample consisted of 26.16% ($n = 96$) males and 62.13% ($n = 228$) females. The Swedish group included 8.17% (n = 30) males and 3.54% ($n = 13$) females. The mean age of the respondents was 17 years, with a range from 16 to 18 years.

Procedure

Selected groups of students were given the survey to complete at the commencement of biology lessons. For the Swedish group, this was given while they were on a fieldwork trip during an exchange visit to the Maltese Islands. The completed sheets were collected and grouped. Using the completed survey sheets, a digital game list was developed. The games were coded and classified according to genre. Two student groups were involved in this compilation. The resulting list was developed after discussion and agreement between the two groups.

The completed survey sheets were then entered in SPSS data sheets according to the following variables: name; college; form; class; age; gender; gaming device; time of playing; game preferences; and game genre.

Table 1. Sample composition by gender

	Frequency	%
Male	126	34.3
Female	241	65.7
Total	367	100.0

Table 2. Composition of Maltese sub-sample by gender

	Frequency	%
Male	96	26.16
Female	228	62.13
Total	324	88.29

Table 3. Composition of Swedish sub-sample by gender

	Frequency	%
Male	30	8.17
Female	13	3.54
Total	43	11.71

Instruments

The survey entitled "Digital games: How much? Which type?" consisted of a single-sheet questionnaire. Participants had to: fill in their name, school, class, and date; tick an option representing average time spent playing games per day or per week; tick the preferred gaming device; tick their favourite game/s from the list of games provided (various randomised genres were included); write down other favourites not included in the list provided; and list the three most-preferred digital games.

The "digital game classification table" includes all the games mentioned in the survey by the respondents. Each game was given an index number and classified into sections according to the following game genres: adventure games; fighting games; first person shooters; role-play games; car racers; sports; simulations; managerial games; strategy games; and puzzle games.

Consulting the following sources identified the genres: previous research (for example, Sherry, 2002a & b); websites dedicated to game research; electronic game magazines; and electronic game departments in online retail stores. The final classification list was compiled after discussion over two classification lists developed separately by two groups of game-enthusiast students.

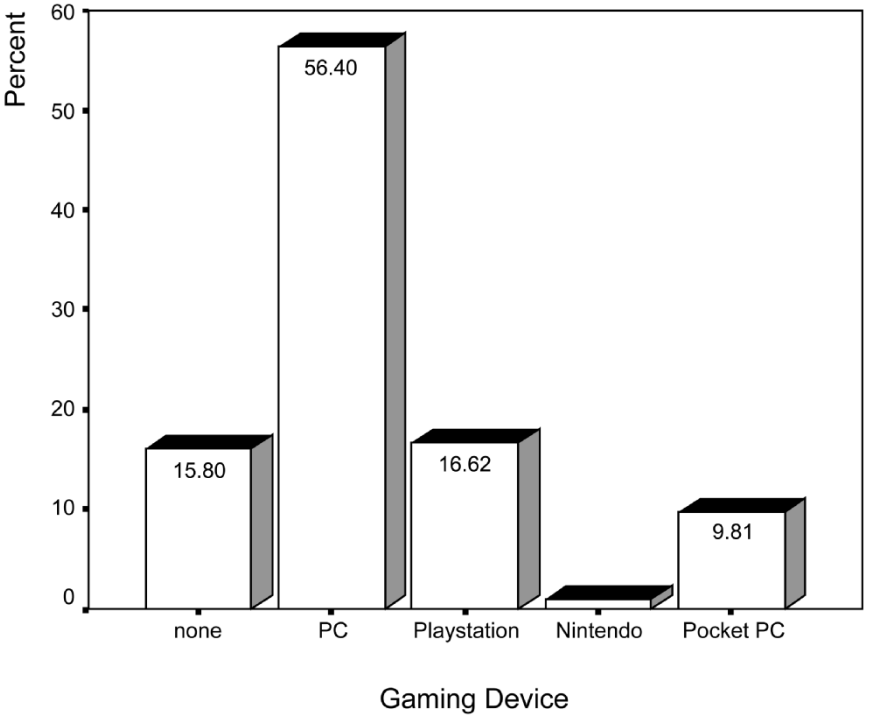

Figure 1. First preference gaming device

Results and Analysis

Data pertaining to the different variables was entered in the SPSS statistical program using the appropriate codes. The main experimental results are presented in the following section according to the identified research questions.

RQ1a: Which Gaming Device is Mostly Used by Students?

First preference gaming device. Considering the whole sample, Figure 1 shows that the personal computer is the most common gaming device (56.4%; $n = 207$), followed by the PlayStation (16.62%; $n = 61$), the mobile phone (9.81%; $n = 36$), and Nintendo (1.1%; $n = 4$). A significant number of students (15.8%; $n = 58$) did not enter their preference, probably showing their lack of interest in playing games. Only rare cases exist of students having no computer or other playing device.

Second preference gaming device. For the whole sample, Figure 2 shows that the mobile phone (13.35%; $n = 49$) is the second most preferred gaming device, followed by the PlayStation (12.26%; $n = 45$), the PC (1.4%; $n = 5$), and Nintendo (1.4%; $n = 5$), and least used is the Xbox (0.5%; $n = 2$). A very high percentage of students (71.12%; $n = 261$) did not indicate their second preferred gaming device,

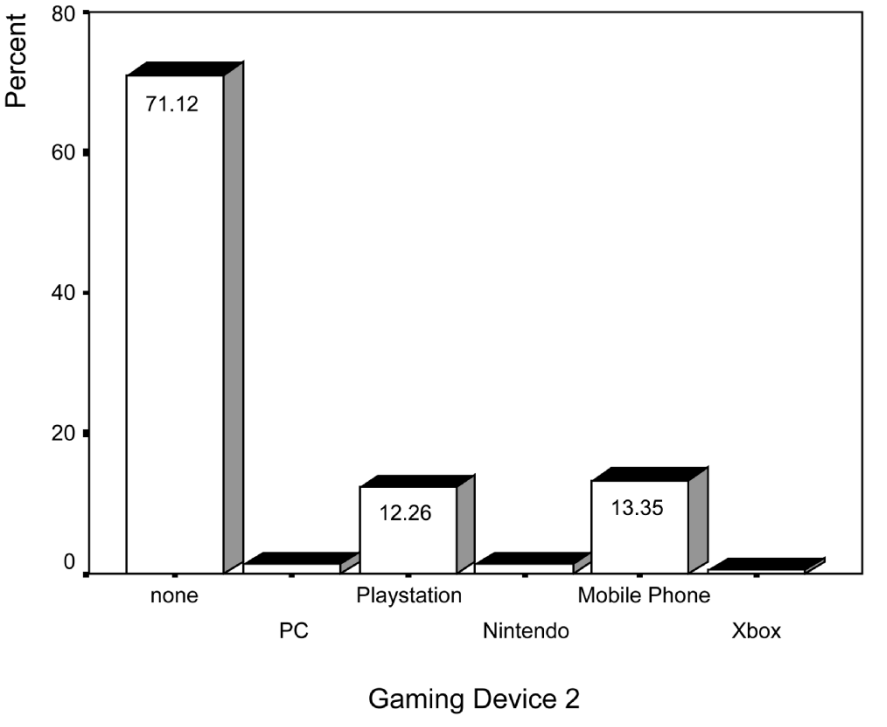

Figure 2. Second preference gaming device

as many use only the PC as their preferred gaming device. Others did not enter any preferred gaming device.

Correlating gaming device used with gender. The correlation between gender and gaming device preference was investigated through Crosstabs and related chi square test, and $p < .001$ was obtained. This shows that there is a very significant gender effect in the use of gaming devices (see Figure 3). For every male, five females did not give their preference for the gaming device use. This is also equivalent to one in every five females. A significant percentage of females either resist or prefer not to play games. Another distinguishing difference is the higher use of mobile phones by females as a gaming device (eight times as much as males). Mobile phones are used to play puzzle games, the most preferred genre reported by females.

RQ1b: Is There Any Difference in the Time Dedicated to Playing Digital Games by Male and Female Students?

As predicted, a gender-based difference in mean playing time (hours per week) was recorded. Table 4 gives the mean hours per week dedicated to playing games for the whole sample.

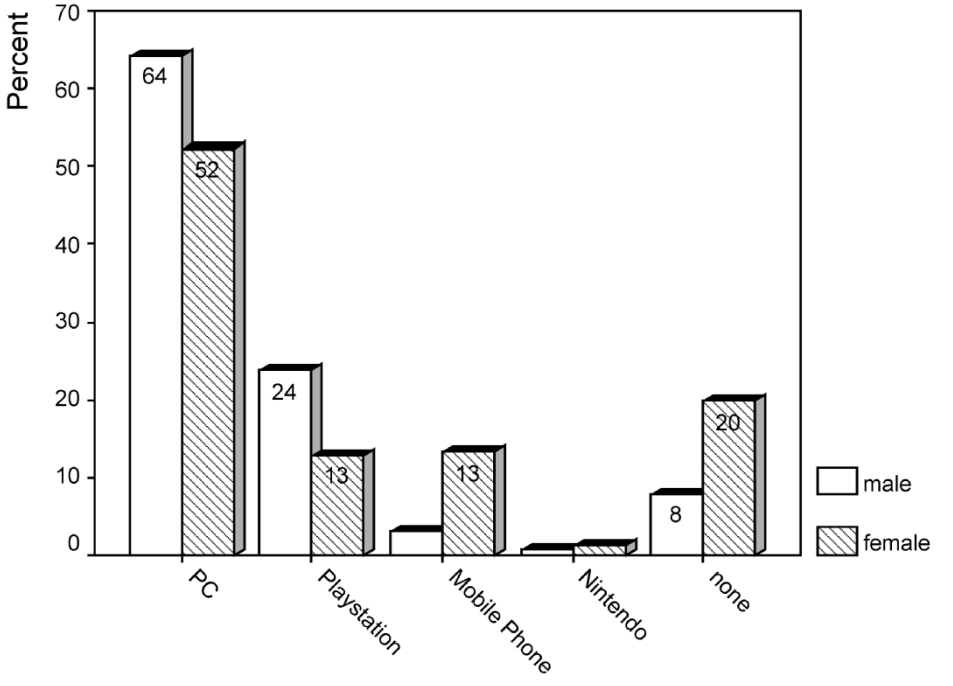

Figure 3. Playing device by gender

The average playing time for males is 6.7119 hours per week and for females 2.4917 hours per week. Linear regression analysis was used to find a model that describes time dedicated to playing games by gender. Table 5 and Figure 4 give the results.

The simple linear regression model relating mean playtime with gender is:

$$\text{Expected mean playtime} = 10.932 - 4.22\text{Gender}$$

There is a difference in the mean playtime of 4.22 in favour of males, meaning that expected playtime for males is 6.72 hours [10.932 − 4.22(1)] while expected playtime for females is 2.49 hours [10.932 − 4.22(2)].

Logistic regression to predict gender from playtime. The *t*-test for equality of means gave a *p* value approximating to zero, showing a highly significant difference between the

Table 4. Mean playing time (hours) per week

Gender	Mean	*n*	SD
Male	6.7119	126	7.2161
Female	2.4917	241	3.2401
Total	3.9406	367	5.3568

Table 5. Linear regression statistic

		Coefficients[a]				
		Unstandardized coefficients		Standardized coefficients		
Model		B	SE	Beta	*t*	Sig.
1	(Constant)	10.932	.942		11.602	.000
	Gender	− 4.220	.547	− .375	− 7.718	.000

[a]Dependent variable = hours
SE = Standard error

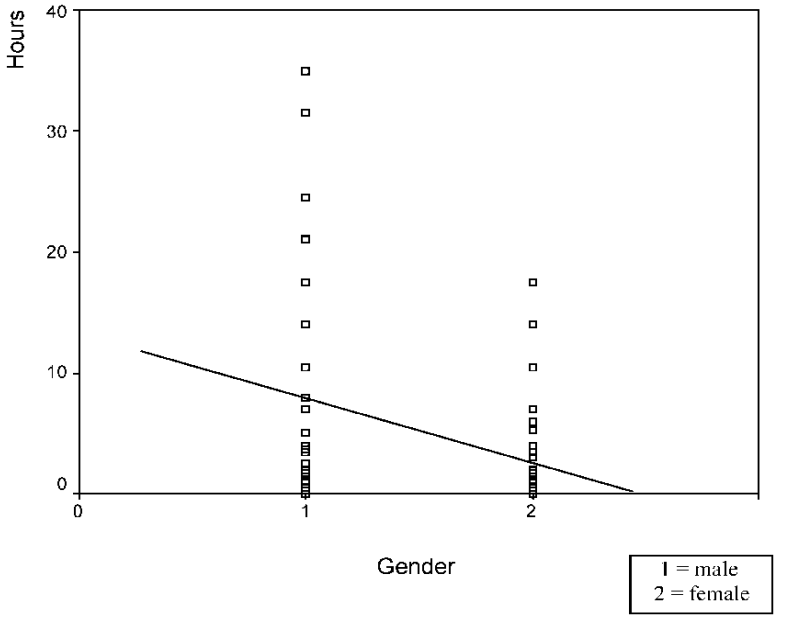

Figure 4. Scatter plot for playing time by gender

male and female playtime values. Figure 4 gives the probability of gender allocation given playtime values.

The logistic regression model for females is as follows:

$$\log\left(\frac{p}{1-p}\right) = 3.842$$

Considering the case when playtime = 30 hours

$$\log\left(\frac{p}{1-p}\right) = 3.842$$

and $p = 0.021$: if someone is dedicating 30 hours to playing games, the probability that she is a female is 0.021.

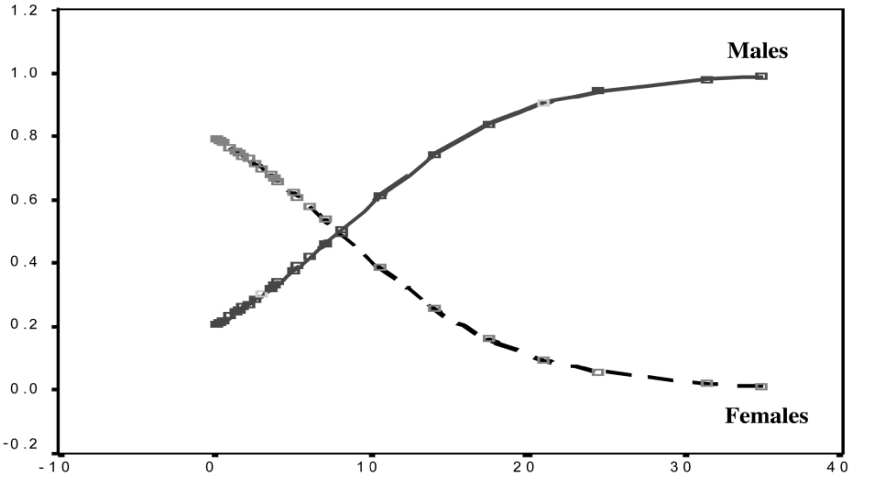

Figure 5. Predicted gender probability for playtime value

The logistic regression model for males is as follows:

$$\log\left(\frac{p}{1-p}\right) = -1.348 + 0.172 \text{ playtime}$$

Considering the case when playtime = 30 hours

$$\log\left(\frac{p}{1-p}\right) = 3.842$$

and $p = 0.979$: if someone is dedicating 30 hours to playing games the probability that he is a male is 0.979.

The graphs in Figure 5 give the gender probability for a given playtime value. For low playtime values, there is a greater probability of female allocation. Conversely, for a higher playtime value there is a greater probability of male allocation.

RQ1c: Is There any Difference in the Time Dedicated to Playing Digital Games by Male and Female Students Within Each Age Cohort?

The two same-age cohorts include the Maltese and Swedish student groups (the latter from Thorildsplan Gymnasium, Stockholm). The Maltese sample had a higher female composition (m:f = 113:184) and the Swedish group a higher male composition (m:f = 29:11). Keeping the smaller Swedish group in its original composition, a Maltese group with the same male:female ratio (m:f = 83:31) was created, using a random technique and eliminating all students that gave no first preference game option. Using this constructed sample, mean playing times were obtained, as shown in Tables 6 and 7.

On average Swedish males dedicated more time to playing digital games than Maltese males. Conversely, Maltese females dedicated more time to playing games than their Swedish counterparts.

A two-way ANOVA with gender and school (Junior College and Thorildsplan

Table 6. Mean playing time (hours) per week for Maltese students

Gender	Mean	*n*	*SD*
Male	7.3991	112	7.3283
Female	2.8095	154	3.3271
Total	6.1474	154	6.7922

Table 7. Mean playing time (hours) per week for Swedish students

Gender	Mean	*n*	*SD*
Male	7.4817	30	8.5883
Female	1.1154	13	2.6153
Total	5.5570	43	7.8508

Gymnasium, Stockholm) as the predictor variable and playtime as the response variable gave $p < .001$ and $p < .860$, respectively. The gender difference observed for the whole sample applies also to the different sub-samples. Males, in both sub-groups, play more than females. On the other hand, when comparing the difference in mean playing time for student groups from the two colleges, the $p < 0.86$ value shows that the difference in mean time dedicated by the Maltese and Swedish students to playing digital games is not significant.

RQ1d: Is There any Difference in the Time Dedicated to Playing Digital Games by Male and Female Students Across Age Cohorts?

The different-age cohorts include Maltese first and second year college students (16–17 and 17–18 years old respectively). The mean time (hours/week) dedicated for playing is given in Tables 8 and 9.

Both male and female first year Maltese students dedicate more time to playing games. Two-way ANOVA taking form (that is, year of study) and gender as the

Table 8. Hours dedicated to playing games by second year Maltese students

Gender	Mean	*n*	*SD*
Male	6.2051	39	7.7057
Female	2.3586	99	3.3867
Total	3.4457	138	5.2627

Table 9. Hours dedicated to playing games by first year Maltese students

Gender	Mean	*n*	*SD*
Male	8.0645	31	7.9632
Female	4.7877	73	13.3398
Total	5.7644	104	12.0470

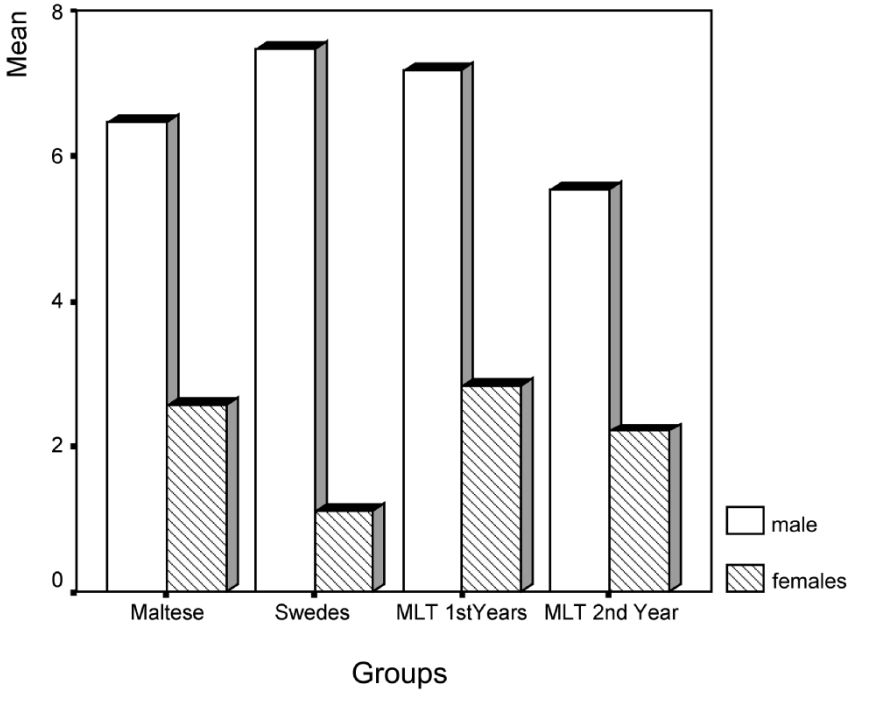

Figure 6. Mean playtime by gender for different groups

predictor variables and playtime as the response variable gives $p < .73$ and $p < .00$ respectively.

The p value for form ($p < .073$), which is slightly greater than the 0.05 standard level of significance, shows that there is a difference that cannot be ignored between the mean playtime of the two forms. First year students dedicate more time to playing than second year students. Within the Maltese sample, there is a highly significant difference in playtime arising from gender, with $p < .001$. Figure 6 shows the mean playing time for the different sub-groups in the sample, summarising the results discussed in this section.

In all groups males dedicate more time to playing games than females. Swedish males spend more time playing than Maltese males. The opposite applies for females, though this has to be interpreted with caution since the Swedish group comprised only 13 females, which is quite a small representative sample. Agewise, Swedish girls are more like second year Maltese females who play even less than Maltese first years. But the female cohort in the Maltese sample has a higher percentage of first years that tend to dedicate more time to playing. Maltese second year students tend to dedicate less time to playing games than first year students. As discussed in the literature review, this gender effect can be attributed to different neurocognitive propensities, the development and influence from gender scripts (the ascribed beliefs, tastes, competencies, motives, and aspirations in the game), and to different emerging social needs between males and females. The difference between

Table 10. Chi square statistic table for first preference games

	Value	*df*	Asymp. Sig. (2-sided)
Pearson chi square	184.526	90	.000
Likelihood ratio	216.930	90	.000
Linear-by-linear association	1.067	1	.302
n of valid cases	367		

Note: 167 cells (91.8%) have expected count less than 5. The minimum expected count is .34.

the Maltese and Swedish cohort is probably a contextual by-product. The Maltese educational system is much more exam-oriented than the Swedish system, which gives more space for the development of various personal dimensions complementary to the academic component. For Swedish males this provides more space for playing games and interactions within the digital games culture. As a general rule females exhibit a higher level of social and emotional maturity, and a corresponding shift in psychosocial needs becomes evident. Gradually their perceptions of games change as they become increasingly considered as solitary media-based impersonal activities. Social interactions and personal relationships with friends become the dominant leisure engagement. The reduction in mean playing time between first and second year students can be attributed to three factors. Faced with career-determining exams, second year students dedicate much of their time and energy to study, giving marginal importance to playing games. Changing social perceptions and the shift in personal and social needs, as experienced by the Swedish counterparts, start to manifest in decreasing interest in digital gaming activity. In this respect, Maltese second year students are more like the Swedish group.

RQ 1e: Is There any Difference in the Type of Games Preferred by Male and Female Students?

There are two related aspects that manifest players' game preferences. These are the first, second, and third game preference options indicated by the students in the questionnaire, and the related game genre obtained by recoding game preferences. Table 10 gives the chi square test statistics for first preference game options. Though $p < .001$ was obtained, the large number of cells having expected counts less than 5 limits the validity of this test.

Since similar results were obtained for second and third preference game options, the related data were condensed to be grouped by game genre and then used to investigate possible associations.

RQ 1f: Is There any Difference in Game Genre Preferred by Male and Female Students?

The first preference games choices were converted to game genre options. Crosstabs and chi square tests were used to establish possible significant difference. As expected, chi square tests gave

$p < .001$, showing strong significant differences. A comparative graph representing percentages by gender for the different genres is given in Figure 7.

Factors that contribute to the highly significant association between gender and genre for first preference games, indicating gender-based tendencies, include the higher percentages of:

- females not giving their preference for any game/genre;
- females opting for the puzzle game genre;
- the higher percentage of females preferring fighting games; and
- males preferring first person shooters, role playing games, sport games, and strategy games.

As Figure 8 shows, this can be further analysed through a comparative bar graph representing percentages by gender (y-axis) for the different first preference games shown on the x-axis as game code numbers.

Factors contributing to the significant association between gender and first preference game options, shown in Figure 8 include the high percentage of:

- females not giving any game preference option (23.7% compared to 8.7%);
- females preferring adventure games (bars in the left section of Figure 8);
- females preferring the following games: adventure—2, 7, 36; fighting—61; car racing—144; managerial—260; and puzzle—313,314;
- males preferring the following games: first person shooters—84; role playing games—107, 113; car racing—137; sport—182, 188; strategy—289;
- males preferring action, first person shooters, and sports games (bars in the game range 62–137); and
- females preferring puzzle games (bars in the range above 300).

(Numbers refer to Game codes listed in Appendix)

From frequency tables for first preference game options, it has been established that the most popular game with males (8.7% selecting it as their first preference) is the first person shooter "Half-Life", followed by the football game "FIFA" (7.1%). The two games mostly preferred by females are the puzzle games "Solitaire" (9.5%) and "Snake" (8.7%). This points to the different styles adopted by males and females. Males prefer command structures that make them feel in control, especially by continually intervening through actions guided by their prominent visuospatial capabilities and manipulating information (guessing distances, calculating angles, deciding strength of action, and so on) in working memory. On the other hand females prefer a more concrete, contextualised, and repetitive activity that does not demand risk taking. They prefer adopting a tinkering approach that requires rapid access and retrieval of information from memory involving comparisons and rhythmic movements. This also accounts for the popularity of fighting games with females

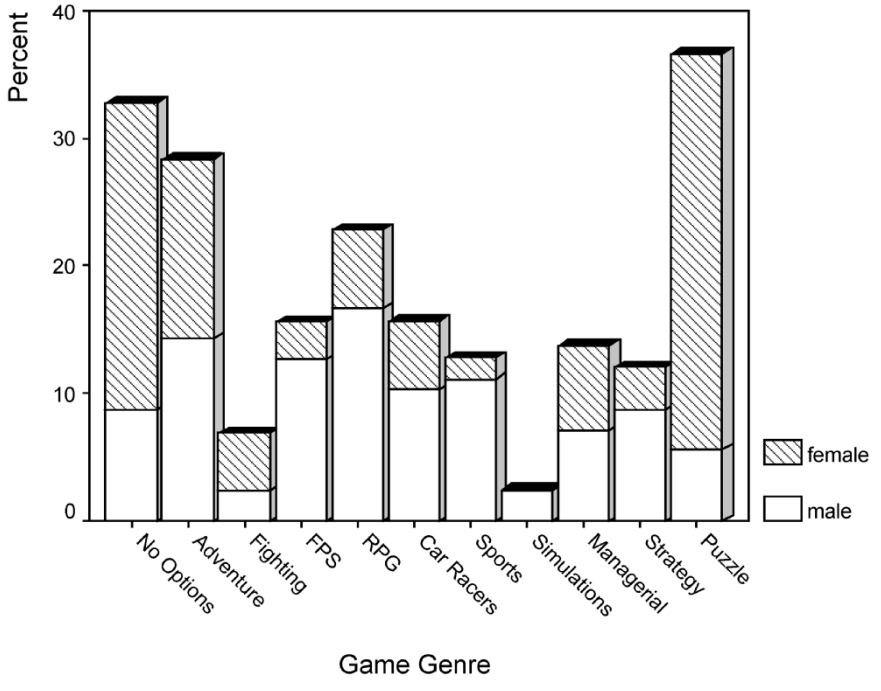

Figure 7a. First preference game genre by gender

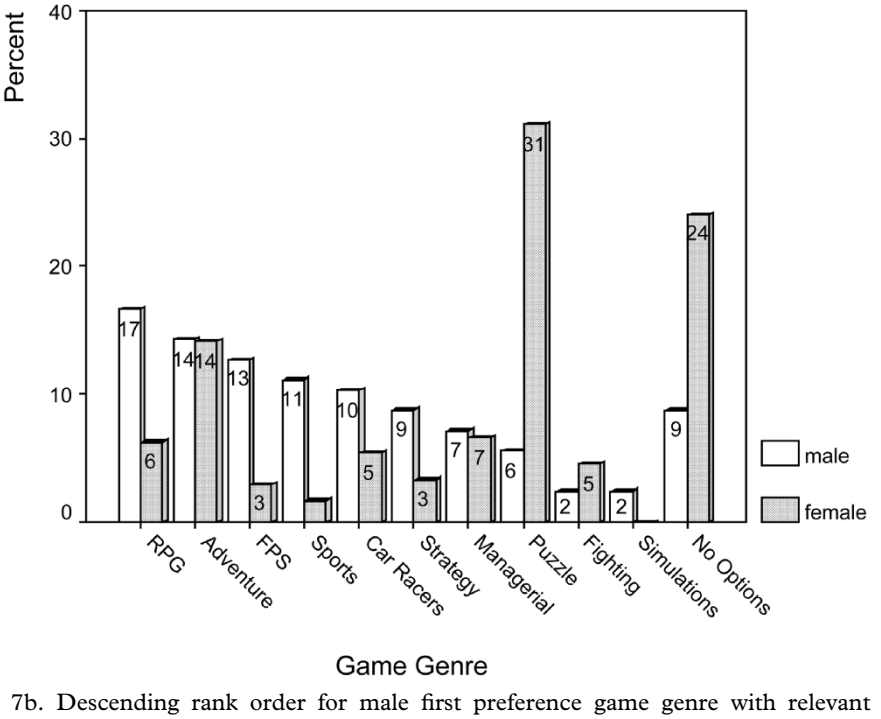

Figure 7b. Descending rank order for male first preference game genre with relevant female preferences

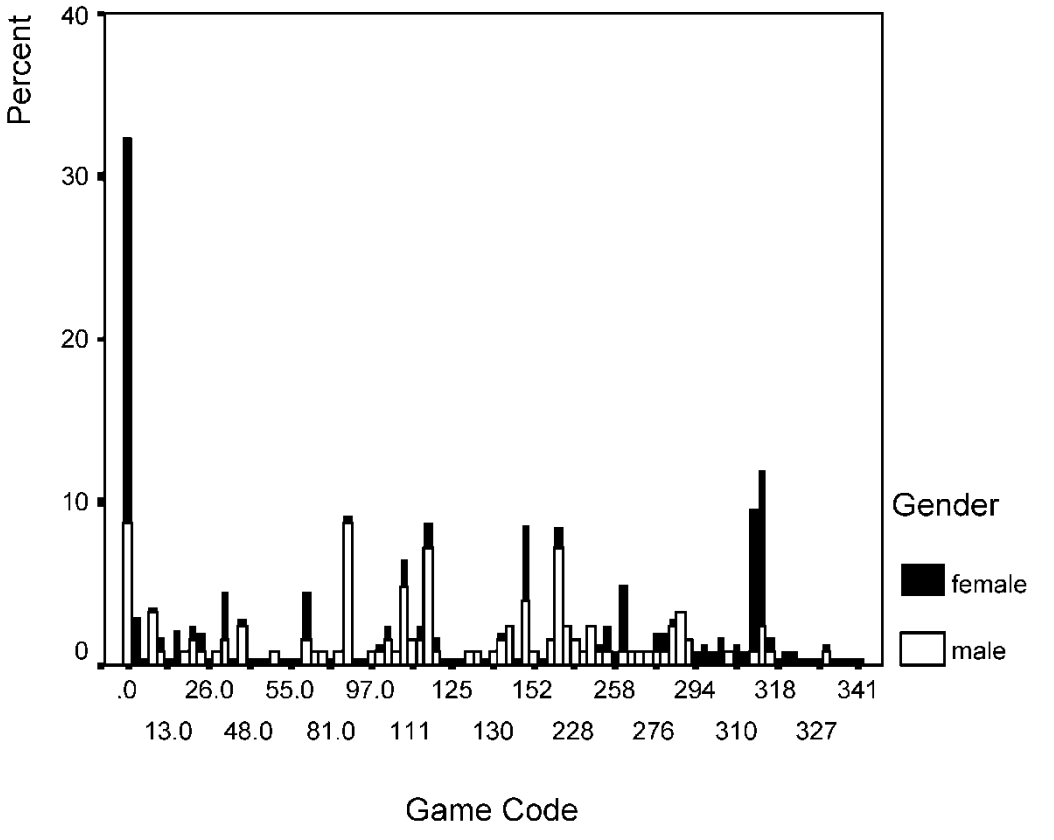

Figure 8. Percentage first preference game options by gender

in contrast with first person shooter games for males. Fighting games involve repeated "gestalts" of actions involving short-term memory comparisons, very similar to those involved in puzzle games. There is minimal use of visuospatial abilities like orientation or targeting. Sherry (2002b) claims that females use such games for challenge and arousal. First person shooters are preferred by males because they are much more aggressive and rely on a whole spectrum of visuospatial skills. This explains also why females prefer car racing games over sports games.

Chi square tests for game genre related to second and third preference game options by gender, for the entire student sample, gave $p < .001$in both cases, showing highly significant differences. As for first preference game options, gender is involved in determining game genre preference. The comparative bar graphs in Figures 9 and 10 give game genre for the second and third preference game options by gender.

The same tendencies in gender–genre associations as described for genre related to the first preference games is observed. But there is an important distinction as regards percentages. For second and third preference games, males show higher percentages than females. Males show a wider repertoire of games than females.

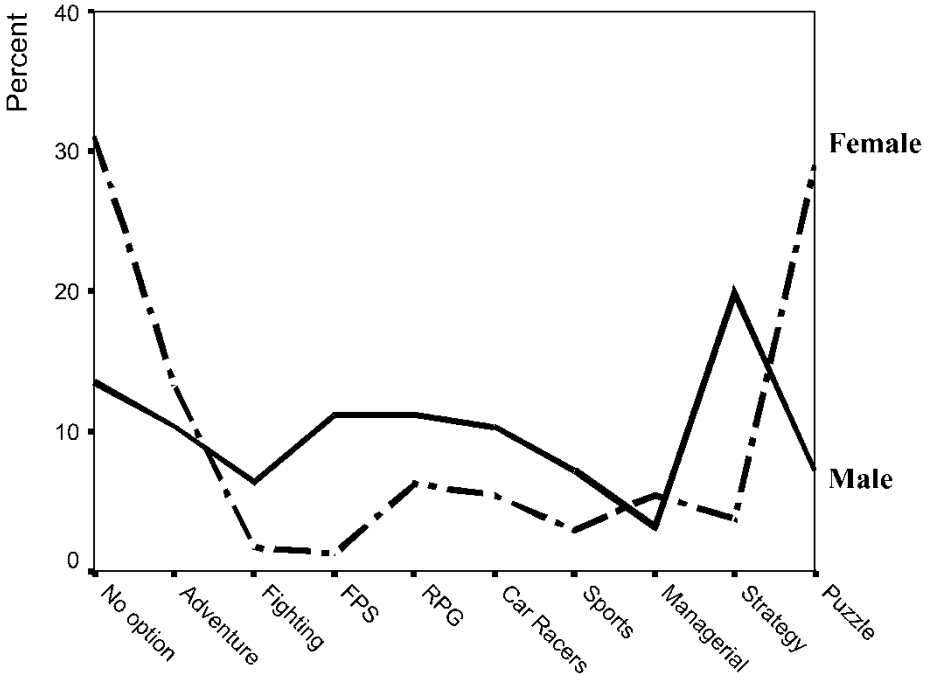

Figure 9. Second preference game genre by gender

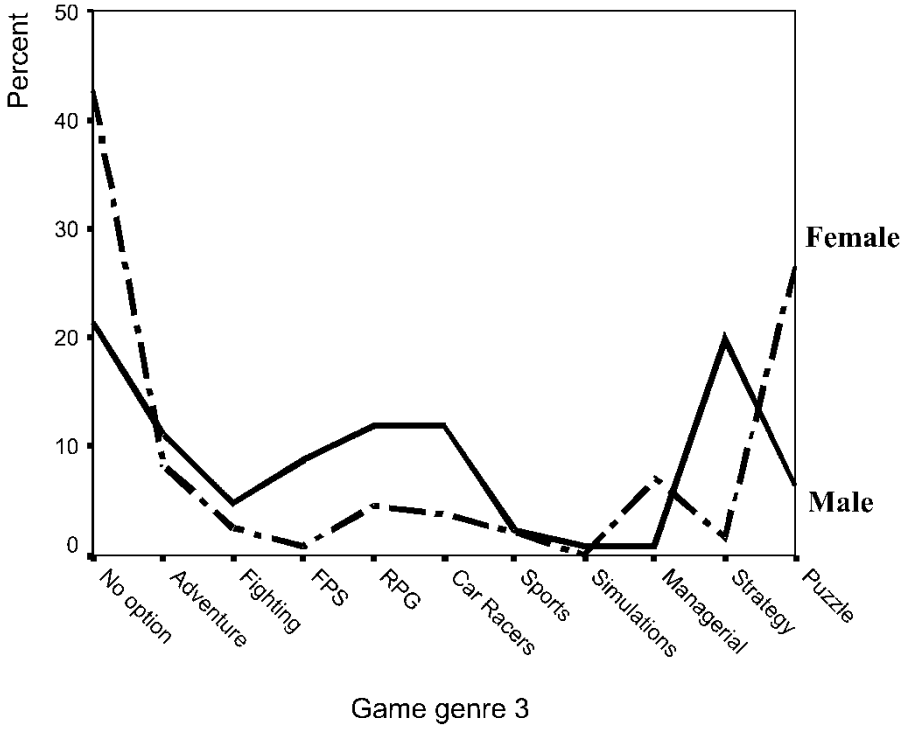

Figure 10. Third preference game genre by gender

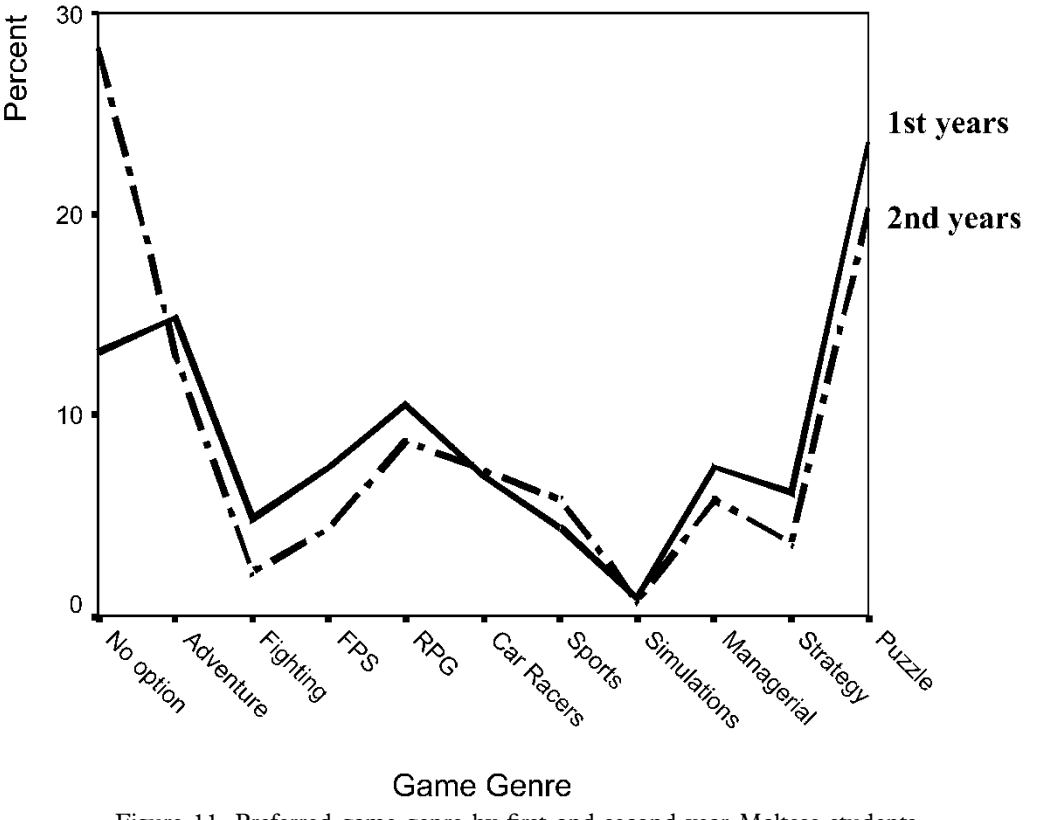

Figure 11. Preferred game genre by first and second year Maltese students

They are more conversant and can give much more game titles when asked than females. This was very evident in questionnaire sheets. While females gave one or very few game titles, many boys gave extensive lists of preferred games.

Is There any Significant Difference in Preferred Game Genre Between First and Second Year Students?

The chi square test for genre of first preference game options with form (first/second year student) gave $p < .281$, showing no significant difference in the type of games used by the two age groups. The relevant comparative bar chart is given in Figure 11.

The decrease in gaming activity is seen in a lower percentage value for most games. The number of students giving no option for preferred games, and hence the related genre, increases outstandingly. A marked decrease in the use of fighting and first person shooter games by second years corresponds to a change in perception; these are apparently considered to be lacking in intellectual stimulation. The slightly higher frequency in preference for car racing and sports games by second year students may be attributed to an increased need for diversion, as a means of

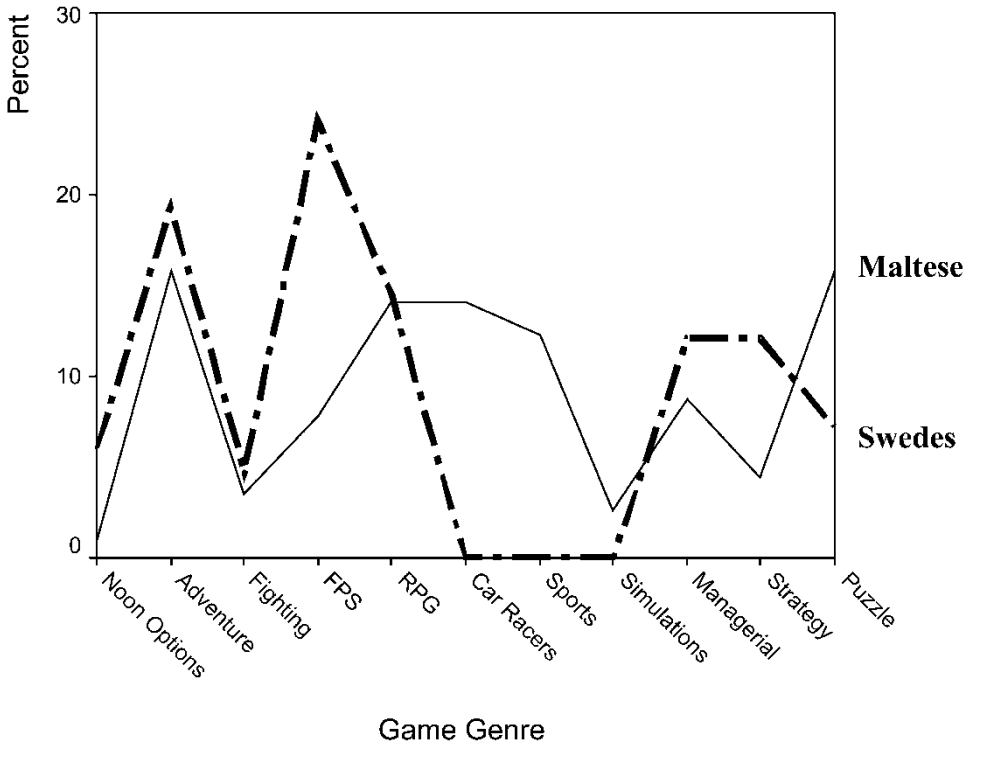

Figure 12. Preferred game genres by college (constructed sample)

alleviating oneself from routine studies. Probably managerial and strategy games are too time consuming and thus less frequently used during the second year of the course.

Is There any Significant Difference in Preferred Game Genre between Maltese and Swedish Students?

Using the constructed sample as described previously, a chi square test for genre of first preference game option with college gave $p < .006$, showing a highly significant difference. A comparative bar chart of percentage frequency for the two colleges (Junior College/Thorildsplan Gymnasium) with genre is given in Figure 12.

Figure 12 illustrates factors contributing to the significant association between the two colleges and genre of first preference games:

- a wider range of game genres was selected by the Maltese (three game genres—car racers, sports, and simulations—were not chosen as first preference games by Swedish students);
- 20% of the Swedes and 15.8% of the Maltese chose adventure games;
- 25% of the Swedes and 9.0% of the Maltese chose first person shooters;
- 12.5% of the Swedes and 8.8% of the Maltese chose managerial games;

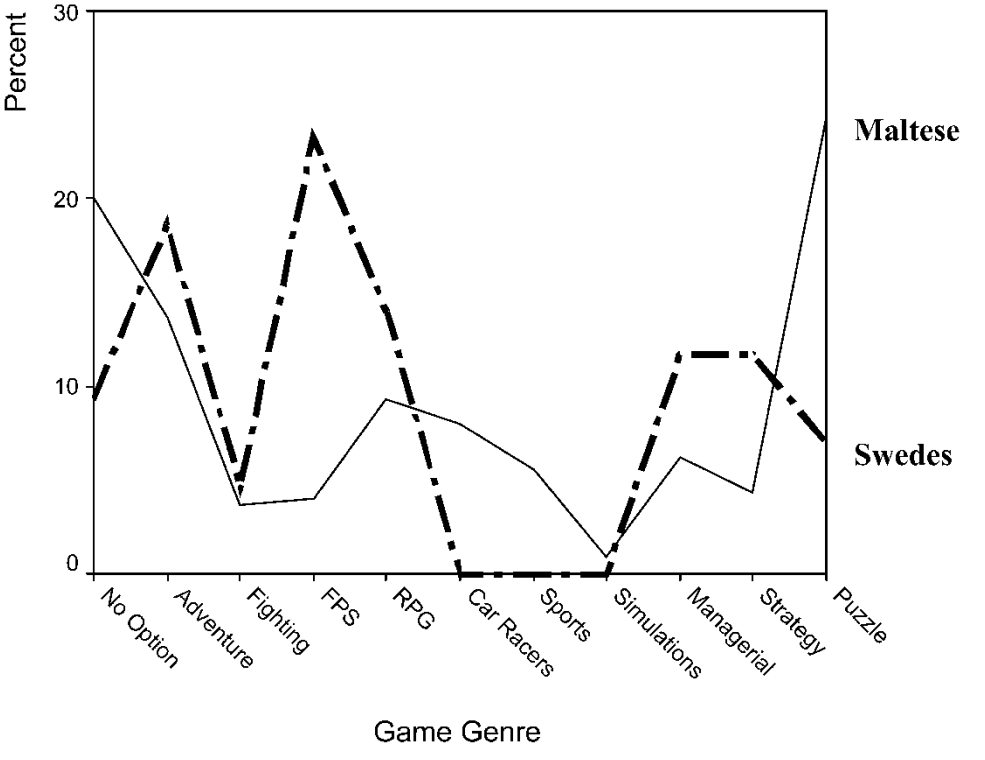

Figure 13. Maltese and Swedes' preferences for different game genres based on real sample

- 12.5% of the Swedes and 4.4% of the Maltese chose strategy games; and
- 7.5% of the Swedes and 15.8% of the Maltese chose puzzle games.

Using frequency tables for the first preference game options of students in this constructed sample, it has been established that the most popular game with Maltese students (with 7.9% selecting it as their first preference) is the "FIFA" football game, followed by the role playing game "Resident Evil" (7%) and the puzzle game "Solitaire" (7%). The most popular game within the Swedish group is the first person shooter "Half-Life" (20%), followed by the adventure game "Supermario" (10%) and the strategy game "Starcraft" (10%). Since the constructed sample has a higher male ratio (m:f = 29:11), then one expects a higher tendency towards games preferred by males over all the sample. This sample-based gender bias is also evident, but obviously in the opposite direction, when one compares the game preferences of the whole Maltese sample with those of the Swedish group. As can be seen in Figure 13, the female component of the Maltese group is immediately evident from the higher value of the no preference option, from the very low preference for first person shooters, and the high value for puzzle games.

Analysis of Figures 12 and 13 shows a higher preference by Swedish students for adventure games, fighting games, first person shooters, role playing games, managerial games, and strategy games. A tentative explanation would be that due to their

changing psychosocial needs, Swedish females are much less attracted to and engaged by games than males. Therefore the bars representing the Swedish game preferences portray a male tendency. Sociocultural components may also be contributing to this complex situation. While Maltese students chose car racers, sports games, and managerial games, none of the Swedes included these.

Conclusion

It is very evident that games offer a context for stylistic expression arising from underlying neurocognitive tendencies. This preliminary investigation into the use of digital games within a Maltese context is in line with findings from similar investigations. Though the computer is the most popular gaming device in use, the tendency in females to play puzzle games leads to a wider use of the mobile phone. Maltese male college students spend more time playing games than females. The pattern for average playtime (hours per week) obtained for Maltese males ($M = 6.712$), females ($M = 2.492$), and for the total group ($M = 3.941$) is comparable to that obtained in other studies (sample mean = 5.00 for British Columbia teens—Media Analysis Laboratory, 1998; and college males $M = 13.77$, females $M = 4.65$—Sherry et al., 2002b). The lower values can be attributed to a number of factors. The lower mean for the whole group is a consequence of the limited time available for playing digital games (and in fact for all other leisure activities), considering that Maltese students are enrolled in a very intensive two-year course that compels them to dedicate most of their time to study. The overt resistance to or apprehension about playing digital games from a good percentage of female students confirms this. Predominant gender scripts in relation to this medium amplify this trend.

The above analysis of gaming tendencies discloses a number of underlying cognitive and motivational gender-related trends. The high percentage of females opting for puzzle, adventure, fighting, and managerial games confirms Sherry et al.'s (2002b) findings that females' top reasons for playing include challenge and arousal. Males' preference for first person shooters, role playing games, and sport and strategy games indicates gratification of different needs—challenge and social interaction. These tendencies can also be seen as a process of accommodation to different underlying gender-related neurocognitive processes. The preferred games of females capitalise on their natural propensities and skills such as perceptual speed, fine motor skills, and sequenced hand movements (Watson & Kimura, 1991). Games preferred by males demand a higher visuospatial ability involving localisation, orientation, mental rotation, target-directed motor skills, greater reaction speed, increased aggression, and greater risk taking. This confirms Halpern and Wright's (1996) and Casey's (1996) claim that males excel at tasks requiring maintenance and manipulation of information in working memory, while females excel at tasks which require rapid access and retrieval of information from stored memory. While males excel at tasks that benefit from combining new strategies, such as mental rotation ability, females tend to draw on memory of past algorithms or knowledge such as verbal fluency, rather than inventing new approaches. These

underlying neurocognitive processes manifest themselves externally as gender-related processing styles. Referring to Turkle and Papert (1990), Rommes (2002) claims that males prefer command structure approaches in computers, as they want to feel in control and they are not afraid of taking risks in learning how to use a computer, thus preferring a "learning by doing" approach. Females favour a more concrete, contextualised, intimate "bricolage" approach and they do not like to take risks while learning, (Turkle 1988; Turkle & Papert, 1990). Game genre preference is yet another context where these tendencies are expressed.

In conclusion, it is important to highlight the indispensable role of metacognition both in the context of learning with the computer through computer-based tools, and learning from the computer, especially about oneself. Digital games can prove to be an enriching experience if they promote reflection about oneself. Gaming experiences should empower users to take control of the underlying cognitive and affective forces that drive this engaging activity. In other words, digital games should serve as a context not only for unbridled intuitive activity, but as an experience that promotes awareness and control. Digital games should lead to a deeper knowledge of one's cognition and motivation, thus enabling better management of these two personality components. For example, knowledge of gender-related stylistic approaches, that manifest themselves so overtly in games, should lead one to appreciate one's neurocognitive and affective assets. At the same time, keeping in mind the eventuality of situations demanding uncongenial processing styles, it is indispensable to change stylistic shortcomings into challenges. Is it possible to use digital games to develop uncongenial male and female processing skills? Is it possible to use specific digital games to develop visuospatial skills in females and training in linguistic skills and memory retrieval in males?

Also, this enhanced metacognitive reflection and personality awareness should challenge established beliefs about technology, technological artefacts, and accepted constructed identities, especially gender scripts (Akrich, 1992; Rommes, 2002) in relation to digital games. Future development of games and use of digital games for instructional purposes should take into consideration this essential meta level intrapersonal and interpersonal activity. By merging action with reflection, digital gaming will be transformed into an experience of personal growth.

References

Ackerman, P. L. (1996). A theory of adult intellectual development: Process personality, interests, and knowledge. *Intelligence*, *22*, 227–257.

Ackerman, P. L., Kyllonen, P. C., & Roberts, R. D. (1999). *Learning and individual differences: Process, trait, and content determinants*. Washington, DC: American Psychological Association.

Akrich, M. (1992). The de-scription of technical objects. In W. Bijker & J. Law (Eds.), *Shaping/technology building society: Studies in sociotechnical change* (pp. 205–224). Cambridge, MA: MIT Press.

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, *12*, 353–359.

Baenninger, M., & Newcombe, N. (1995). Environmental input to the development of sex related differences in spatial and mathematical ability. *Learning and Individual Differences*, *7*, 363–379.

Bonanno, P. (2001). *Cognitive style and academic performance of advanced biology students.* Unpublished MPhil Dissertation, University of Malta.

Bryden, M. P., & George, J. (1990). Sex differences and the role of figural complexity in determining the rate of mental rotation. *Perceptual and Motor Skills*, *70*, 467–477.

Casey, M. B. (1996). Gender, sex, and cognition: Considering the interrelationship between biological and environmental factors. *Learning and Individual Differences*, *8*, 39–53.

Coren, S., Ward, L. M., & Enns, J. T. (1994). *Sensation and perception* (4th ed.). Fort Worth, TX: Harcourt Brace College Publishers.

Crawford, M., Chaffin, R., & Fitton, L. (1995). Cognition in social context. *Learning and Individual Differences*, *7*, 341–362.

Fisher, S. (1994). Identifying video game addiction in children and adolescents. *Addictive Behaviors*, *19*, 545–553.

Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (1998). *Cognitive neuroscience: The biology of the mind.* New York, London: W. W. Norton and Company.

Gordon, H. W., & Lee, P. A. (1986). A relationship between gonadotropins and visuospatial function. *Neuropsychologia*, *24*, 563–576.

Gouchie, C., & Kimura, D. (1991). The relationship between testosterone levels and cognitive ability patterns. *Psychoneuroendocrinology*, *16*, 323–334.

Griffiths, M. D. (1991) The observational analysis of adolescent gambling in UK amusement arcades. *Journal of Community and Applied Social Psychology*, *1*, 309–320.

Halpern, D. F. (1986). *Sex differences in cognitive abilities.* Hillsdale, NJ: Erlbaum.

Halpern, D. F. (1992). *Sex differences in cognitive abilities* (2nd ed.). Hillsdale, NJ: Erlbaum.

Halpern, D., & Tan, U. (2001). Stereotypes and steroids: Using a psychobiosocial model to understand cognitive sex differences. *Brain and Cognition*, *45*, 344–392.

Halpern, D. F., & Wright, T. M. (1996). A process oriented model of cognitive sex differences. *Learning and Individual Differences*, *8*, 3–24.

Inglis, J., & Lawson, J. S. (1982). A meta-analysis of sex differences in the effects of unilateral brain damage on intelligence test results. *Canadian Journal of Psychology*, *36*, 670–683.

Kimura, D. (1996). Sex, sexual orientation and sex hormones influence human cognitive function. *Current Opinion in Neurobiology*, *6*, 259–263.

Krikorian, R., Bartok, J. A. & Gay, N. (1996). Immediate memory capacity for nonsequential information: the configural attention test. *Neuralpsychology*, *10*, 352–356.

MacCoby, E., & Jacklin, C. (1974). *The psychology of sex differences.* Stanford, CA: Stanford University Press.

Margolis, J., & Fisher, A. (2002). *Unlocking the clubhouse: Women in computing.* Cambridge, MA: MIT Press.

Media Analysis Laboratory. (1998). *Video game culture: Leisure and play preferences of B.C. teens.* Media Analysis Laboratory, Simon Fraser University. Burnaby B.C.

Moffat, S. D., & Hampson, E. (1996). A curvilinear relationship between testosterone and spatial cognition in humans: possible influence of hand preference. *Psychoneuroendocrinology*, *21*, 323–337.

Nicholson, K. G., & Kimura, D. (1996). Sex differences for speech and manual skill. *Perceptual and Motor Skills*, *82*, 3–13.

Phillips, C. A., Rolls, S., Rouse, A., & Griffiths, M. D. (1995). Home video game playing in schoolchildren: A study of incidence and patterns of play. *Journal of Adolescence*, *18*, 687–691.

Riding, R. (1991). *Cognitive Styles Analysis users' manual.* Birmingham, UK: Learning and Training Technology.

Rommes, E. (2002). *Gender scripts and the Internet*. Enschede The Netherlands: Twente University Press.

Rosengren, K. E., & Windahl, S. (1989). *Media matter: TV use in childhood and adolescence*. Norwood, NJ: Ablex Publishing Corporation.

Rubin, A. (1994). Ritualized and instrumental television viewing. *Journal of Communication*, *34*, 67–77.

Sherry, J. L. (2001). The effects of violent video games on aggression: A meta-analysis. *Human Communication Research*, *27*, 409–431.

Sherry, J. L., Lucas, K., Rechtsteiner, S., Brooks, C., & Wilson, B. (2001). *Video game uses and gratifications as predictors of use and game preference*. Paper presented at the annual International Communication Association, San Francisco, CA.

Sherry, J., de Souza, R., Greenberg, B. S., & Lachlan, K. (2002a). *Age and video game U and G: Why do adolescents play video games? Developmental stage predicts video game uses and gratifications, game preference, and amount of time spent in play*. Retrieved 24/3/03 from http://web.ics.purdue.edu/~sherryj/videogames/papers.htm

Sherry, J., Holstrom, A., Binns, R., Greenberg, B. S., & Lachlan, K. (2002b). Gender and electronic game play. Retrieved 24/3/03 from http://web.ics.purdue.edu/~sherryj/videogames/papers.htm

Stumpf, H. (1995). Gender differences in performance on tests of cognitive abilities: Experimental design issues and empirical results. *Learning and Individual Differences*, *7*, 275–287.

Subrahmanyam, K., & Greenfield, P. M. (1994). Effects of video game practice on spatial skills in girls and boys. *Journal of Applied Developmental Psychology*, *15*, 13–32.

Tannenbaum, P. (1996). Do you want to bet on it? Having confidence in research findings. *Journal of Behavioral and Social Sciences*, *1*, 217–226.

Turkle, S. (1988). Computational reticence: Why women fear the intimate machine. In C. Kramarae (Ed.), *Technology and women's voices* (pp. 41–61). New York, London: Routledge and Kegan Paul.

Turkle, S., & Papert, S. (1990). Epistemological pluralism: Styles and voices within the computer culture. In I. Harl & S. Papert (Eds.), Constructionism (pp. 161–193). Norwood, NJ: Ablex.

Vlachos, F., Andreou, G., & Andreou, E. (2003). Biological and environmental influences in visuospatial abilities. *Learning and Individual Differences*, *13*, 339–347.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin*, *117*, 250–270.

Watson, N. V., & Kimura, D. (1991). Nontrivial sex differences in throwing and intercepting: Relation to psychometrically-defined spatial functions. *Personality and Individual Differences*, *12*, 375–385.

Watson, N. V., & Kimura, D. (1989). Right-hand superiority for throwing but not for intercepting. *Neuropsychology*, *27*, 1399–1414.

Wigand, R. T., Borstelmann, S. E., & Boster, F. J. (1985). Electronic leisure: Video game usage and the communication climate of video arcades. *Communication Yearbook*, *9*, 275–293.

Wilson, J. R., DeFries, J. C., McClearn, G. C., Vanderberg, S. G., Johnson, R. C., & Rashad, M. N. (1975). Cognitive abilities: Use of family data as a control to assess sex and age differences in two ethnic groups. *International Journal of Aging and Human Development*, *6*, 261–275.

Appendix.

Data Table: Game Code

Ad	*Adventure Games*
2	Crash Bandicot
6	Driver
7	Grand Theft Auto 1–8
9	Harry Potter and the Chamber of Secrets
13	Highlander
17	Indiana Jones
20	Midtown madness 2
21	Metal Gear Solid
22	Monkey Island
26	Ragman
29	Rainbow 6 Black Thorn
36	Supermario
44	Worm Odessey
45	Worms–Red Alert
48	Asterix
49	Spyro
50.1	Planet of the Apes
50.3	In Cold Blood
Ftg	*Fighting Games*
53	Diehard II
55	Death Trap Dungeon
60	Street Fighter
61	Tekken 1/2/3....Tag
64	Golden Axe
FPS	*First Person Shooters*
76	Battle Field 1942
81	Duke Nuekin
83	Ghost Recon
84	Half Life
94	Pac Man
95	Hitman
97	Doom
100	Red Faction
100.2	Quake
100.4	Blade of Darkness
RPG	*Role—Playing Games*
107	Final Fantasy 1–8
111	Mafia–City of Lost Heaven
112	Max Payne
113	Resident Evil 1–4
118	Tomb Raider 1–5
125	Hercules
125.1	Nox
125.3	Aladdin
125.5	Shadowbane
CR	*Car Racers*
126	4 X 4 Evolution
129	Carmageddon

130	Colin McRoe Rally
135	Formula 1
137	Gran Turismo 1–3
139	Kart Racing
144	Need for Speed 1/2/ …….
152	GT Advance 3: Pro Concept Racing
154	Rage Racers
	Sports
180	D with Managerial Championship Manager included Games.
182	FIFA 98–2003
188	ISS Pro Evolution Soccer
Sim	*Simulations*
228	Flight Simulator 95/98/2000….
230	Flight Unlimited 1–3
MG	*Managerial Games*
252	Championship Manager
256	Sim City 2000
257	Roller Coaster Tycoon
258	Theme Hospital
260	The Sims
262	Zootycoon
263	Caesar III
264	Deus Ex
Stg	*Strategy Games*
276	Age of Empires 1/2/3 …
280	Civilisation 1/2/3
281	Command and Conquer
289	Starcraft 1/2/3 …
293	Warcraft 1/2/3
294	Age of Mythology
Puz	*Puzzle Games*
304	Encarta Mindmaze
305	Freecell
307	Minesweeper
308	Music 200 (Music Maker)
310	Pinball
311	Puzzle Bubble
313	Snake
314	Solitaire
317	Tetris
318	Tic Tac Toe
322	Spider Solitaire
323	Bantuni
324	Hexa
325	Risk I/II
327	Draughts
329	Crazy Taxi
330	Looney Tunes
333	Hamgaroo
335	Bricks
337	Bookworm
341	Line up 4