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EMPIRICAL RESEARCH

Does Playing Sports Video Games Predict Increased Involvement in Real-Life Sports Over Several Years Among Older Adolescents and Emerging Adults?

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Abstract Given the extreme popularity of video games among older adolescents and emerging adults, the investigation of positive outcomes of video game play during these developmental periods is crucial. An important direction for research in this area is the investigation of a link between sports video game play and involvement in real-life sports among youth. Yet, this association has not been examined in the long-term among older adolescents and emerging adults, and thus represents an exciting new area for discovery. The primary goal of the current study, therefore, was to examine the long-term association between sports video game play and involvement in real-life sports clubs among older adolescents and emerging adults. In addition, we examined whether self-esteem was an underlying mechanism of this longitudinal association. We surveyed older adolescents and emerging adults ($N = 1132$; 70.6 % female; M age = 19.06 years, range of 17–25 years at the first assessment) annually over 3 years about their video game play, self-esteem, and involvement in real-life sports. We found a long-term predictive effect of sports video game play on increased involvement in real-life sports over the 3 years. Furthermore, we demonstrated that self-esteem was an underlying mechanism of this long-term association. Our findings make an important contribution to an emerging body of literature on the positive outcomes of video game play, as they suggest that sports video game play may be an effective tool to promote real-life sports participation and physical activity among older adolescents and emerging adults.

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Keywords Sports video game play · Self-esteem · Involvement in real-life sports · Older adolescents · Emerging adults · Longitudinal

Introduction

Video games are a very popular form of media among older adolescents (e.g., 18–21 years; Steinberg 2010) and emerging adults (e.g., up to 25 years; Arnett 2000). According to Lenhart et al. (2008), 81 % of 18–29-year-old Americans play video games and half of these older adolescent and emerging adult gamers play games at least a few times a week. Through the 1990s and early 2000s, psychological research on video games (not including "serious" games which are designed for purposes other than entertainment) was focused on negative outcomes such as aggression (see meta-analytic reviews by Anderson et al. 2010; Ferguson in press; Greitemeyer and Mügge 2014; but also Ferguson and Kilburn 2010 for critiques of this literature) to a greater degree than positive outcomes (see reviews by Adachi and Willoughby 2013a; Granic et al. 2014). Recently, however, researchers have begun to focus increasingly on the positive impact of video games on attitudes and behavior. A novel direction for research in this area is the investigation of a link between sports video game play and involvement in real-life sports among youth. For example, Adachi and Willoughby (2014a) recently demonstrated that sports video game play predicted higher involvement in real-life sports clubs over time among adolescents (participants were in grade 9 at the beginning of the 4-year longitudinal study). Yet, this long-term association has not been examined among older adolescents and emerging adults, and thus represents an exciting new area for discovery. Specifically, it is important to elucidate

long-term predictors of older adolescents' and emerging adults' involvement in real-life sports, because real-life sports participation and physical activity are associated with a host of positive outcomes during these age periods, such as positive social interactions and a sense of belonging (e.g., Sturts and Ross 2013), higher life satisfaction (e.g., Maher et al. 2013), and higher university retention rates (e.g., Huesman et al. 2009). The primary goal of the current study, therefore, was to examine the long-term association between sports video game play and involvement in real-life sports clubs among older adolescents and emerging adults. In addition, we examined whether self-esteem was an underlying mechanism of this longitudinal association.

Self-Determination Theory

Adachi and Willoughby (2014a) situated their work on the long-term link between adolescents' sports video game play and involvement in real-life sports within the Media Practice Model (Steele and Brown 1995), which suggests that adolescents' and emerging adults' specific beliefs and behaviors will influence the type of media that they consume, and, in turn, their interactions with media will impact their beliefs and behaviors. Yet, we believe that the prominent theory of human motivation, Self-Determination Theory (SDT; Deci and Ryan 2000; Ryan and Deci 2000), offers an even more cogent explanation for this long-term association. The primary focus of SDT is on the specific factors that promote or impede motivation. According to SDT, environments that support the satisfaction of the three basic human needs of competence (sense of efficacy), autonomy (personal agency), and relatedness (social connectedness), facilitate optimal functioning, positive well-being (e.g., self-esteem), and intrinsic motivation. Importantly, video game play has been shown to provide support for the satisfaction of these basic needs, and, in turn, positively predicts elevations in psychological well-being such as self-esteem, as well as future video game play (e.g., Przybylski et al. 2010; Ryan et al. 2006). Thus, we hypothesize that self-esteem may be an underlying mechanism through which sports video game play predicts increased involvement in real-life sports over time. Specifically, older adolescents' and emerging adults' sports video game play may predict elevations in self-esteem, which, in turn, may predict increased involvement in real-life sports.

For example, positive experiences during sports video game play, such as experiencing the thrill of victory or developing sport-related knowledge or strategies, may enhance players' sense of competence, and, in turn, may elevate their self-esteem. Furthermore, individuals with higher self-esteem may be more likely to feel optimistic about what they are capable of doing and have the confidence necessary to approach novel challenges, compared to individuals with lower self-esteem (e.g., Taylor and Brown 1988). For instance, researchers have demonstrated that adolescents with higher levels of self-esteem participated in real-life sports more frequently 1 year later, compared to adolescents with lower levels of self-esteem (Adachi and Willoughby 2013b, 2014a).

Sports Video Game Play and Involvement in Real-Life Sports

Given that traditional media use is a sedentary activity, it often has been characterized as a predictor of physical inactivity and obesity (e.g., Krause and Benavidez 2014; Nelson et al. 2007; but also see Kowert et al. 2014 for a study in which limited support was found for negative social, physical, and psychological stereotypes of video game players). With the more recent development of active video games (AVGs) that involve physical activity to play the game (e.g., *Wii Fit*, *DanceDanceRevolution)*, however, researchers increasingly have focused on the positive association between playing AVGs and physical activity. For example, several meta-analyses have found that playing AVGs was positively associated with outcomes such as energy expenditure, heart rate, and oxygen consumption among children, adolescents, and adults (e.g., LeBlanc et al. 2013; Peng et al. 2011; also see systematic review by Barnett et al. 2011).

In contrast, there is a limited amount of work investigating whether playing AVGs has a "gateway" effect on increasing physical activity or real-life sports participation outside of the video game context (see Krause and Benavidez 2014 for a discussion of this potential gateway effect). For example, Kastenmüller et al. (2013) have provided some evidence of this association, as they found that the degree to which participants indentified with their avatar in AVGs was positively related to their motivation to engage in physical activity outside of the game context, as well as to their actual participation in other forms of physical activity one week later (also see Jenney et al. 2013). Similarly, there is limited research examining the predictive effect of playing traditional sports video games (e.g., played with traditional hand-held controllers or keyboards) on increased physical activity or involvement in real-life sports. In terms of initial evidence of this link, Ballard et al. (2009) found that the frequency of sports video game play was positively associated with vigorous physical activity among emerging adults, whereas playing massive multiplayer online role playing games (MMORPGs; non-sports games) was negatively related to physical activity. Ballard et al. suggested that participants who played sports video games may be more intrinsically interested in engaging in physical activity than participants

who played MMORPGs; however, due to the concurrent design of this study (all measures were assessed at one time point), the direction of effects between sports video game play and physical activity were not clear (i.e., does sports video game play predict later physical activity and/or does physical activity predict later sports video game play?).

To our knowledge, Adachi and Willoughby (2014a) have conducted the only longitudinal study on the link between sports video game play and involvement in real-life sports. Using autoregressive cross-lagged path analyses, they demonstrated a bidirectional association between adolescent sports video game play and involvement in real-life sports over 4 years (participants were in grade 9 at time 1), such that sports video game play predicted higher levels of involvement in real-life sports over time, and involvement in real-life sports predicted higher levels of sports video game play over time, controlling for stability in both behaviors. In addition, they found that self-esteem was an underlying mechanism of the predictive effect of sports video game play on involvement in sports. Specifically, sports video game play predicted higher levels of self-esteem over time controlling for stability in self-esteem, and, in turn, self-esteem predicted higher levels of involvement in real-life sports over time, controlling for stability in real-life sports involvement. Adachi and Willoughby concluded that sports video game play may be an important activity to promote real-life sports participation among adolescents. It is unclear, however, whether these longitudinal associations also exist among older adolescents and emerging adults.

The Current Study

The main goals of the current study were twofold. The first goal was to investigate the long-term association between sports video game play and involvement in real-life sports among older adolescents and emerging adults. Consistent with Adachi and Willoughby (2014a), we hypothesized that sports video game play would be associated with involvement in real-life sports over several years among these developmental periods. The second goal was to examine whether self-esteem was an underlying mechanism of this association. Consistent with past research demonstrating a positive link between video game play and self-esteem (e.g., Adachi and Willoughby 2014a; Ryan et al. 2006), we hypothesized that self-esteem would be an underlying mechanism of the long-term predictive effect of sports video game play on involvement in real-life sports. Specifically, we predicted that sports video game play would predict higher levels of self-esteem over time, and, in turn, self-esteem would predict higher levels of involvement in real-life sports over time. In addition, consistent with previous research that has found no moderating effects of gender on the link between video game play and a variety of outcomes (e.g., Adachi and Willoughby 2013c, d), we hypothesized that gender would not moderate the associations between sports video game play and involvement in real-life sports.

Importantly, the present research makes several significant contributions to our developmental understandings of older adolescents and emerging adults. Specifically, we provide the first investigation of the longitudinal links between sports video game play, self-esteem, and involvement in real-life sports during these developmental periods. Second, although the autoregressive cross-lagged path models that were conducted in Adachi and Willoughby (2014a, b) allowed for the examination of whether sports video game play predicted higher levels of involvement in real-life sports over time (and vice versa), these models did not provide information about continuous developmental trajectories or change in these behaviors. In the present research, therefore, we used latent growth curve modelling to examine whether the frequency of sports video game play at one time point predicts *change* in older adolescents' and emerging adults' involvement in real-life sports scores over several years, and vice versa. Finally, it is not clear whether the predictive effect of video game play on involvement in real-life sports is specific only to sports video games, as Adachi and Willoughby did not control for the effect of other types of video game play (e.g., violent games) on involvement in real-life sports. To examine the specificity of this predictive effect, therefore, we included violent video game play (i.e., fighting/action/first-person shooter games) as well as sports video game play as predictors of involvement in sports. We chose to include violent video games in our models because of the high popularity of this game genre (ESA 2014).

Method

Participants

Participants were 1132 undergraduate students (70.6 % female) enrolled at a mid-sized university in southern Ontario, Canada, who were surveyed across 4 consecutive years. At the first assessment, all participants were in their first year of university ($M = 19.06$ years, $SD = .92$, range of 17–25 years). Data on socioeconomic status indicated that mean levels of education for mothers and fathers fell between "some college, university, or apprenticeship program" and "completed a college/apprenticeship and/or technical diploma." Our sample was comprised predominantly of domestic-Canadian students (88 %), and common ethnic backgrounds of these students other than Canadian were British (19 %), Italian (16.8 %),

French (9.5 %), and German (9 %), consistent with the broader demographics for the region (Statistics Canada 2006). Of the international students, the majority were from Asia (36.1 %), European Union (15.7 %), the Caribbean (10.2 %) and Africa (10.2 %). The overall retention rate of these students was excellent. Out of the original 1132 students that completed the survey in Year 1, 84 % completed the survey in at least 2 of the 4 years, and 70 % of the sample was still retained at year 4. This 3-year retention rate is very high. There were no significant differences between participants who completed the survey at all four time points or at less than four time points on any of the study measures. As missing data were not dependent on the values of the study measures, it is reasonable to assume that this data is missing at random (Little and Rubin 2002; Schafer and Graham 2002). Missing data were estimated using the expectation maximization (EM) estimation method. Involvement in real-life sports was not assessed in wave 1; therefore we used variables that were assessed at waves 2, 3, and 4 (hereafter referred to as year 2, year 3, and year 4) in our analyses. The only variables in our models that were assessed in year 1 were the demographic factors (i.e., gender, age, born in Canada, and parental education).

Procedure

First-year university students from various academic disciplines were invited to complete a survey examining factors related to adjustment to university by way of posters, classroom announcements, website posting, and visits to on-campus student residences (year 1). Participants were given monetary compensation for their participation at year 1 ($10), year 2 ($20), year 3 ($30), and year 4 ($40). At year 2, 3, and 4 all students who participated in the first assessment (year 1) were invited to participate again, by way of emails, posters, and classroom announcements. All assessments were conducted a year apart. The study was approved by the University Ethics board prior to survey administration at all assessments, and participants provided informed active consent prior to participation at each year. The survey was administered by trained research assistants.

Measures

Demographic Factors

Gender (1 = *male*, 2 = *female*), age, born in Canada (*yes*/*no*), and parental education (one item per parent, averaged for participants reporting on both parents, with a scale of 1 = *did not finish high school* to 6 = *professional degree*, $r = .40$) were assessed each year (because this information remained consistent from year to year, only the demographic variables from year 1 were included in the analyses).

Involvement in Real-Life Sports

Involvement in real-life sports was assessed in years 2, 3, and 4 by asking participants how frequently they participated in real-life sports clubs in the previous year on a 6-point scale (1 = *never* to 6 = *several times a week*).

Sports Video Game Play

Sports video game play was assessed each year by asking participants how frequently they played sports video games (e.g., *FIFA Soccer*) on an average day based on a 5-point scale (1 = *not at all* to 5 = *5 or more hours*).

Self-Esteem

Self-esteem was assessed each year with Rosenberg's (1965) Self-Esteem Scale. The measure included 10 items (e.g., I take a positive attitude toward myself) that were rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha was .92 in year 2 and .91 in year 3.

Violent Video Game Play

Violent video game play was assessed each year with three items, by asking participants how frequently they played action video games (e.g., *God of War*) on an average day, how frequently they played first-person shooter games (e.g., *Call of Duty*) on an average day, and how frequently they played fighting video games (e.g., *Mortal Kombat*) on an average day, based on a 5-point scale (1 = *not at all* to 5 = *5 or more hours*). Higher composite scores indicated a higher frequency of action/fighting video game play.

Plan of Analysis

First, we conducted a dual trajectory latent growth curve model in *AMOS 22* (Arbuckle 1995–2013) to examine the 3-year association between sports video game play and involvement in real-life sports among older adolescents and emerging adults (see Fig. 1). Specifically, we examined whether sports video game play in year 2 (i.e., the intercept) predicted change in participants' involvement in real-life sports over the three years (year 2, year 3, and year 4), and vice versa. We included violent video game play in year 2 in the model to examine whether the predictive effects of video game play on change in participants' involvement in real-life sports were specific to sports video game play, but not violent video game play. Next, we conducted an autoregressive path analysis to examine whether self-esteem is an underlying mechanism of the predictive effect of sports video game play on involvement

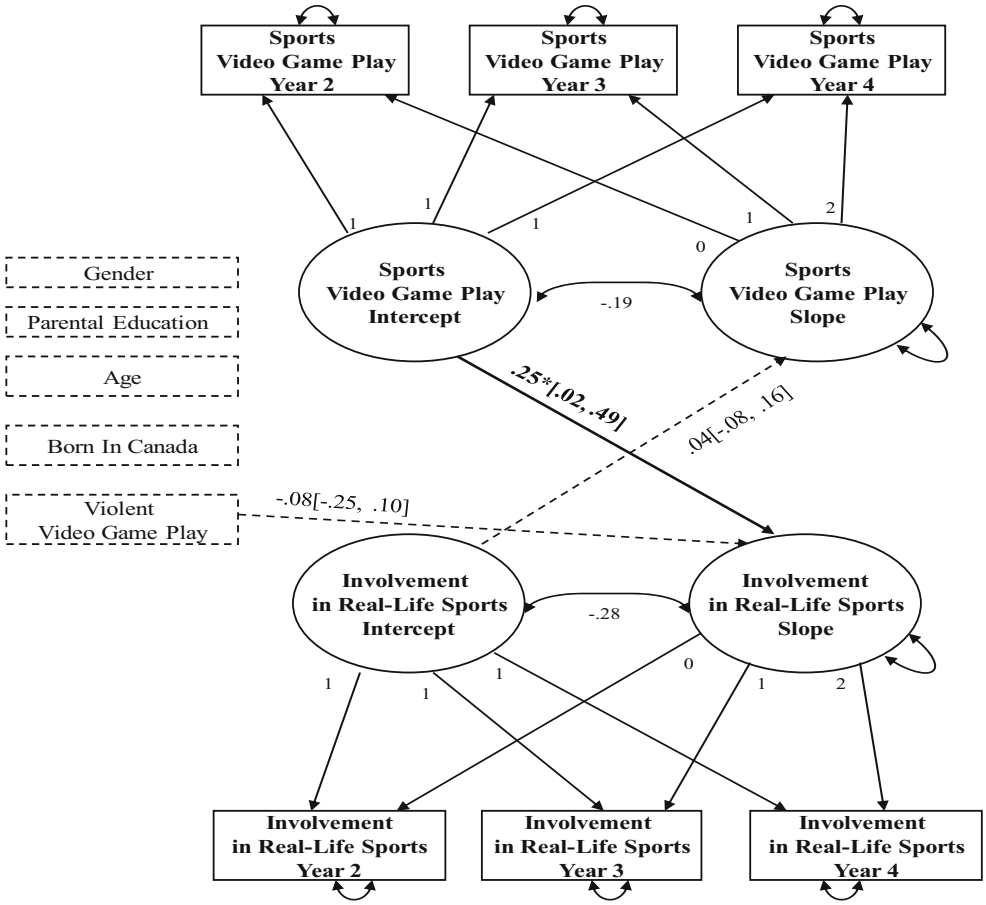

Fig. 1 Final model results for analysis examining the 3-year association between sports video game play and involvement in real-life sports. *Notes* Covariates are indicated with *dashed lines*. Not shown are paths from control variables to the slopes of involvement in sports or sports video game play, or the covariances among theexogenous variables and intercepts. Standardized coefficients (95 % confidence intervals are in *brackets*) are reported. Results for covariates and covariances can be obtained from the first author. $*p < .05$; $**p < .01$; $***p < .001$

in real-life sports (see Fig. 2). Specifically, we examined whether sports video game play in year 2 predicted elevations in self-esteem in year 3 after controlling for previous levels of self-esteem, and, in turn, whether self-esteem in year 3 predicted higher levels of involvement in real-life sports in year 4 after controlling for previous levels of involvement in real-life sports. Gender, age, born in Canada, and parental education were included as co-variates in both models.

Results

Preliminary Analyses

Table 1 outlines the means and standard deviations for the study variables and Table 2 outlines the bivariate correlations of the main study variables. All measures showed acceptable skewness and kurtosis except for the video game play variables and age. To address this issue of non-normality, we used a log10 transformation on the sports video game play variables and an inverse transformation on the violent video game play variable and age, which brought skewness and kurtosis to acceptable levels for each variable. These transformed variables were used in the subsequent analyses.

The 3-Year Association Between Participants' Sports Video Game Play and Involvement in Real-Life Sports

The Univariate Growth Trajectory of Involvement in Real-Life Sports

Latent growth curve modeling was used to estimate individual trajectories of involvement in real-life sports across the 3 years. Two latent factors were estimated: intercept (starting point) and slope (rate of change over time). We

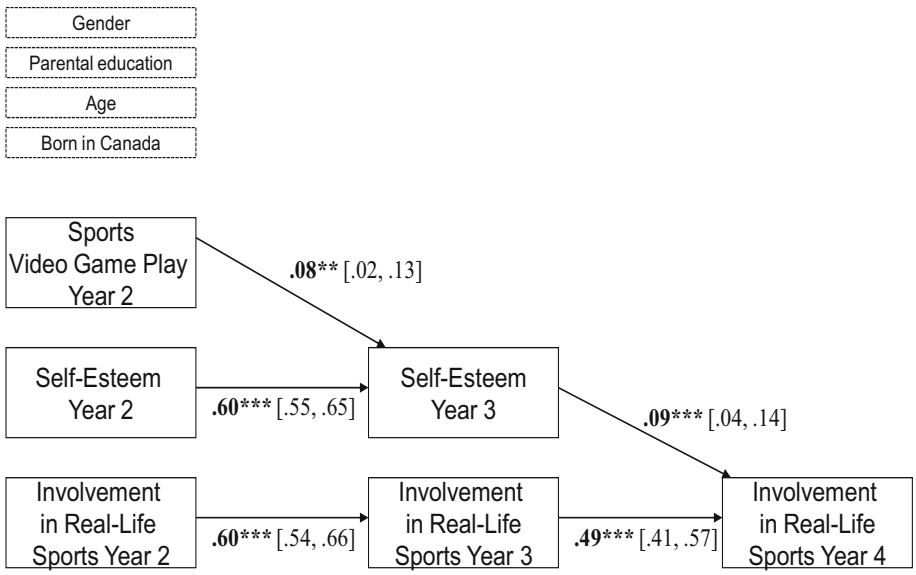

Fig. 2 Final model results for analysis assessing the indirect predictive effect of sports video game play on young adults' involvement in real-life sports through self-esteem. *Notes* Covariates are indicated with *dashed lines*. Not shown are covariances among variables within each time point or paths related to covariates. Standardized coefficients are reported and 95 % CIs are in *brackets*. Results for covariates and covariances can be obtained from the first author. *<.05, **<.01, ***<.001

Table 1 Means and standard deviations for the study measures

Variable	Scale range	Year 2 M (SD)	Year 3 M (SD)	Year 4 M (SD)
Involvement in real-life sports	1–6	2.24 (1.79)	2.30 (1.82)	2.34 (1.83)
Sports video game play	1–5	1.29 (.74)	1.25 (.70)	1.24 (.65)
Self-esteem	1–5	3.82 (.61)	3.85 (.60)	
Violent video game play	1–5	1.23 (.515)		
Age		19 years, 1 month		
Parental education	1–6	3.65 (1.27)		
Gender	1–2	70.6 % female		
Born in Canada	1–2	1.12 (.32)		

Table 2 Correlation table for the main study variables

Variable	1	2	3	4	5	6	7	8	9
1. Involvement in real-life sports 2	–								
2. Involvement in real-life sports 3	.63***	–							
3. Involvement in real-life sports 4	.49***	.60***	–						
4. Sports video game play 2	.25***	.34***	.21***	–					
5. Sports video game play 3	.26***	.31***	.27***	.66***	–				
6. Sports video game play 4	.23***	.29***	.23***	.63***	.76***	–			
7. Self-esteem 2	.14***	.18***	.15***	.06*	.04	.01	–		
8. Self-esteem 3	.12***	.14***	.17***	.08**	.00	.02	.61***	–	
9. Violent video game play 2	.07*	.09**	.04	.59***	.38***	.39***	−.09**	−.06*	–

2 = year 2; 3 = year 3; 4 = year 4

* $p < .05$; ** $p < .01$; *** $p < .001$

identified a linear growth model, which provided an excellent fit for the data, $\chi^2(1) = .97$, $p = .325$, CFI = 1.00, RMSEA = .000 (.000–.078), indicating a slight linear increase in participants' involvement in real-life sports over time as well as significant variability in the slope ($p < .001$).

The Univariate Growth Trajectory of Sports Video Game Play

Latent growth curve modeling was used to estimate individual trajectories of sports video game play across the

3 years. Two latent factors were estimated: intercept (starting point) and slope (rate of change over time). We identified a linear growth model, which provided an excellent fit for the data, $\chi^2(1) = 3.01$ $p = .08$, CFI = 1.00, RMSEA = .042 (.000–.101), indicating a slight linear decrease in participants' sports video game play as well as significant variability in the slope ($p < .001$).

The Dual Trajectory Cross-Lagged Latent Growth Curve Model Assessing the 3-Year Link Between Sports Video Game Play and Involvement in Real-Life Sports

To examine whether the frequency of sports video game play in year 2 predicted change in participants' involvement in real-life sports over the three years, and vice versa, we estimated paths from the intercept of sports video game play to the slope of involvement in real-life sports, and from the intercept of involvement in real-life sports to the slope of sports video game play, while simultaneously controlling for violent video game play, gender, age, born in Canada, and parental education (see Fig. 1). In addition, covariances were specified among the control variables and the intercepts of involvement in real-life sports and sports video game play, as well as between the residuals of the two slopes. Model fit was excellent, $\chi^2(17) = 41.81$ $p = .001$, CFI = .99, RMSEA = .036 (.022–.050). The intercept of sports video game play (year 2) significantly predicted the slope of involvement in real-life sports, such that frequency of sports video game play in year 2 predicted steeper increases in participants' involvement in real-life sports. In contrast, the intercept of involvement in real-life sports did not significantly predict the slope of sports video game play. In addition, violent video game play did not significantly predict the slope of involvement in real-life sports, suggesting that the predictive effect of video game play on increased involvement in real-life sports was specific to sports video games.

Examining Whether Self-Esteem is an Underlying Mechanism of the Long-Term Predictive Effect of Sports Video Game Play on Involvement in Real-Life Sports

To examine whether self-esteem is a mechanism through which sports video game play predicts higher levels of involvement in real-life sports, we conducted an autoregressive path analysis in which paths were specified from sports video game play in year 2 to self-esteem in year 3, and from self-esteem in year 3 to involvement in real-life sports in year 4, while simultaneously controlling for previous levels of self-esteem and involvement in real-life sports, as well as violent video game play, gender, age, born in Canada, and parental education (see Fig. 2). Model fit was excellent, $\chi^2(3) = 63.88$ $p = .085$, CFI = 1.00, RMSEA = .033 (.000–.067). Sports video game play in year 2 significantly predicted higher levels of self-esteem in year 3 after controlling for previous levels of self-esteem and the covariates (i.e., gender, parental education, age, born in Canada), and self-esteem in year 3 predicted higher levels of involvement in real-life sports in year 4 after controlling for previous levels of involvement in real-life sports and the covariates. Given these significant paths, we assessed the indirect predictive effect of sports video game play in year 2 on involvement in real-life sports in year 4 through self-esteem in year 3. Using bias-corrected bootstrapping (bootstrap samples = 2000), we found a significant indirect effect, $\beta = .008$ [.001, .016], $p = .016$. Thus, the results provide support for an indirect mediation model (MacKinnon et al. 2007; Zhao et al. 2010), in which sports video game play predicted higher levels of self-esteem, and, in turn, self-esteem predicted higher levels of involvement in real-life sports.

Gender as a Moderator

As predicted there were no significant differences in the pattern of findings as a function of gender ($ps > .05$ in χ^2_{diff} tests between constrained and unconstrained models).

Discussion

Over the past two decades, psychological research on the effect of video game play (not including "serious" games that are designed for purposes other than entertainment) on attitudes and behavior has been focused on negative outcomes (e.g., aggression) to a greater degree than positive outcomes (see reviews by Adachi and Willoughby 2013a; Granic et al. 2014). Recently, however, researchers increasingly have investigated positive outcomes of video game play (e.g., Adachi et al. 2014; Adachi and Willoughby 2013c, 2014a; Ferguson and Garza 2011; Greitemeyer and Cox 2013). For example, researchers have demonstrated a long-term association between sports video game play and involvement in real-life sports among adolescents (participants were in grade 9 at the beginning of the 4-year longitudinal study; Adachi and Willoughby 2014a). To our knowledge, however, no researchers have examined this long-term association among older adolescents and emerging adults, even though real-life sports participation and physical activity are associated with many health and psychological benefits during these developmental periods (e.g., Maher et al. 2013; Sturts and Ross 2013; Huesman et al. 2009). Thus, it is important to elucidate whether sports video game play is a long-term predictor of involvement in real-life sports among older adolescents and emerging adults.

Consistent with the findings of Adachi and Willoughby (2014a), we demonstrated a long-term predictive effect of sports video game play on involvement in real-life sports among older adolescents and emerging adults. Using latent growth curve modeling, we found that the frequency of sports video game play at year 2 predicted steeper increases in older adolescents and emerging adults' involvement in real-life sports over the three years. In other words, although participants reported a slight increase in their involvement in real-life sports over the three years on average, those who played sports video games more frequently in year 2 had a steeper increase in their involvement in real-life sports compared to participants who played sports video games less frequently in year 2. This finding supports the notion that sports video game play may have a "gateway" effect on increasing older adolescents' and emerging adult's involvement in real-life sports over time.

Next, we found that self-esteem was a mechanism through which sports video game play predicted involvement in real-life sports over time. Specifically, we found that sports video game play in year 2 predicted higher levels of self-esteem in year 3, after controlling for previous levels of self-esteem and the covariates (i.e., gender, parental education, age, born in Canada), and, in turn, self-esteem in year 3 predicted higher levels of participants' involvement in real-life sports in year 4, after controlling for previous levels of involvement in real-life sports and the covariates. These findings are aligned with past video game research grounded in SDT, which demonstrated that video game play supported the satisfaction of basic human needs (competence, autonomy, and relatedness), and thus predicted higher levels of self-esteem and future video game play (e.g., Ryan et al. 2006). Consistent with an SDT-based perspective, therefore, it may be the satisfaction of basic needs during sports video game play that predicts higher levels of self-esteem, and, in turn, higher motivation to engage in future sport-related activities such as real-life sports. For example, players may satisfy their need for competence by experiencing the thrill of victory when playing sports video games or by developing sport-related knowledge or strategies. Furthermore, sports video game play often is an autonomous activity, such that players can choose which sports games they play and which strategies or movements they use while playing the games. Finally, the need for relatedness may be satisfied during sports video game play as players often cooperate with other players (either in person or online) on the same team to compete against a common opponent. Given that need satisfaction during sports video game play was not directly assessed in the current study, future research should investigate whether sports video games provide support for players' competence, autonomy, and relatedness needs.

In addition, we included violent video game play in both models to examine whether the predictive effects of video game play on self-esteem and involvement in real-life sports was specific to sports video games. We found null effects of violent video game play on involvement in real-life sports and self-esteem, which suggests that these long-term associations may be specific to sports video game play. Finally, we did not find a significant predictive effect of involvement in real-life sports on change in participants' sports video game play over the 3 years. Thus, it appears that participants' sports video game play declined on average over the 3 years regardless of how frequently they played real-life sports in year 2.

The current study has important developmental implications for older adolescents and emerging adults. Specifically, video game play is often thought of as a barrier to exercise (e.g., Kowert et al. 2014). However, sports video games in particular actually may be an effective tool to promote real-life sports participation and physical activity among older adolescents and emerging adults. Furthermore, sports video game play may positively predict psychological well-being (e.g., self-esteem) over time, which may help to explain the predictive effect of sports video game play on older adolescents' and emerging adult's involvement in real-life sports. These findings are especially important given that real-life sports participation and physical activity are associated with a host of positive outcomes during these developmental periods (e.g., Maher et al. 2013; Sturts and Ross 2013; Huesman et al. 2009). Furthermore, older adolescents and emerging adults spend more time with media (including video games) than any other activity (Coyne et al. 2013). In addition, the notion that sports video game play may facilitate older adolescents' and emerging adults' motivation to engage in real-life sports highlights the importance of providing older adolescents and emerging adults with readily accessible opportunities to get involved in real-life sports, such as through intramural sports leagues in the university and community settings.

Directions for Future Research

Consistent with previous video game research that used an SDT-based approach (e.g., Przybylski et al. 2010; Ryan et al. 2006), researchers could examine whether the satisfaction of basic human needs (i.e., competence, autonomy, and relatedness) during sports video game play provides a fundamental explanation for the predictive effect of sports video game play on self-esteem and involvement in real-life sports. Specifically, research is needed to investigate whether need-satisfaction during sports video game play directly predicts elevations in self-esteem and involvement in real-life sports over time. Furthermore, researchers should

examine whether this association differs when sports video games are played with other people (either in-person or online) versus alone. For example, although competence and autonomy needs may be met when playing sports video games with other people or alone, relatedness-need satisfaction may occur primarily when playing with other people in a cooperative format (players work together to compete against a common opponent). Thus, the predictive effect of sports video game play on older adolescents' and emerging adults' involvement in real-life sports may be stronger when these games are played cooperatively with other people.

Another important direction for future research is to investigate whether the long-term link between sports video game play and involvement in real-life sports exists during other developmental periods. For example, recent research has shown that video game play has become quite prevalent among adults. Specifically, according to a nationally representative study in the United States, 32 % of video game players are between 18 and 35 years, and 39 % are over 35 years old (ESA 2014). Thus, researchers should examine whether sports video game play has a gateway effect on involvement in real-life sports/physical activity over time during adulthood. It also is important to examine whether playing sports video games predicts higher levels of self-esteem and involvement in real-life sports among children, given that real-life sports participation/physical activity has been shown to remain fairly stable from childhood to adulthood (e.g., Perkins et al. 2004). Thus, playing sports video games during childhood may foster the development of sport-related confidence and intrinsic motivation at an early age, which may result in a stable trajectory of real-life sports participation and physical activity throughout the lifespan.

Limitations and Strengths

A limitation of the present study was that sports video game play and involvement in real-life sports were each assessed by one item. For example, the measure of involvement in real-life sports did not allow for the assessment of the heterogeneity of participants' real-life sports experiences, such as whether they played competitive versus house league sports or team based versus individualized sports. Importantly, however, both measures have strong face validity and we provided examples of popular sports video games when asking participants to report on their frequency of sports video game play. Another limitation is that the effect sizes for the structural paths that were significant in the autoregressive path analyses were small in magnitude. Considering that involvement in real-life sports, and self-esteem were highly stable over time (i.e., stability effects of $\beta = .57–.75$), however, small predictive effects on change in levels of these variables were expected (Adachi and Willoughby 2014b). Indeed, these effect sizes are common in longitudinal models when controlling for stability between adjacent time points of data and accounting for concurrent associations among variables within each time point (e.g., Adachi and Willoughby 2014b). It is important to note, however, that we are not suggesting that small effects in autoregressive models are *always* important. The importance of these effects should be assessed individually on a case by case basis (see Adachi and Willoughby 2014b). In addition, the present studies used samples of North American university students and high school students, and thus findings may not generalize to other geographic regions, including those with differing ethnic and/or demographic populations.

There also were several important strengths of the present research. This was the first study to demonstrate a long-term link between sports video game play and involvement in real-life sports among older adolescents and emerging adults, which suggests that this longitudinal association is not limited to earlier periods of development such as adolescence. In addition, we extended previous research on this topic which employed traditional autoregressive path models (Adachi and Willoughby 2014a) by conducting a latent growth curve model to examine whether the sports video game play at one time point predicts *change* in participants' involvement in real-life sports scores over several years. Furthermore, we demonstrated that the predictive effect of video game play on involvement in real-life sports may be specific to sports video game play.

Conclusion

We provided initial evidence of a 3-year association between sports video game play and involvement in real-life sports among older adolescents and emerging adults. Specifically, sports video game play in year 2 predicted steeper increases in participants' involvement in real-life sports over the three years. In addition, we demonstrated that self-esteem is an underlying mechanism of this long-term association, such that sports video game play predicted higher levels of self-esteem over time, and, in turn, self-esteem predicted higher levels of participants' involvement in real-life sports over time. Overall, these findings make an important contribution to an emerging body of literature on the positive outcomes of video game play, as they suggest that, although video game play often is thought of as a catalyst for inactivity, sports video game play may be an effective tool to promote real-life sports participation and physical activity among older adolescents and emerging adults.

Author contributions P.A. conceived the study, conducted most of the statistical analyses, and drafted the manuscript. T.W. collected the data and participated in the statistical analyses as well as the drafting of the manuscript. All authors read and approved the final manuscript.

Conflict of interest The authors report no conflict of interests.

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