Sex Roles
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BRIEF REPORT

Gender, Video Game Playing Habits and Visual Memory Tasks

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Abstract The current research examined whether visuospatial recall of both abstract and common objects was related to gender or object familiarity. Seventy two undergraduates from a university in the Southern U.S. were asked to draw the Rey Complex Figure and a series of common objects from memory. A pilot sample of seventy three undergraduates had previously identified common objects as "male" "female" and "neutral" exemplars. Males were significantly better at drawing "male" and "neutral" exemplars whereas females were better at drawing "female" exemplars. Neither gender was significantly better at the Rey task. These results question whether males have an inherent advantage in visual memory. Results also found that experience with playing violent video games was associated with higher visual memory recall.

Keywords Gender · Computer games · Visual memory

Introduction

In January of 2005 Lawrence Summers, then president of Harvard University, suggested that the discrepancy between males and females entering the engineering professions could be better explained by "innate" factors rather than social influences. Among other influences, such as innate differences in interest, Summers suggested that innate differences in abilities related to engineering may also play a role in lower rates of females entering engineering and science professions (Summers 2005). Summers' comments set off a very emotional reaction throughout various political and scientific organizations, (e.g. National Organization of Women 2005; Hennessey et al. 2005). Arguably much of this reaction was to an unpopular belief that promised little hope for change. This reaction is also arguably understandable; given the history of prejudice and oppression that has impeded women's progress in engineering and the sciences. However, the intensity of reaction that followed Summers' comments resolved little in regards to whether men and women inherently differ in regards to the visuospatial abilities that are typically required in engineering professions. This paper seeks to address this issue by considering whether differences in visual memory can be better explained by gender, or rather by object familiarity (i.e. learning history). Furthermore, this paper will also examine whether individuals who have "trained" themselves for visuospatial tasks through experience with video games demonstrate a "transfer of appropriate processing" to other visual memory recall tasks.

Gender and Visuospatial Ability

Much has been written and debated about the issue of whether males and females differ in overall intelligence (e.g. Halpern 2000; Nyberg 2005; Pinker and Spelke 2005). It is beyond the scope of this paper to review this body of literature. Rather this paper will concern itself specifically with research regarding gender differences in visuospatial ability. For some time it has been argued that, due to evolutionary differences arising from the gender based division of labor in hunter–gatherer societies (Silverman

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and Eals 1992; Morris 1999) men and women have developed different abilities related to visuospatial organization and perception which persist until the present day. It remains less clear, however, whether these differences would translate into an overall gender difference in visuospatial ability, or whether each gender would demonstrates strengths in specific visuospatial abilities related to the food gathering tasks that hunter–gatherer ancestors had engaged in.

A number of articles have suggested gender differences in relation to visuospatial processing (e.g. Livesey and Intili 1996), perception (e.g. Collaer and Hill 2006; Cherney and Collaer 2005) and mental rotation tasks (e.g. Parsons et al. 2004). Generally these differences favor men, suggesting an overall better average male performance on visuospatial tasks relative to females. Halpern and Collaer (2005) suggest that such differences may be due to a combination of factors, including differences in neurological organization, exposure to sex hormones, different learning experiences and social stereotypes. Many of the tasks used to assess visuospatial ability are of a relatively abstract nature, somewhat removed from day-to-day visuospatial tasks. Common tasks involve visual memory of abstract objects (e.g. the Rey task, described below), abstract visual attention tasks such as the flanker compatibility task (Green and Bavelier 2003) and mental rotation tasks involving fitting abstract 'solids' together into puzzles (e.g. Tetris-like games). As the size of effect noted in visuospatial ability differences between the genders varies with the specific task (Halpern and Collaer 2005) development of tasks which are more representative or externally valid may be important to understanding the extent of gender differences in visuospatial ability in real-world environments. The possibility remains that the observed sex differences may be due less to an actual innate difference, and rather because the abstract tasks assigned in these tests favor abilities and experiences that are more often practiced by males. For example Cherney and Collaer (2005) found that prior experience with math courses, as well as gender, predicted performance on visual perception tasks.

In regards to understanding the mechanism for gender differences in visuospatial performance, several studies have focused on attentional factors. Livesey and Intili (1996) in a study of 4-year-old children and using block design and a visual memory task, found that boys tended to make better use of visuospatial cues than did girls, accounting for their better performance on both tasks. Collaer and Hill (2006) similarly noted that attentional factors helped explain gender differences on a visuospatial perception task in adult undergraduates. It may be, however, that the attention cues provided in these abstract tasks are those that favor tasks which males practice in real life, and tend not to favor tasks that females practice.

Carroll (1993) notes that visuospatial abilities consist of multiple individual abilities which are not always directly related. Gender differences in ability on these tasks may vary by task, with greater gender differences for abilities such as mental rotation, and less differences for abilities such as visual memory (Voyer et al. 1995). Baenninger and Newcombe (1995) note that gender differences in visual spatial abilities may be due to differences in experiences with boys receiving more relevant life experiences than girls, although there has been little research to conclusively demonstrate this possibility.

Video Games and Visuospatial Abilities

As an example of one particular task in modern society that may be useful in honing visuospatial ability, repetitive play of computer games may facilitate the transfer-appropriate-processing of visuospatial tasks used in the games to other cognitively related visuospatial tasks. Tasks such as mental rotation, speeded perception and visual memory are likely to be enhanced by different types of computer games and the cognitive abilities practiced during these tasks may transfer to other related visuospatial tasks. For instance, De Lisi and Wolford (2002) found that children who played computer games subsequently outperformed a control group on a mental rotation task and that this effect worked for both boys and girls. Similarly Yi and Lee (1997) found that boys with greater video game experience demonstrated better mental rotation and processing speed than boys with less video game experience and this benefit came without any significant costs in regards to behavior problems. Sims and Mayer (2002) however found that while video game experience did enhance performance on mental rotation task, no enhancement was seen on other visuospatial tasks. Thus transfer-appropriate-processing is domain specific. The game used in their experiment (Tetris) is fairly specific itself as a mental rotation game. Other games that call upon various visuospatial abilities may produce benefits in other visuospatial skills.

Several studies have examined violent video games specifically. Generally these studies have found the violent/action games are associated with significant increases in visuospatial ability (Castel et al. 2005; Green and Bavelier 2003; Green and Bavelier 2006; Rosser et al. 2007). Given that the effects for violent games appear to be larger and more transferable than those found for non-violent games (e.g. Sims and Mayer 2002) there may be something specific about the performance expectations of violent games that actually fosters visuospatial abilities. Given that males are more likely that females to choose violent video games to play (Griffiths and Hunt 1996) this may help elucidate some of the specific differential practice effects seen for males and females, particularly in recent generations.

The transfer-appropriate-processing model would suggest that cognitive tasks that are learned in one modality are likely to transfer experience enhanced performance to similar cognitive tasks (Graf and Ryan 1990). Video games and violent games in particular often involve the need for visual attention to details as game responses may vary dependent upon those details (e.g. different weapons for different enemies; differential responses to ‘bad guys’ and ‘innocent bystanders’). Increased practice with the use of detail-specific visual memory recall may be expected to transfer to other visual memory recall tasks under the transfer-appropriate-processing model.

The Present Study

The present study seeks to expand upon the existing literature in two ways, in this case involving visual memory. Visual memory was chosen as it is an area which has been examined to a lesser degree than other visuo-spatial tasks related to gender differences and video game play. First, males and females were given a series of visual memory recall tasks. Unlike in other studies the objects to be recalled (and drawn) varied between “masculine”, “neutral” and “feminine” exemplars. A pilot study of potential exemplar items was conducted to identify those that are most highly associated with male and female gender. In the main study, participants were asked to recall and draw from memory objects which the pilot sample had identified as being more familiar to males and females, or equally familiar to both sexes. If males demonstrated better visual recall across all tasks, this would argue in favor of the belief that males are inherently better at overall visual memory than are females, irrespective of the practice potential of the task, as would be consistent with research in other areas of visuospatial ability. By contrast, if males and females each demonstrated better visuospatial recall for objects that are “domain specific” or more familiar and practiced for “average” individuals of their gender, this would suggest that the transfer-appropriate-processing model is a better explanation for group gender differences in visuospatial ability. The first hypothesis of this study was that visual memory would be “domain specific”, namely that males would be significantly better at visual recall for “male” exemplars with females significantly better at visual recall of “female” exemplars. The second element of this study was to examine whether experience with video game playing is predictive of performance on a visual memory recall task. Both previous total exposure to video games and exposure to violent video games specifically were examined. As violent video games such as first-person-shooters often involve the use of different strategies for different opponents, such games may provide a particular practice opportunity for visual memory practice. As such, the second hypothesis of this study was that video game experience and experience with violent video games specifically would be significantly predictive of visual memory.

Pilot Study

In order to identify common objects for memory recall with which males and females would have had greater prior experience, a pilot test was conducted to provide empirically valid exemplars.

Method

Participants

The pilot study sample consisted of 73 students from a predominantly Hispanic serving university in South Texas. Of the participants, 23 (32%) were male and 50 (68%) were female. The majority of the participants (67 or 92%) were Hispanic, with 2 Caucasian (2%), 1 African-American (1%) and 3 who were listed as “Other” (4%). The mean age of the participants was 22.5 (SD=3.6) with a mean education level equivalent to junior standing in college.

Measures

Participants in the pilot study were presented with a rating sheet with 29 potential exemplars (Table 1). One potential item (M-16) had been eliminated prior to testing due to potential specialized knowledge required. Participants were asked to rate on a 4-point Likert scale how much experience they felt they had either using or viewing each object. All objects were common objects that most individuals of either gender would be expected to have seen during their lifetime. None of the objects required specialized knowledge. Example objects include, “baby carriage,” “umbrella,” and “cell phone.”

Procedure

Potential participants were approached in classroom settings and offered an opportunity to participate in the study in exchange for extra credit. Student volunteers were provided with an informed consent form, which they were asked to read and then sign. Students then were given a demographic questionnaire as well as the object checklist described above. All procedures were designed to comply with APA standards for psychological research with human subjects. MANOVA analyses with gender as the indepen-

Table 1 Ratings of familiarity for common items.

Variable	Male	Female
House	3.91 (.29)	3.94 (.24)
Umbrella	2.65 (1.27)	3.38 (1.05)
Bicycle	3.09 (.95)	3.34 (1.00)
Tulip	2.26 (1.05)	2.88 (.99)
Cat	3.00 (1.00)	3.28 (1.05)
Barstool	2.91 (1.28)	3.06 (1.07)
Football	3.57 (.77)	3.33 (1.05)
Tow truck	2.61 (1.20)	2.40 (1.07)
Desktop computer	3.83 (.39)	3.82 (.48)
Electric guitar	2.52 (1.31)	2.65 (1.22)
Revolver	2.78 (1.28)	2.00 (1.09)
Diamond ring	2.52 (1.31)	2.65 (1.22)
Spider	2.57 (1.17)	3.34 (1.00)
Swiss army knife	3.09 (1.04)	3.16 (1.03)
Baby carriage	2.70 (1.11)	3.18 (1.04)
Compact (makeup)	1.70 (.97)	3.74 (.56)
Brassier	2.09 (1.18)	3.46 (1.01)
Coffee pot	2.57 (1.20)	3.42 (.95)
Video game controller	3.40 (.94)	2.65 (1.12)
Microwave oven	3.48 (.79)	3.67 (.72)
Saddle	2.43 (1.30)	2.14 (1.14)
Cell phone	3.70 (.76)	3.92 (.34)
Ipod	3.48 (.90)	3.08 (1.03)
Eyeglasses	3.30 (1.26)	3.46 (1.00)
Hand mixer	2.22 (1.17)	2.58 (1.18)
Leaf blower	2.35 (1.34)	2.08 (1.10)
ATM card	3.43 (.84)	3.86 (.53)
High-heeled shoe	2.13 (1.36)	3.70 (.76)
Printer	3.65 (.65)	3.78 (.58)

Standard deviations are in parentheses. Items were measured on a 4-point Likert scale from “1 = Not at all familiar” to “4 = Very familiar.”

dent variable and familiarity score for each object as the dependent variable were used in order to determine the most suitable “exemplar” items.

Results

Results from the MANOVA analysis revealed that there was a significant main effect for gender on ratings of exemplars (using Wilk’s Lambda F [30, 36]=6.06, p<.001; d=.82). Potential exemplars were identified s for both “masculine” “feminine” and “neutral” items by examining the effect size outcomes for the univariate analyses. For the “masculine” items, the two items rated as more familiar with males with the highest effect size were selected. These proved to be “revolver” (F [1, 65]=7.68, p<.01; d=.67) and “video game controller” (F [1, 65]=6.53, p<.01; d=.63). For the “feminine” items, the two items rated as more familiar with females with the highest effect size were selected. These proved to be “make up compact” (F [1, 65]=117.98, p<.001; d=2.67) and “brassier” (F [1, 65]=25.96, p<.001; d=1.25). For the “neutral” items, two items with effect sizes that were close to 0 were selected. These were “bicycle” (F [1, 65]=.40, p>.05; d=.17) and “eyeglasses” (F [1, 65]=.13, p>.05; d=.08).

Discussion

The pilot study was successful in identifying two “male,” “female” and “neutral” exemplars. As can be seen the “female” exemplars are somewhat more gender specific than the “male” exemplars, possibly due to a greater diffusion of females into male roles than males into female roles. These six identified exemplars were used in the second (main) study.

Main Study

Method

Participants

The main study sample consisted of 72 students from a predominantly Hispanic serving university in South Texas. Of the participants, 29 (40%) were male and 43 (60%) were female. The majority of the participants (66 or 92%) were Hispanic, with 2 Caucasian (3%), 1 Asian-American (1%) and 3 who were listed as “Other” (4%). The mean age of the participants was 23.6 (SD=6.0) with a mean education level equivalent to junior standing in college.

Materials

Rey complex figure The Rey complex figure test (Meyers and Meyers 1995) is a measurement of visual memory and perceptual organization. In this task a complicated, abstract figure is presented to participants who are then asked to draw the figure from memory. Recall can either be immediate or delayed. In the case of the current study, an immediate recall was used. Scoring is based upon the positioning and distortion of 18 separate parts of the drawing and is based upon the system presented in Spreen and Strauss (1998). Participants were given a point “credit” if the part of the drawing was placed in the correct location, and a second point for each part that had been drawn correctly, irrespective of placement. Interrater reliability for the Rey task was .93. Spreen and Strauss report that the Rey complex figure task demonstrates an internal consistency reliability of .80 and is predictive of individuals with cognitive decline, right-hemisphere legions and occipital lobe and frontal lobe lesions. The Rey task is used to provide a reference point for visual memory for an object with which participants have no prior familiarity.

Exemplars Six exemplars were identified in the pilot study, and were used here. The revolver and video game controller were “male” exemplars, the brassier and make-up compact were “female exemplars, with the bicycle and eyeglasses as “neutral” exemplars. Standardized rubrics for scoring the exemplars based upon the presence or absence of six separate components of each exemplar. For example the rubric for the exemplar “bicycle” included “chain that leads to rear wheel,” “identifiable seat”, “frame between seat and rear wheel forms an ‘A’ shape,” “brakes located on handlebars or petals,” “wheels have spokes” and a rating of overall quality for a total possible score of “6.” Score ranges on all exemplars were from zero to six. Each participant’s exemplar drawings were rated by two independent raters who had been trained in scoring. Interrater reliability for exemplar scoring was .91. Masculine, feminine and neutral exemplars were collapsed into single “masculine” “feminine” and “neutral” visual recall exemplar scores combined across raters.

Video game habits A measure of video game playing habits adapted from that described in Anderson and Dill (2000) was used to measure video game playing habits. Participants were asked to list games that they had regularly played. For each of the listed games participants were asked to respond to item “How often do you play this game?” on a 5-point Likert scale anchored from “Almost never” to “Very often.” For each of the listed games participants were also asked to respond to item “How violent is the game?” on a 5-point Likert scale anchored from “No violence” to “Extremely violent.” Ratings for time exposure and violent content were multiplied and summed across all listed games to compute a score assessing total exposure to violent game content. Participants were also asked to report how many hours per week they played video games recently as well as during high school and middle school. This allowed for a general measure of video game playing habits in participants. In our sample, the measure of exposure to violent video games obtained a coefficient alpha of .88. The coefficient alpha for time spent playing all video games currently and in the past was .85.

Procedure

Students were approached in classrooms and invited to participate in exchange for extra credit. Student volunteers signed up for appointment times in a specially designated laboratory. Participants were first presented with an informed consent form which they were asked to read and then sign. After students had given consent, they were shown the Rey complex figure for 1 min duration and then asked to draw it in immediate recall with a 3 min time limit. Participants were asked to draw each of the six exemplars (revolver, make-up compact, bicycle, video game controller, brassier, eyeglasses, in that order) from memory and were given 3 min for each drawing. Each exemplar was named verbally one at a time without any visual cues, with 3 min pause for drawing between each exemplar. Time limits were used in order to examine both accuracy and efficiency of visual memory recall. Finally, following the six exemplars, participants were asked to fill out a demographic sheet and the video game questionnaire. Video game exposure is based on previous life experience and thus such data is correlational in nature.

Results

The first hypothesis of this study was that male and female performance on visual memory would be “domain specific” with males performing better on “male” exemplars and females performing better on “female” exemplars. In order to understand the domain specificity of visual memory, a baseline analysis for an abstract drawing (the Rey test) for which domain specificity was unlikely (as neither gender had prior experience with it) was conducted. Differences between males and females on the Rey complex figure test, “masculine,” “feminine” and “neutral” exemplars were analyzed using MANOVA analyses. In each analysis, the effect size is denoted in terms of d. Results indicated a significant main effect for gender (using Wilk’s Lambda F [4, 67]=10.38, p<001; d=.80). Univariate analyses revealed no significant differences between males and females on the Rey complex figure test (F [1, 70]=.00, p<.99; d=.00). In fact the male mean of 47.24 (SD=13.32) was identical to the female mean 47.24 (SD=11.49). Since the Rey presents an abstract item that is not subject to prior experience, this provides an illuminating look at the raw visual memory abilities of males and females.

Gender differences in male, female and neutral exemplar visual memory were examined to test the first hypothesis that visual memory was domain specific. As hypothesized, visual memory did demonstrate domain specificity,

Table 2 Means, standard deviations and effect size d for masculine, feminine and neutral exemplars.

Gender	Masculine	Feminine	Neutral
Males	18.93 (SD=3.66)	13.34 (SD=4.46)	13.24 (SD=3.92)
Females	14.93 (SD=4.76)	15.37 (SD=3.70)	11.44 (SD=3.25)
	d=.93	d=.49	d=.52

Note: d=effect size Cohen’s d for exemplar categories by gender.

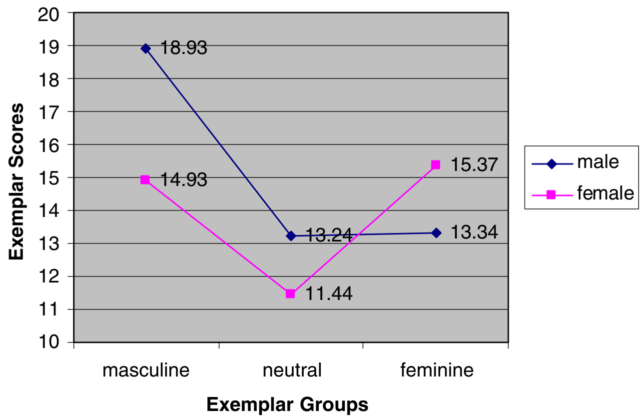

Fig. 1 Male and female means on visual memory exemplar groups. Note: score ranges are from 0 to 24.

although males also demonstrated better visual memory recall of "neural" items than did females. Specifically univariate analyses revealed that males demonstrated greater visual memory recall for "masculine" items (F [1, 70]=14.63, p<.001; d=.93) and "neutral" items (F [1, 70]= 4.50, p<.05; d=.52). Females demonstrated greater visual memory recall for "feminine" items (F [1, 70]=4.41, p<.05; d=.49). It should be noted that the effect sizes for these results (See Cohen 1992) range from "moderate" to (for the case of "masculine" exemplars) large. Table 2 presents means and standard deviations for male and female participants across the three exemplar groups. Male and female means for each of the exemplar groups are demonstrated in Fig. 1.

The second hypothesis of the study was that experience with video games and violent games specifically would predict visual memory performance. Regarding the relationship between video game experience and drawing ability, time spent playing video games (in hours per week since middle school) and exposure to violent video games specifically were correlated with drawing ability for the Rey test, each of the exemplar groups and total drawing ability (a composite score of the Rey and six exemplars). Out of concern that the male exemplar "video game controller" would provide an unfair advantage to video game players, this exemplar was dropped from the "masculine" exemplar group and from the total drawing ability measure. Results of these correlations are presented in Table 3. Results supported the hypothesis that time spent playing video games as well as exposure to violent video games specifically predicted increased visual memory recall performance, including for the Rey task (for total time playing video games) and for male (the revolver, since the video game controller was removed from this analysis) and neutral exemplars but not for the female exemplars. Because of the possibility that these results may be due to gender effects rather than do to unique effects of the video games themselves, (i.e. that males self-select to play more violence video games than do females) two stepwise regressions were used to control for gender effects. In the first regression, total video game playing time and gender were entered as predictors of visual memory as measured by the drawing tasks. Results indicated a positive predictive relationship, R=.33, R^2=.11, which was statistically significant F (1, 70)=8.51, $p \le .01$. An examination of standardized coefficients (β or beta-weight) found that only video game exposure (β=.33; partial r=.33) to be a significant predictor of visual memory. Gender was not a significant predictor. With the video game controller included in the analyses, results were essentially unchanged R=.34, R^2=.11, which was statistically significant F (1, 70)=8.98, $p \le .01$. An examination of standardized coefficients (β or beta-weight) found that only video game exposure (β=.34; partial r=.34) to be a significant predictor of visual memory. Related to violent video game exposure, regressions results indicated a positive predictive relationship, R=.26, R^2=.07, which was statistically significant F (1, 70)=4.98, $p \le .02$. An examination of standardized coefficients (β or beta-weight) found that only violent video game exposure (β=.26; partial r=.26) to be a significant predictor of visual memory. Gender was not a significant predictor. With the video game controller included in the analyses, results were essentially unchanged R=.28, R^2=.08, which was statistically significant F (1, 70)=5.73, $p \le .02$. An examination of standardized coefficients (β or beta-weight) found that only violent video game exposure (β=.28; partial r=.28) to be a significant predictor of visual memory.

Discussion

Results from this study help elucidate differences in visual memory recall performance in males and females.

Table 3 Zero-order correlations between outcome and predictor measures

Variable	Rey	Video game controller	Revolver	Make-up compact	Bra	Bicycle	Eyeglasses	Total drawing ability
Time playing	.22*	.19	.42**	.08	.10	.24*	.34**	.34**
Violent games	.17	.22	.34**	.14	.01	.25*	.30*	.28*

Time Playing = Time spent playing all video games; Violent Games = Exposure to violent video games specifically.
*$p \le .05$
**$p \le .01$

Results generally supported the first hypothesis of the study that visual memory recall develops through transfer-appropriate-processing with each gender developing domain specific abilities relative to common tasks that they practice with regularly. Lack of differences on the Rey test is consistent with this observation, as the "abstract" nature of the Rey task would shield it from gender-specific transfer-appropriate-processing. Males may have a slight advantage in that they demonstrate increased visual memory recall for "neutral" exemplars as well as "masculine" exemplars. Results from this study demonstrate differences in performance for gender-specific tasks and suggest that visual memory recall is related to task specificity. Although the results are supportive of the belief that task experience drives performance, it is also possible that innate ability may be instrumental in guiding self-initiated task experience. It should be emphasized that it remains unclear whether these differences in visual memory recall ability are evolutionarily inherent or due to socialized differences in practice effects. The transfer-appropriate-process model here appears to be adjustable to either path of development, and naturally it may be that both evolutionary and learning effects are at work to produce differences between males and females. However, gender effects in visual memory may prove to be more nuanced than has previously been thought.

Arguably both the evolved behaviors related to "hunting" and "gathering" would involve visuospatial tasks, although the specifics of these tasks may vary. Males, presumably relegated to the hunting side of ancestral food procurement, may have evolved to develop skills related to mental rotation, distance estimation and speeded processing. Females, presumably relegated to the gathering side of food procurement (see Morris 1999), may have developed visuospatial abilities related to visual recognition, visual memory and visual accuracy. Thus, visuospatial abilities may follow along a transfer-appropriate-processing model (see Graf and Ryan 1990; Roediger 1990) wherein performance on visuospatial tasks is related to experience with cognitively similar tasks. Although usually conceptualized along a learning/experience paradigm, transfer-appropriate-processing is not incompatible with an evolutionary approach in which differences in innate preferences increases the probability that males and females will practice at different tasks, and thus hone somewhat different visuospatial abilities.

Regarding the effects of playing video games, it appears that time spent playing video games, including exposure to violent video games specifically, is associated with enhanced performance on visual memory recall tasks consistent with the second study hypothesis. This effect was true even when gender was controlled, and thus can not be explained merely as gender differences in video game playing habits. As many video games involve memory for shapes (whether Tetris shapes, spaceships, enemies, etc.) it is not surprising to find that practicing at video game playing would be associated with improvements in cognitively relevant tasks. This, too, is consistent with transfer-appropriate-processing. It should be noted that this element of the study was correlational and thus causality can not be inferred.

Future research could expand upon the current results in several ways. First, more studies that examine cognitive abilities in relation to gender and domain-specific behaviors may provide a more nuanced understanding of gender differences in cognitive abilities that move beyond much of the current debate regarding overall intelligence differences. It may ultimately prove difficult to examine whether such differences are evolutionary in nature or are due to socialization or some combination of the two, but efforts to examine the etiology of such gender differences would be enlightening. Finally, given the expansion in the use of video games, including those with violent content, it may be fruitful to examine the benefits (rather than simply the risks) of playing such games with an aim toward developing games that may provide learning opportunities as well as entertainment. Although it has been common to vilify games with violent content, it may be more useful to examine ways in which games with such content can be put to positive use. An example, called *Re-Mission* (a first person shooter game) has already been developed for cancer education and has demonstrated positive results in young cancer patients (Kato and Beale 2006). More developments along these lines would be welcome.

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