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Men Do Not Rule the World of Tanks: Negating the Gender-Performance Gap in a Spatial-Action Game by Controlling for Time Played

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Abstract

The present research addresses the stereotype that women and girls lack the ability to succeed compared to men and boys in video games. Previous lab-based research has found that playing spatial-action video games potentially reduces the gender gap in spatial-thinking skills, while previous field studies of less spatially oriented online games have found that the perceived gender-performance gap actually results from the amount of previous gameplay time, which is confounded with gender. Extending both lines of research, the present field study examines player performance in a spatial-action game, the vehicle-based shooter *World of Tanks*. Results from 3,280 players suggest that women appear to accrue fewer experience points per match than men, signaling lower performance ability, but that when the amount of previous gameplay time is statistically controlled, this gender difference is negated. These results lend support to the claim that playing video games—even spatial-action games—diminishes the gender-performance gap, which is potentially useful for promoting gender equity in STEM fields.

Keywords

gender-performance gap stereotype, online games, spatial-action games, field study

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The gender-performance gap stereotype—the notion that women and girls lack the ability to succeed in technical pursuits compared with men and boys—is common in video games. Although nearly half of all gamers are women and girls (Entertainment Software Association, 2018), they are still treated as inferior minorities (Hartmann & Klimmt, 2006; Kafai et al., 2008; Lucas & Sherry, 2004; Ratan, Taylor, et al., 2015; Williams et al., 2009); and face hostility, harassment, negative gender stereotypes, and sexism in gaming communities and the games industry (Fox & Tang, 2014; Fullerton et al., 2011; Gray, 2012; Ivory et al., 2014). When women and girls encounter such treatment, they become demotivated to gain experience in video gaming, diminishing their ability to develop skills and thereby reinforcing the "men are better at video games" stereotype in a self-fulfilling cycle (Brown et al., 1997; Chan, 2008). Exposure to gender stereotypes in video gaming also promotes stereotypical attitudes about offline behavior (e.g., women should be communal, nurturing, and sympathetic, while men should be competitive, ambitious, and independent; Eagly & Karau, 1991, 2002; Kidder, 2002). This has implications in the workplace, such as the expectation that women belong in jobs that are considered "pink-collar" or feminine (e.g., nurse, teacher, secretary; Britton, 2000). Furthermore, because video games promote skills and interest in STEM (Science, Technology, Engineering, and Math) fields (Cassell & Jenkins, 2000; Granic et al., 2014; Subrahmanyam & Greenfield, 1994; Turner, 2014), the stereotype that women and girls cannot succeed in video gaming may hinder their pursuit of these technical fields. Clearly, the gender-performance gap stereotype is harmful in multiple ways and so the present research aims to contribute evidence to help debunk this stereotype.

The gender-performance gap stereotype in video games, observed through social and cultural patterns, is seemingly validated by research findings of biologically based sex differences in spatial reasoning (Lauer et al., 2019; Maccoby & Jacklin, 1978). Because many video games require spatial reasoning, some may argue that females are at a biological disadvantage as gamers compared with males. However, spatial cognition differences result not purely from biological sex, but also from environmental and psychosocial factors (Levine et al., 2016), such as gender, which is not binary and is not fully correlated with sex (Bem, 1981; Lips, 2017; Wong et al., 2016).[1] Meta-analyses suggest that spatial abilities can be improved through training (Baenninger & Newcombe, 1989; Uttal et al., 2013), although training often influences women and men similarly and thus does not reduce the gender-performance gap (Spence & Feng, 2010; Uttal et al., 2013). However, lab-based studies have found that playing certain spatial-action video games (e.g., fast-paced games that require navigation in a three-dimensional virtual environment or object rotation) over a significant amount of time (at least four cumulative hours) enhances women's spatial skills to a greater extent than men's, thereby diminishing the gender gap (Cherney, 2008; Feng et al., 2007). This suggests that spatial-action video games—which some people willingly play for large amounts of time in their daily lives—might be helping to counteract the gender-performance gap in video games.

Previous research on online games "in the wild" (i.e., field studies) suggests that performance differences are largely driven by factors that are confounded with gender,

such as the amount of play time, but not gender itself (Lehdonvirta et al., 2014; Ratan, Taylor, et al., 2015; Riedl et al., 2015; Shen et al., 2016). As a limitation, such field studies have focused on a subset of game genres (e.g., online role-playing games) that require a relatively low level of spatial-thinking skills compared with other genres (e.g., shooters). Addressing this limitation, the present research contributes a similar inquiry but in the context of spatial-action video games. In other words, the present study merges two lines of research: lab studies which have found that spatial-action video games can reduce gender-performance gaps (in a controlled context) and field studies which have found that performance gaps are driven by time played, not gender, for players of online games ("in the wild"). The present research thereby extends the external validity of both these lines of research.

Literature Review and Hypotheses

Some video games research may seem to support gender stereotypes. Men and boys have been found to prefer more competitive, action, achievement-oriented game genres and roles, while women and girls prefer more cooperative, casual, assistive, and socially oriented games and roles (Cassell & Jenkins, 2000; Jansz et al., 2010; Lucas & Sherry, 2004; Nielsen, 2009; Poels et al., 2012; Shen, 2013; Trepte et al., 2009; Williams et al., 2009; Yee, 2006). People may believe that such distinctions arise from sex differences in certain types of spatial cognition, such a mental rotation, which are well-documented (Lauer et al., 2019; Maccoby & Jacklin, 1978). However, sex-based spatial cognition differences have been found to dissipate through multiple types of training, including playing video games (Cherney, 2008; Feng et al., 2007; Spence & Feng, 2010). Furthermore, a growing body of research suggests that implied associations between gender and skill in gaming are flawed (Taylor, 2012) because they underemphasize the fact that men and boys have more previous experience and spend more time playing games compared with women and girls (Lucas & Sherry, 2004; Williams et al., 2009). In other words, women and girls appear to have lesser abilities in video games simply because they tend to spend less time with games than men and boys, in part because of the demotivating sexism experienced in these environments. But as this time distinction diminishes, so do the gender differences in abilities (Blumberg & Sokol, 2004; Jenson et al., 2007; Ratan, Fordham, et al., 2015).

Multiple studies have used large-scale data sets to dispel the gender-performance gap stereotype, though these have been almost entirely from nonspatial-action game genres. One study with approximately 14,000 players from the massively multiplayer role-playing online games (MMOs) *EVE Online* and *EverQuest II* found that when statistically controlling for the amount of time played, there was no meaningful difference in the amount of virtual resources that men and women accrued (Lehdonvirta et al., 2014). Another study of approximately 11,000 players from *Everquest II* and *Chevaliers' Romance III*, a Chinese MMO, found no difference in the rate at which players levelled up, or increased their in-game levels, when controlling for total time played (Shen et al., 2016). Another study of approximately 17,000 players in the multiplayer online battle arena game (MOBA) *League of Legends* found that when

statistically controlling for the number of matches played, there was no meaningful gender difference in players' skill rating, as reflected by a skill metric developed by the game company (Ratan, Taylor, et al., 2015). And another study with approximately 110,000 players from the online real-time strategy (RTS) game *Travian* found that even without controlling for playing time, women *outperformed* men in the game's primary success metric (village population) in multiple countries (e.g., Finland, Indonesia; Riedl et al., 2015).

While these previous studies lend strong support to the argument that the gender-performance gap stereotype in video games is inaccurate, there is little research to support the applicability of this claim within spatial-action game genres. This is an important extension of the previous research given that video games often require skills like mental rotation, for which there is evidence of sex-based cognitive differences (Lauer et al., 2019; Maccoby & Jacklin, 1978); thus, potentially supporting the stereotypical view that women players may be adept at "casual" genres of games, but inept in spatially oriented genres, like shooters (i.e., the gender-performance gap stereotype; Lucas & Sherry, 2004; Paaßen et al., 2016; Vermeulen et al., 2011). However, some research suggests that playing action-oriented video games diminishes this gender-performance gap (Cherney, 2008; Feng et al., 2007; Spence & Feng, 2010), suggesting that the same may be true in spatially oriented games.

Following the findings from nonspatial-action games (Lehdonvirta et al., 2014; Ratan, Taylor, et al., 2015; Riedl et al., 2015; Shen et al., 2016), we expect that women have spent less time playing than men (Hypothesis 1), and thus the gender-performance gap will appear to be real given a simple comparison of performance between men and women players (Hypothesis 2). However, this gap might be negated when the amount of time spent playing the game is controlled statistically in this comparison. We probe this possibility in a research question, but do not articulate it as a hypothesis because it is essentially an expectation of failing to reject the null hypothesis after a previous similar test successfully rejected it.

Hypothesis 1: Among players of a spatial-action game, women have spent less time playing than men.
Hypothesis 2: In a simple comparison by gender, men perform better than women at a spatial-action game.
Research Question 1: When controlling for amount of time spent playing a spatial-action game, are the performance differences suggested by a simple gender comparison negated?

Method

Data were collected from the game *World of Tanks* (WoT), an online tank-battle game in which teams of 7 to 15 players battle each other in 15-minute matches using tanks of different types and strength tiers from a first-person perspective. This "hardcore" game (Peeples, 2015) can be classified within the vehicle-based shooter genre, similar

to first-person shooters, and satisfies our criteria as a spatial-action game. Through a collaboration with the research team, the game's publisher, Wargaming.Net, supplied both survey data and matching behavioral data from the game's server logs.

The survey data were collected via invitation between March 14 and 19, 2018, with 15,000 players who had completed at least 300 matches invited from both North and South America and 3,502 survey completions, for a response rate of 23.34%. No participation incentive was awarded and all participants provided consent for their data to be used. Players were invited by Wargaming.Net to participate in the voluntary survey "to help us make World of Tanks even more fascinating by delivering a better experience to our players." The survey included a variety of questions about social and psychological variables and demographics that were not examined in the present research. Survey invitations were distributed randomly, to a stratified sample of players based on experience levels. Specifically, given the potential for differing response rates based on experience level, the sample was weighted to achieve approximately equal representation across experience levels (split into 10 groups across all experience points). This facilitated a balanced representation across levels and thus likely representativeness of the player base, with the caveat that only players who had completed at least 300 matches were invited (ensuring that all respondents were beyond the initial learning period).

The behavioral data were drawn retroactively for these 3,502 players for the time period of March 1 to March 31, 2018, covering over one million matches played. After eliminating incomplete responses and nonactive players, we have a study sample of 3,280 cases, with 3,227 men and 53 women, consistent with responses to the game company's prior surveys of their players. This demonstrates that WoT is a particularly masculine space, although many studies of gender-related patterns have relied on smaller samples of women or girls (Feng et al., 2007; Hoeft et al., 2008; Kinzie & Joseph, 2008; Tafalla, 2007).

Measures

Player performance was assessed by total earned experience points (XP) during March 2018. XP are earned primarily by damaging enemy tanks, assisting others, and winning battles. It is a direct measure of in-game performance. We aggregated all XP earned during the 31-day period for every player.

- Battle count was the total number of battles in which a player was involved during the study period.
- Prior battle count was the player-lifetime battle count prior to the study period.
- Tank level, based on a 1 to 10 ranking defined in the game, was calculated as the average tank level a player used in battles during the study period. This measure was included as a control variable because higher level tanks do more damage and thus earn more XP.
- Participant gender was recorded through the survey.

Analysis

To test Hypotheses 1 and 2 comparing men and women players' various experience and performance indicators, we conducted a series of one-tailed independent sample *t* tests. Because there were far more men than women, we used Welch's *t* test as it is a better alternative than the original student *t* test for samples with unequal variance and unequal sample size (Ruxton, 2006). We calculated the effect sizes for these simple comparisons using Hedge's *g*, which is similar to Cohen's *d* but does not assume equal sample sizes (Hedges & Olkin, 1985).

To test Research Question 1, we ran a linear regression model predicting total XP earned during the study period. The independent variable is gender (men being the comparison group), and control variables included the players' lifetime battle count prior to the study period, the number of battles played during the study period, and average tank level during the study period.

Results

We found that, consistent with Hypothesis 1, women tend to have less experience playing WoT than men. According to a series of Welch's *t* tests, prior battle count, study-period battle count, and tank level were all lower for women than men (Table 1). Effect sizes for these comparisons are in the 0.20 to 0.30 range, which are considered small but not negligible.

Consistent with Hypothesis 2, also according to a Welch's *t* test, women gained lower XP per battle than men (Table 1). The effect size is also small but not negligible, with a Hedge's *g* of 0.28.

Finally, addressing Research Question 1, results of a regression analysis did not find that that performance differed by gender when controlling for study-period battle count, prior battle count, and tank level (Table 2).

Discussion

The present study offers one of the first large-scale examinations of the gender-performance gap stereotype in a spatial-action game, a genre which tends to be stereotypically masculine. This study contributes to a body of research which suggests that performance differences in online games are largely driven by factors that are confounded with gender, such as amount of play time, but not gender itself (Lehdonvirta et al., 2014; Ratan, Taylor, et al., 2015; Riedl et al., 2015; Shen et al., 2016). However, these previous studies examined games that rely on spatial-thinking skills to a lesser extent than in the present research. Findings from 3,280 players of a vehicle-based shooter, WoT, suggest that the gender-performance gap stereotype is inaccurate, even in spatial-action games, driven by gendered disparities in the amount of play time, not actual differences in skill. Specifically, women players were found to have played fewer matches and to gain lower XP in a simple comparison by gender. However, when the amount of play was statistically controlled, this gender difference was negated.

Table 1. Comparison of Men and Women's Game-Related Metrics.

	Men (N = 3,227)	Women (N = 53)	t	p (one tail)	Hedge's g
Prior battle count	14902.86	11392.75	1.8264	.03668	0.2528635
Study-period battle count	333.7242	260.8868	2.2235	.01514	0.3078907
Average tank level	6.599198	6.176733	2.0699	.02164	0.2865847
Performance (XP gained)	124275.36	95195.43	2.0285	.0237	0.2808674

Table 2. Regression Model Predicting Total XP Gain (N = 3,280).

	B	*SE*	t	p
Gender	5.84E + 03	5.66E + 03	1.032	.302
Study-period battle count	3.56E + 02	2.28E + 00	155.968	<.001
Prior battle count	5.94E − 01	5.85E − 02	10.151	<.001
Average tank level	1.64E + 04	5.37E + 02	30.474	<.001
Adjusted R^2 = .8989				

Note. *SE* = standard error.

This finding suggests that gendered stereotypes about performance ability in digital games are inaccurate, even in spatially oriented game genres. Although there are biologically based sex differences in spatial reasoning (Lauer et al., 2019; Maccoby & Jacklin, 1978), in addition to biological (e.g., hormonal) differences, environmental and psychosocial factors influence spatial cognition (Levine et al., 2016), which explains why they can be improved through training (Baenninger & Newcombe, 1989; Uttal et al., 2013). The present research is consistent with previous lab-based findings that the gender-performance gap diminishes after a significant amount of time spent playing spatial-action games (Cherney, 2008; Feng et al., 2007). However, unlike these previous studies in which participants played for 4 to 10 hours of a spatial-action game in a controlled environment, most participants in the present study had played thousands of matches of WoT, constituting hundreds of hours of gameplay. Thus, the present findings provide evidence that spatial-action video games—which some people willingly play for large amounts of time in their daily lives—might be helping to counteract the gender-performance gap in video games.

This study extends two lines of research. It contributes to the external validity of the lab-based studies of video games as a tool for training spatial cognition (Cherney, 2008; Feng et al., 2007), supporting the notion that the gendered-performance gap can be reduced through gaming "in the wild." Furthermore, this study contributes to the validity of the research on the gender-performance gap stereotype in online games, suggesting that the stereotype is inaccurate for spatial-action games in addition to the less-spatially oriented types of games previously studied (Lehdonvirta et al., 2014; Ratan, Taylor, et al., 2015; Riedl et al., 2015; Shen et al., 2016).

This research has notable practical implications, namely that women and girls should be supported and encouraged to play spatial-action games, despite the negative social forces they may encounter (Fox & Tang, 2014; Fullerton et al., 2011; Gray, 2012; Ivory et al., 2014), in order to help break the vicious cycle of the gendered-performance gap in video games (Brown et al., 1997; Chan, 2008) by counteracting the stereotype. In other words, by playing more spatial-action games, women and girls may diminish the preexisting performance gap by improving their spatial-thinking skills at a greater rate than men and boys, and thereby offering evidence that the stereotype is false. Of course, this is easier said than done and requires support from gaming communities and friends to stand up against the demotivating hostility and sexism that women and girls tend to encounter in these environments (Fox & Tang, 2014; Fullerton et al., 2011; Gray, 2012; Ivory et al., 2014). The present research provides empirical evidence that could help fuel such social support. If gaming communities recognize that women and girls can compete at the same level as men and boys given a sufficient amount of gameplay time, then these communities will hopefully facilitate the opportunities for such gameplay. The benefits of this more egalitarian gaming context extend beyond itself, given that both video gaming and spatial cognition (Wai et al., 2009) are associated with skills and interest in STEM fields (Cassell & Jenkins, 2000; Granic et al., 2014; Subrahmanyam & Greenfield, 1994; Turner, 2014).

Limitations

As a primary limitation, although this study included a large total population compared with most research in the field, the sample of women players was relatively small. Just as with other studies of games and gender that have used small samples of women or girls (Feng et al., 2007; Hoeft et al., 2008; Kinzie & Joseph, 2008; Tafalla, 2007), it is possible that the women WoT players in this study—especially those who persist into the higher levels—are not representative of women generally or women gamers (which is also true for the men in this study as well as most academic research studies). We attempted to address this issue by using a stratified sample to ensure an equal representation across experience levels. Furthermore, the finding that women from the sample had less experience and lower skills than the men players in the simple gender comparison, not controlling for time played, is consistent with other studies of other game genres. Thus, we believe that the main finding—that controlling for time played negates this gender difference—is reliable given this sample. However, to reinforce this conclusion, future research should examine spatial-action games in which women are more equally represented. In addition, to enhance the validity of inferences regarding the causal direction of these findings, namely that playing spatial-action games for more time reduces gender differences in ability, future research should use experimental methods. A longitudinal field experiment in which participants' amount of spatial-action gameplay is manipulated and gender differences are measured over time would provide further credence to the claim that the gender-performance gap stereotype in video games is false and driven by observations of spurious correlations.

The present research was also limited in its ability to consider how microtransactions may influence the gender-performance gap. In WoT, a free-to-play game, some players use real currency to purchase slight in-game advantages (e.g., stronger tanks or ammunition). If men are more or less likely than women to spend money for such advantages, this could augment or diminish the gender-performance gap. Future research should consider the effect of such purchasing behavior on performance differences.

Conclusion

The limitations notwithstanding, the present research contributes to the growing evidence that women and girls are just as capable as men and boys at video games, even in spatially oriented game genres. Given the link between spatial-action games and the development of skills and interest in STEM fields (Cassell & Jenkins, 2000; Granic et al., 2014; Subrahmanyam & Greenfield, 1994; Turner, 2014), this study supports the claim that promoting gender equity in video gaming may help facilitate gender equity in STEM fields as well.

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Note

1. While recognizing this important distinction between gender and sex, we still examine the gender-performance gap stereotype as binary (women and girls compared with men and boys) given that the stereotype derives from social and cultural associations of video gaming as a masculine space.

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