CHILD DEVELOPMENT

Child Development, November/December 2016, Volume 87, Number 6, Pages 1877–1892

The Longitudinal Association Between Competitive Video Game Play and Aggression Among Adolescents and Young Adults

Paul J.C. Adachi and Teena Willoughby
Brock University

The longitudinal association between competitive video game play and aggression among young adults and adolescents was examined. Young adults (N = 1,132; M_{age} = 19 years) were surveyed annually over 4 years about their video game play and aggression, and data from a 4-year longitudinal study of adolescents (N = 1,492; M_{age} = 13 years) was reanalyzed. The results demonstrated a longitudinal association between competitive video game play and aggressive behavior among both age groups. In addition, competitive video game play predicted higher levels of aggressive affect over time, which, in turn, predicted higher levels of aggressive behavior over time, suggesting that aggressive affect was a mechanism of this link. These findings highlight the importance of investigating competitive elements of video game play that may predict aggression over time.

The longitudinal positive association found between video game play and aggression, which is defined as behavior that is intended to harm another individual (Dodge, Coie, & Lynam, 2006), is an important issue as video games have become one of the fastest growing forms of entertainment in the world. To date, the vast majority of video game and aggression research has been either experimental or cross-sectional. Only a small fraction of the research has assessed longitudinal effects (e.g., Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013; Möller & Krahé, 2009). Furthermore, the limited longitudinal work on this topic has been conducted with adolescents or children (e.g., Adachi & Willoughby, 2013a; Ferguson, Garza, et al., 2013; Ferguson, Ivory, & Beaver, 2013; Willoughby, Adachi, & Good, 2012) rather than young adults, even though video game play is highly prevalent among young adults (e.g., Lenhart, Jones, & Macgill, 2008). Research is needed, therefore, to examine the longitudinal link between video game play and aggression during the developmental period of young adulthood. In addition, although over 2 decades of research has been focused on the effect of *violent* video game content on elevating aggression (see Anderson et al., 2010; Ferguson, 2015a; Greitemeyer & Mügge, 2014, for reviews), researchers recently have demonstrated a link between *competitive* video game play (i.e., video games in which the player competes against opponent characters) and aggression, representing an important new direction in this field (e.g., Adachi & Willoughby, 2011a; Adachi & Willoughby, 2013a; Breuer, Scharkow, & Quandt, 2015; Carré, Campbell, Lozoya, Goetz, & Welker, 2013). The first goal of the present research was to examine whether competitive video game play predicts aggression over 4 years among young adults, in addition to over 2 years among adolescents. The second goal was to investigate whether aggressive affect was a mechanism of this longitudinal link by testing the indirect predictive effect of competitive video game play on aggressive behavior through aggressive affect.

Research on the Effects of Video Game Play on Aggression

Research on the link between video game play and aggression has been focused mainly on violent game content (see Anderson et al., 2010; Ferguson, 2015a; Greitemeyer & Mügge, 2014, for reviews; but also see Adachi & Willoughby, 2011b; Engelhardt, Mazurek, Hilgard, & Bartholow, 2015; Ferguson, 2015b; Ferguson & Dyck, 2012 Ferguson & Kilburn, 2010; Markey, Markey, & French, 2014; Pryzbylski,

We would like to thank Dr. Michael Busseri for his valuable feedback. Teena Willoughby acknowledges funding received from the Social Sciences and Humanities Research Council of Canada and the Owl Children's Trust.

Correspondence concerning this article should be addressed to Paul Adachi, Department of Psychology, Brock University, St. Catharines, ON, Canada L2S 3A1. Electronic mail may be sent to pa08fg@brocku.ca.

 0009-3920/2016/8706-0018
DOI: 10.1111/cdev.12556

Deci, Rigby, & Ryan, 2014; Tear & Nielsen, 2013). Interestingly, violent video games in general also tend to be competitive (Carnagey & Anderson, 2005). For instance, players compete with opponent characters (either human-controlled or computer-generated) in hand-to-hand combat in fighting games (e.g., Mortal Kombat). To examine the short-term effect of competitive video game play (both violent and nonviolent competitive games) on aggression, Adachi and Willoughby (2011a) systematically matched violent and nonviolent video games in terms of competitiveness (as well as difficulty and pace of action) in an experimental study. They found that the highly competitive games produced more aggressive behavior than the less competitive games irrespective of the amount of violent content (also see Anderson & Carnagey, 2009, for an effect of violent video game play on aggression when controlling for competition). Furthermore, researchers have shown short-term effects of playing both violent and nonviolent competitive video games against other people on aggression (e.g., Breuer et al., 2015; Griffiths, Eastin, & Cicchirillo, 2015; Schmierbach, 2010; Shafer, 2012). In terms of longitudinal research, to our knowledge, Adachi and Willoughby (2013a) conducted the only longitudinal study on this association, as they examined whether playing competitive video games that are predominately nonviolent (e.g., sports and racing games) was associated with aggressive behavior over 4 years among adolescents. They demonstrated a longitudinal association between sports/racing (competitive) video game play and aggression; however, violent and competitive video games (e.g., action/fighting games) were not included as predictors of aggression. Thus, research is needed to examine the longitudinal predictive effect of the common competitive element among both violent (e.g., action/fighting) and nonviolent (e.g., sports/racing) competitive video games on aggression. Furthermore, potential mechanisms of this longitudinal link are unknown, representing an important area of investigation.

Aggressive Affect as a Mechanism Through Which Competitive Video Game Play Predicts Aggression

To date, no researchers have examined the mechanisms of the longitudinal link between competitive video game play and aggression. The frustration–aggression hypothesis (Berkowitz, 1989; Dollard, Miller, Doob, Mowrer, & Sears, 1939) is particularly relevant for explaining this association. This hypothesis holds that when an individual's goal is thwarted (or threatened), the individual may experience aggressive affect such as anger and hostility, which, in turn, may make the individual more likely to behave aggressively. Importantly, people are even more likely to become aggressive if they believe that the goal blocking is deliberate rather than inadvertent (e.g., Berkowitz, 1989; Kulik & Brown, 1979). The frustration–aggression hypothesis, therefore, is especially pertinent for explaining the link between competition and aggression, as competitors deliberately block each other's goal of winning during competitive encounters. Furthermore, competition may impact aggressive affect and aggressive behavior even among competitors who reach the end goal of winning the competition (Berkowitz, 1989).

Although competitive experiences may influence state levels of aggressive affect in the short-term (e.g., Breuer et al., 2015), exposure to competition over longer periods of time may lead to elevations in more stable, trait levels of aggressive affect. For example, repeated exposure to competition may lead to more frequent and intense feelings of anger and hostility when faced with a potential competitive situation. As a result, people may have greater difficulty inhibiting the expression of this aggressive affect over time, which may facilitate the translation of aggressive affect into aggressive behavior. Playing competitive video games, therefore, may lead to elevations in trait levels of aggressive affect, and in turn, people with elevated trait levels of aggressive affect may be more likely to behave aggressively. In addition, it is important to note that noncompetitive video games also involve a similar goal of advancing through the levels of a game and thus may involve the threat of failure, which may impact aggressive affect. Consistent with the frustration–aggression hypothesis, however, competitive video games may be more likely to induce anger and hostility than noncompetitive video games, because only competitive games involve the threat of *deliberate* goal blocking from one's opponents (e.g., other vehicles trying to overtake the player in a race), which may feel like a personal attack (Berkowitz, 1989).

Third Variable Framework

It is important to consider the possibility that a longitudinal link between video game play and aggression may be due to their common associations with other unmeasured or "third" variables, such as gender or other risky behaviors (e.g.,

alcohol use). For example, Ferguson (2011) has argued for the importance of testing the third variable hypothesis in media and aggression studies by including multiple risk factors in researchers' statistical models. To address this issue, in the present research we included several demographic variables (e.g., gender, parental education, age) as well as alcohol use, which has been found in past studies to be predictive of aggression (e.g., Maldonado-Molina, Jennings, & Komro, 2010). In addition, consistent with Adachi and Willoughby (2013a), we controlled for participants' involvement in sports to rule out the potential third variable explanation that participants who play sports video games also play real sports, and that it is the playing of real sports, not sports video games, that predicts aggression over time.

Study 1

In Study 1, we surveyed a large longitudinal sample of young adults about their video game play, aggressive affect, and aggressive behaviors. We addressed two goals. The first goal was to investigate whether competitive video game play is associated with aggression over 4 years among young adults. Consistent with research showing a link between competitive video game play and aggression (Adachi & Willoughby, 2011b; Adachi & Willoughby, 2013a; Breuer et al., 2015), we hypothesized that there would be a significant longitudinal association between competitive video game play and aggression among young adults. We also examined whether aggression might predict competitive video game play over time (suggesting that more aggressive young adults might be more likely to self-select into playing competitive video games than less aggressive young adults) to elucidate the direction of the longitudinal effects. The second goal was to investigate whether aggressive affect (i.e., anger and hostility) is a mechanism of the longitudinal link between competitive video game play and aggression, consistent with the frustration–aggression hypothesis. Finally, we examined whether gender moderated these associations. Researchers have consistently demonstrated no gender differences in the link between video game play and aggression (see meta-analyses by Anderson et al., 2010; Ferguson, 2015a), and thus we hypothesized that gender would not moderate the associations between video game play and aggression in the current study.

Method

Participants

Participants were 1,132 undergraduate students (70.6% female) enrolled at a mid-sized university in southern Ontario, Canada, who were surveyed across 4 consecutive years from 2010 to 2013. At the first assessment, all participants were in their 1st year of university (M = 19 years, 1 month, 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 comprised predominantly 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. Of the original 1,132 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 longitudinal retention rate is very high. There were no significant differences between participants who completed the survey at all four time points or at < 4 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 these data are missing at random (Little & Rubin, 2002). Missing data were estimated using the expectation maximization (EM) estimation method.

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 (Time 1). Participants were given monetary compensation for their participation at Time 1 ($10), Time 2 ($20), Time 3 ($30), and Time 4 ($40). At Times 2, 3, and 4, all students who participated in the first assessment were invited to participate again, by way of e-mails, posters, and classroom announcements. All assessments were conducted a year apart. The study was approved by the University Research 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

The study measures were assessed at all of the time periods except for aggressive affect (assessed at Time 2 and Time 3) and involvement in sports (assessed at Time 2).

Aggressive behavior. Direct aggressive behavior was assessed with four items (e.g., How often have you pushed and shoved someone during the last year?) based on a 5-point scale (1 = *never* to 5 = *everyday*; Marini, Spear, & Bombay, 1999). Cronbach's alphas ranged from .74 to .77, and higher composite scores indicated a higher frequency of aggressive behavior. Importantly, this measure assesses both physical (e.g., shoved, hit) and verbal (e.g., swore, ridiculed) forms of direct aggression, and has functioned well in previous longitudinal studies of adolescents (e.g., Willoughby et al., 2012). Furthermore, past research has supported the validity of this measure (e.g., Adachi & Willoughby, 2013a) by demonstrating that it is strongly associated with other well-validated measures of aggression (e.g., Little, Jones, Henrich, & Hawley, 2003).

Aggressive affect. Trait levels of aggressive affect were assessed with a composite of the anger (three items; e.g., "Sometimes I feel like a powder keg ready to explode") and hostility (three items; e.g., "I wonder why sometimes I feel so bitter about things") subscales of the short form (Diamond & Magaletta, 2006) of the Buss and Perry Aggression Questionnaire (1992), based on a 5-point scale (1 = *very unlike me* to 5 = *very like me*). Cronbach's $\alpha = .87$ (Time 2) and .88 (Time 3), with higher scores indicating higher levels of aggressive affect.

Competitive video game play. To assess the frequency of competitive video game play, we specifically chose types of video games that are *inherently* competitive. We asked participants to report on their playing of sports, racing, fighting, and action video games because the main goal of these games is to compete against opponent characters in sports (sports video games), races (racing video games), hand-to-hand combat (fighting video games), or battles using weapons (action video games). Thus, competition is inherent in the structure of these games (see Adachi & Willoughby, 2011b; Adachi & Willoughby, 2013a, for further discussions of competitive vs. noncompetitive video games). Furthermore, researchers have demonstrated that these types of video games tend to be matched in terms of participants' ratings of competitiveness; that is, there were no significant differences between games in ratings of competitiveness (e.g., Adachi & Willoughby, 2011a; Valadez & Ferguson, 2012). Although competition is inherent in the structure of sports, racing, action, and fighting video games, high levels of violent content are unique to action and fighting games. Thus, we created separate variables to assess the frequency of playing competitive and nonviolent (sports/racing) versus competitive and violent (action/fighting) video games.

Competitive and nonviolent (sports/racing) video game play. Frequency of playing video games that are competitive and nonviolent was assessed with two items, by asking participants how frequently they played sports video games (e.g., FIFA Soccer) on an average day and how frequently they played racing video games (e.g., Gran Turismo) 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 sports/racing video game play. Sports and racing games are highly competitive but predominately nonviolent, because although a few sports games contain some aggressive content (e.g., football or boxing games), most do not (e.g., soccer, golf, basketball, snowboarding, tennis, baseball). Furthermore, researchers have shown that sports games that are thought to contain some aggressive content, such as football games, are often rated by participants as very low in terms of violence (e.g., Griffiths et al., 2015). Similarly, although some racing games allow vehicles to come into contact with each other during a race, this behavior usually is discouraged as it causes both vehicles to slow down and thus impedes the player's goal of winning the race. Furthermore, sports and racing games do not contain the more extreme violence that can be found in many action and fighting games, such as "blood-soaked battles to the death with a variety of lethal weapons" (Adachi & Willoughby, 2013a, p. 1093). Sports/racing video games also have been shown to be rated as less violent than action/fighting video games (e.g., Adachi & Willoughby, 2011a; Valadez & Ferguson, 2012).

Competitive and violent (action/fighting) video game play. Frequency of playing video games that are competitive and violent was assessed with two items by asking participants how frequently they played action video games (e.g., Grand Theft Auto, God of War) 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*). Action and fighting games are highly competitive and violent because they involve competing with opponent characters in battles with weapons or hand-to-hand combat fights. Higher composite scores indicated a higher frequency of action/fighting video game play. Again, action/fighting video games have been shown to be rated as more violent than sports/racing video games (e.g., Adachi & Willoughby, 2011a; Valadez & Ferguson, 2012).

Noncompetitive and nonviolent video game play. Frequency of playing video games that are noncompetitive and nonviolent were assessed with four items (Adachi & Willoughby, 2013a) by asking participants how frequently they played puzzle, building model worlds, quiz, and arts/design video games on an average day based on a 5-point scale (1 = *not at all* to 5 = *5 or more hours*). The four items assessing noncompetitive and nonviolent video game play only were used in a preliminary factor analysis.

Third variables

Demographics. Gender (1 = male, 2 = female), age, 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.

Involvement in sports. Involvement in sports was assessed at by asking participants how frequently they participated in sports clubs in the previous year on a 6-point scale (1 = *never* to 6 = *several times a week*).

Alcohol consumption. Alcohol consumption was assessed by asking participants how frequently they drink on an 8-point scale (1 = *never* to 8 = *every day*; recoded to a 6-point scale) and on average, how many drinks they consume when drinking alcohol on a 6-point scale (1 = *less than 1 drink* to 6 = *over 10 drinks*). The correlation between these two items was .65. Higher composite scores indicated higher alcohol consumption.

Plan of Analyses: A Latent Variable Approach

A latent variable represents an unmeasured construct that explains the covariance between the observed indicator variables and can represent a broad array of phenomena (Kline, 2011). Researchers often use a latent variable approach to study observable behaviors (e.g., measured with items assessing the frequency of engaging in the behaviors) that may be explained by a latent construct, such as a propensity to engage in antisocial behavior (with indicators such as the frequency of daily cigarette use; Bentley et al., 2013), sedentary behavior (with indicators such as the frequency of watching television; Donovan, Jessor, & Costa, 1993), physical aggression (with indicators such as the frequency of physically aggressive behaviors; Boxer et al., 2013; Card & Little, 2007; Carlo et al., 2012), and interparental violence (with indicators such as the frequency of children's exposure to physical aggression between their parents; Manning, Davies, & Cicchetti, 2014). In the current study, we created a latent variable to represent a propensity to play competitive video games, with the frequency of action/fighting and sports/racing video game play as the indicators, given that these types of video games are inherently competitive (the correlation between the frequency of action/fighting and sports/racing video game play was $r = .58$ at Time 1, $r = .70$ at Time 2, $r = .65$ at Time 3, and $r = .54$ at Time 4). In contrast, a propensity to play violent video games is not a viable explanation for this shared variance, given that action/fighting games tend to be much more violent than sports/racing games (e.g., Adachi & Willoughby, 2011a; Valadez & Ferguson, 2012). The advantage of using a latent variable approach is that we were able to estimate a latent factor representing a propensity to play competitive video games while parsing out variance that is not common to both types of games (Card & Little, 2007; Kline, 2011).

We estimated a four-time period autoregressive cross-lagged model in *AMOS 22* (Arbuckle, 1995–2013), in which bidirectional paths were estimated across each adjacent time period between the competitive video game play factor and aggression (see Figure 1). Stability paths across each time period within the competitive video game play factor and aggression also were specified, as well as covariances among the variables within each time point. In addition, gender, parental education, age, alcohol consumption, and involvement in sports were included as covariates. To examine whether the competitive video game play factor indirectly predicted aggressive behavior through aggressive affect, we added aggressive affect at Time 2 and Time 3 to the model (see Figure 2). Paths were estimated from the competitive video game play factor at Time 1 to aggressive affect at Time 2 and from aggressive affect at Time 2 to aggressive behavior at Time 3, as well as from the competitive video game play factor at Time 2 to aggressive affect at Time 3 and from aggressive affect at Time 3 to aggressive behavior at Time 4. Because the competitive video game play factors at Time 3 and Time 4 were not pertinent to this final analysis, they were removed from the model.

Results and Discussion

Preliminary Analyses

Appendix 1 outlines the means and standard deviations for the main study variables. All measures showed acceptable skewness and kurtosis with the exception of the video game variables and age. To address this issue of non normality, we used an inverse transformation on the video game play variables and age, which brought skewness and kurtosis to acceptable levels for each variable. We examined mean differences in the main study variables (i.e., video game play, aggressive behavior, and aggressive affect) as a function of gender. A significant multivariate main effect was found (Wilks $\lambda < .001$, partial $\eta^2 = .43$). Overall, men reported more aggressive behavior, aggressive affect, sports/racing, action/fighting, and quiz video game play than women. There were no differences between men and women in terms of building model worlds, puzzle, or arts/design video game play.

Before estimating a latent competitive video game play factor in the autoregressive cross-lagged models, we conducted an exploratory factor analysis (EFA) with four frequency of competitive video game play variables (sports, racing, action, and fighting games) and four frequency of noncompetitive video game play variables (arts/design, building model worlds, quiz games, and puzzle games). Given that EFA analyzes the shared variance between variables to determine their underlying factor(s), we were interested in examining whether the frequency of playing competitive video games loaded onto a competitive video game play factor and whether the frequency of playing noncompetitive video games loaded onto a noncompetitive video game play factor, consistent with our hypotheses (see Carlo et al., 2012, for a similar

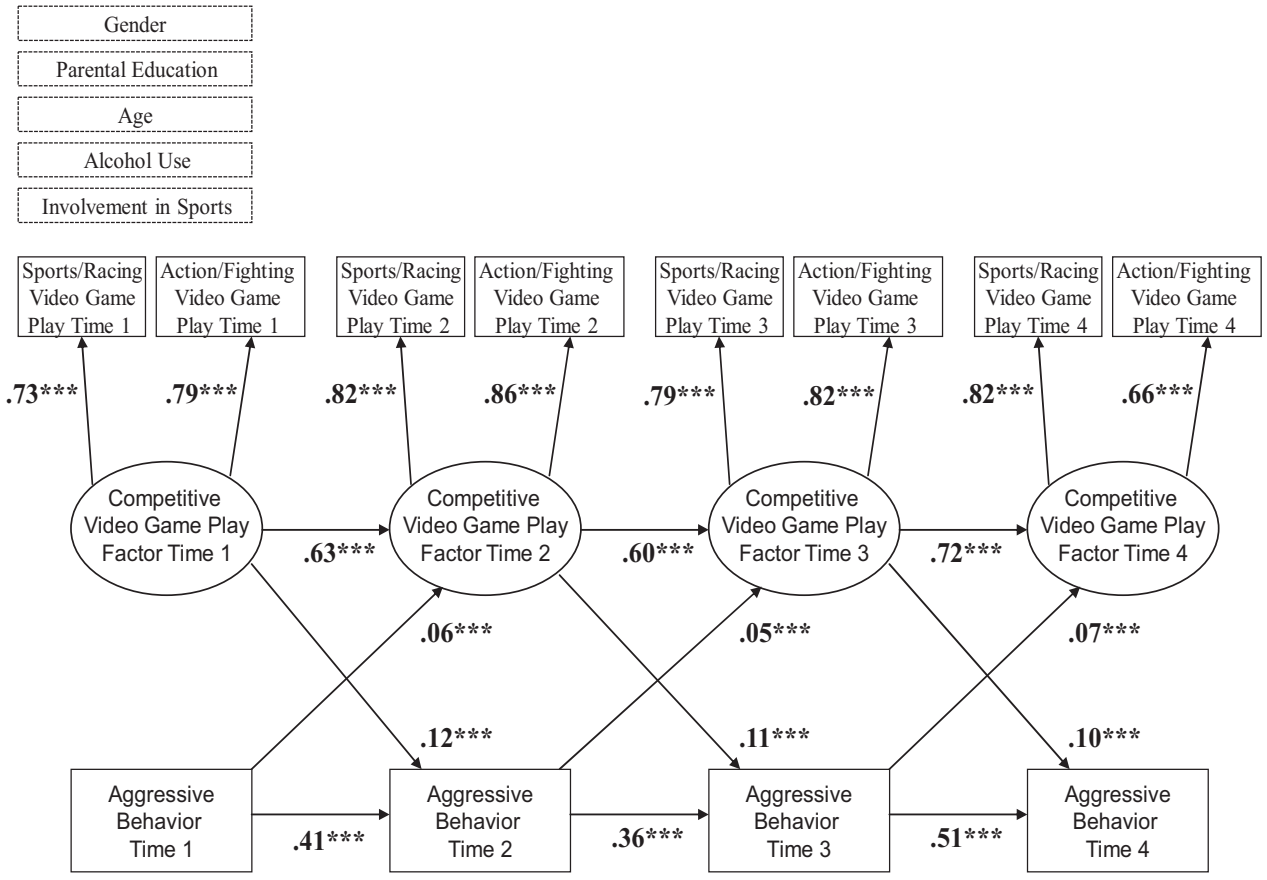

Figure 1. Final model results for young adults for analysis assessing the longitudinal bidirectional associations between the competitive video game play factor and aggressive behavior, between sports/racing video game play and aggressive behavior, and between action/fighting video game play and aggressive behavior, controlling for the third variables.
Note. Third variables are indicated with dashed lines. Not shown are covariances among variables within each time point or paths related to third variables. Standardized coefficients are reported.
***$p < .001$.

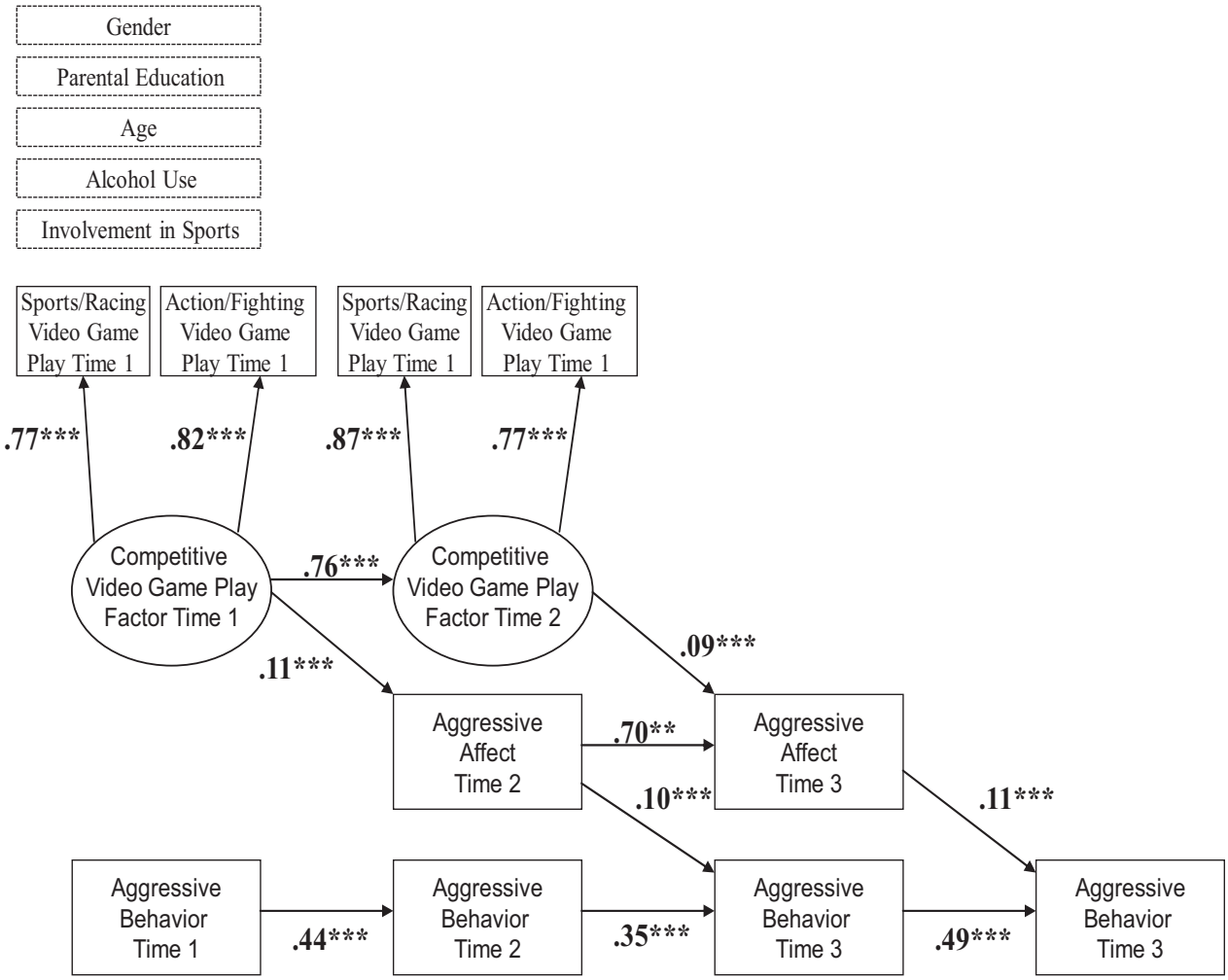

Figure 2. Final model results for young adults for analysis assessing the indirect predictive effects of the competitive video game play factor, sports/racing video game play, and action/fighting video game play on aggressive behavior through aggressive affect, controlling for the third variables.
Note. Third variables are indicated with dashed lines. Not shown are covariances among variables within each time point or paths related to third variables. Standardized coefficients are reported.
$^{**}p < .01$. $^{***}p < .001$.

example in which EFA was used to determine physical aggression factors prior to estimating a latent physical aggression factor in a structural equation model). In contrast, if the EFA revealed that both the frequency of competitive and noncompetitive video game play variables loaded onto only one factor, then this factor would represent a propensity to play video games in general rather than a propensity to play competitive video games specifically. Importantly, the results revealed two distinct factors: a competitive video game play factor (factor loadings: action = .76, fighting = .56, racing = .60, sports = .56) and a noncompetitive video game play factor (factor loadings: puzzle = .65, quiz = .63, arts/design = .57, and building model worlds = .44), providing statistical support for the estimation of a latent competitive video game play factor in the autoregressive cross-lagged models. Furthermore, of the participants who played video games, 60% played either competitive or noncompetitive video games (assessed as a dichotomous play vs. no play), whereas 40% played both competitive and noncompetitive games.

The Longitudinal Bidirectional Association Between the Competitive Video Game Play Factor and Aggressive Behavior Among Young Adults

We first assessed whether the pattern of results was invariant across time. Invariance was tested by

comparing a model in which all cross-lagged paths were constrained to be equal across time to the unconstrained model in which all structural paths were free to vary. The chi-square difference test of relative fit indicated that the unconstrained model was not a significantly better fit than the constrained model, suggesting that the patterns of associations among the measures were consistent across the four time points, $p > .05$. As the constrained model was the most parsimonious model, all further interpretations were based on the constrained model (see Figure 1). Model fit was adequate, $\chi^2(51) = 353.64$, $p < .000$, comparative fit index (CFI) = .97, root mean square error of approximation (RMSEA) = .072 (.065–.080). All factor loadings were significant at $p < .001$. The competitive video game play factor predicted higher levels of aggressive behavior over time, after controlling for previous levels of aggression and the third variables. In addition, aggressive behavior predicted higher levels of the competitive video game play factor over time, after controlling for previous levels of the competitive video game play factor and the third variables. Of interest, examination of the standardized residual covariance matrix in the statistical output indicated that there were no significant unique longitudinal associations between action/fighting video game play and aggression, or between sports/racing video game play and aggression (*p*s > .05), after controlling for the competitive video game play factor, stability in aggression, and the third variables. We might have expected a significant residual correlation between action/fighting or sports/racing video game play and aggression independent of the competitive video game play factor, for example, if unique elements of either type of game (e.g., violent content in action/fighting games) were driving an association with aggression.

Aggressive Affect as a Mechanism of the Longitudinal Predictive Effect of the Competitive Video Game Play Factor on Aggressive Behavior Among Young Adults

Again, we assessed whether the pattern of results was invariant across time by comparing a model in which all cross-lagged paths were constrained to be equal across time to the unconstrained model in which all structural paths were free to vary. The chi-square difference test of relative fit indicated that the unconstrained model was not a significantly better fit than the constrained model, suggesting that the patterns of associations among the measures were consistent across the four time points, $p > .05$. As the constrained model was the most parsimonious model, all further interpretations were based on the constrained model (see Figure 2). Model fit was adequate, $\chi^2(28) = 157.75$, $p < .001$, CFI = .98, RMSEA = .064 (.054–.074). The competitive video game play factor predicted higher levels of time aggressive affect over time, and, in turn, aggressive affect predicted higher levels of aggressive behavior over time. Given these significant direct predictive effects, we assessed the indirect predictive effects of the Time 1 competitive video game play factor on Time 3 aggressive behavior through Time 2 aggressive affect, and of the Time 2 competitive video game play factor on Time 4 aggressive behavior through Time 3 aggressive affect. Using bias-corrected bootstrapping (bootstrap samples = 2,000), we found a significant indirect predictive effect for the competitive video game play factor at Time 1, $\beta = .01$, 95% CI [.005, .021], $p = .001$, and Time 2, $\beta = .01$, 95% CI [.004, .020], $p < .001$. Thus, the results provide support for an indirect mediation model (MacKinnon, Fairchild, & Fritz, 2007; Zhao, Lynch, & Chen, 2010) in which the Time 1 competitive video game play factor uniquely predicted higher Time 2 aggressive affect, which, in turn, predicted higher Time 3 aggressive behavior, and the Time 2 competitive video game play factor uniquely predicted higher Time 3 aggressive affect, which, in turn, predicted higher Time 4 aggressive behavior. Again, examination of the standardized residual covariance matrix in the statistical output indicated that there were no significant unique longitudinal associations between action/fighting video game play and aggression, or between sports/racing video game play and aggression (*p*s > .05), after controlling for the competitive video game play factor, stability in aggression, and the third variables.

Gender as a Moderator

Gender also was included as a moderator in each analysis and as predicted there were no significant differences in the pattern of findings as a function of gender (*p*s > .05 in χ^2_{diff} tests between constrained and unconstrained models).

Study 2

In Study 2, we extended the findings from Study 1 with young adults by examining the longitudinal association between the competitive video game play factor and aggression among adolescents. We

reanalyzed data from Adachi and Willoughby (2013a) in which a longitudinal bidirectional association between sports/racing video game play and aggression among adolescents was demonstrated, although action/fighting video game play was not directly included in the model. We hypothesized that the competitive video game play factor would predict higher levels of aggression over time. We also examined whether aggression might predict the competitive video game play factor over time to elucidate the direction of the longitudinal effects. Finally, we examined whether gender moderated these associations.

Method

Participants

Students (N = 1,492; 50.8% female) from eight high schools encompassing a school district in Ontario, Canada took part in the study in Grades 9, 10, 11, and 12 (M_{age} in Grade 9 = 13 years, 10 months). This study was part of a larger cohort-sequential project. In the larger study, surveys were completed five times between 2003 and 2008, with some students starting the study in 2003 and others starting the study in 2004. The analyses for the present study are based on the cohort of students who entered the study in Grade 9 in 2004 and completed the survey in Grades 9, 10, 11, and 12. The overall participation rate ranged from 83% to 86% across the four time points; nonparticipation was due to student absenteeism (average of 13.5%), parental refusal (average of .06%), or student refusal (average of 1.4%). Student absenteeism from class was due to illness, a co-op placement, a free period, or involvement in another school activity. Consistent with the broader Canadian population (Statistics Canada, 2001), 92.4% of the participants were born in Canada and the most common ethnic backgrounds reported other than Canadian were Italian (31%), French (18%), British (15%), and German (12%). Data on socioeconomic status indicated mean levels of education for mothers and fathers falling between "some college, university or apprenticeship program" and "completed a college/apprenticeship/technical diploma." Furthermore, 70% of the respondents reported living with both birth parents, 12% with one birth parent and a stepparent, 15% with one birth parent (mother or father only), and the remainder with other guardians (e.g., other relatives, foster parents, etc.). As missing data were not dependent on the values of the study measures, it is reasonable to assume that these data are missing at random (Little & Rubin, 2002). Missing data were estimated using the EM estimation method. Frequency of video game play was not assessed in Grade 9 or 10; therefore, analyses for video game variables were only available for Grades 11 and 12.

Procedure

Active informed assent was obtained from the adolescent participants. Parents were provided with written correspondence mailed to each student's home prior to the survey administration outlining the study; this letter indicated that parents could request that their adolescent not participate in the study. An automated phone message about the study also was left at each student's home phone number. This procedure was approved by the participating school board and the University Research Ethics Board. At all time periods, the questionnaire was administered to students in classrooms by trained research staff. Students were informed that their responses were completely confidential.

Measures

The aggression measures were assessed at all of the time periods. The video game play variables were assessed in Grades 11 and 12, and the third variables were assessed in Grade 9.

Aggressive behavior. See Study 1. Cronbach's αs > .85 in each grade.

Competitive and nonviolent (sports/racing) video game play. See Study 1.

Competitive and violent (action/fighting) video game play. See Study 1.

Third variables

Demographics. Gender (see Appendix 1, for analyses assessing gender as a moderator of the results), number of computers in the home, 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 used as covariates.

Involvement in sports. Involvement in sports was measured with two items ("How often in the last month have you played organized sports in school?" and "How often in the last month have you played organized sports outside of school?"), based on a 5-point scale (1 = *never* to 5 = *every day*). The correlation between the two items was .50. Higher composite scores indicated higher frequency of involvement in sports.

Plan of Analysis

In order to assess the longitudinal bidirectional association between the competitive video game play factor and aggression among adolescents, we created a latent factor to represent a propensity to play competitive video games consistent with Study 1 (the correlation between action/fighting and sports/racing video game play was $r = .41$ in Grade 11 and $r = .40$ in Grade 12). Next, we created an autoregressive cross-lagged model similar to Study 1 (see Figure 3). In addition, we included gender, parental education, number of computers in the home, and involvement in sports as covariates.

Results and Discussion

Preliminary Analyses

Appendix 1 outlines the means and standard deviations for the main study variables. All measures showed acceptable skewness and kurtosis with the exception of the video game variables. To address this issue of non-normality, we used a log10 transformation on the Grade 11 and Grade 12 video game variables in the adolescent sample, which brought skewness and kurtosis to acceptable levels. We examined mean differences in the main study variables (i.e., video game play and aggressive behavior) as a function of gender. A significant multivariate main effect was found (Wilks $\lambda < .001$, partial $\eta^2 = .43$). Overall, men reported more aggressive behavior, sports/racing video game play, and action fighting video game play than women.

The Longitudinal Bidirectional Association Between the Competitive Video Game Play Factor and Aggressive Behavior Among Adolescents

We first assessed whether the pattern of results was invariant across time by comparing a model in which all cross-lagged paths were constrained to be equal across time to the unconstrained model in which all structural paths were free to vary. The chi-square difference test of relative fit indicated that the unconstrained model was not a significantly better fit than the constrained model, suggesting that the patterns of associations among the measures were consistent across the four time points, $p > .05$. As the constrained model was the most parsimonious model, all further interpretations were based on the constrained model (see

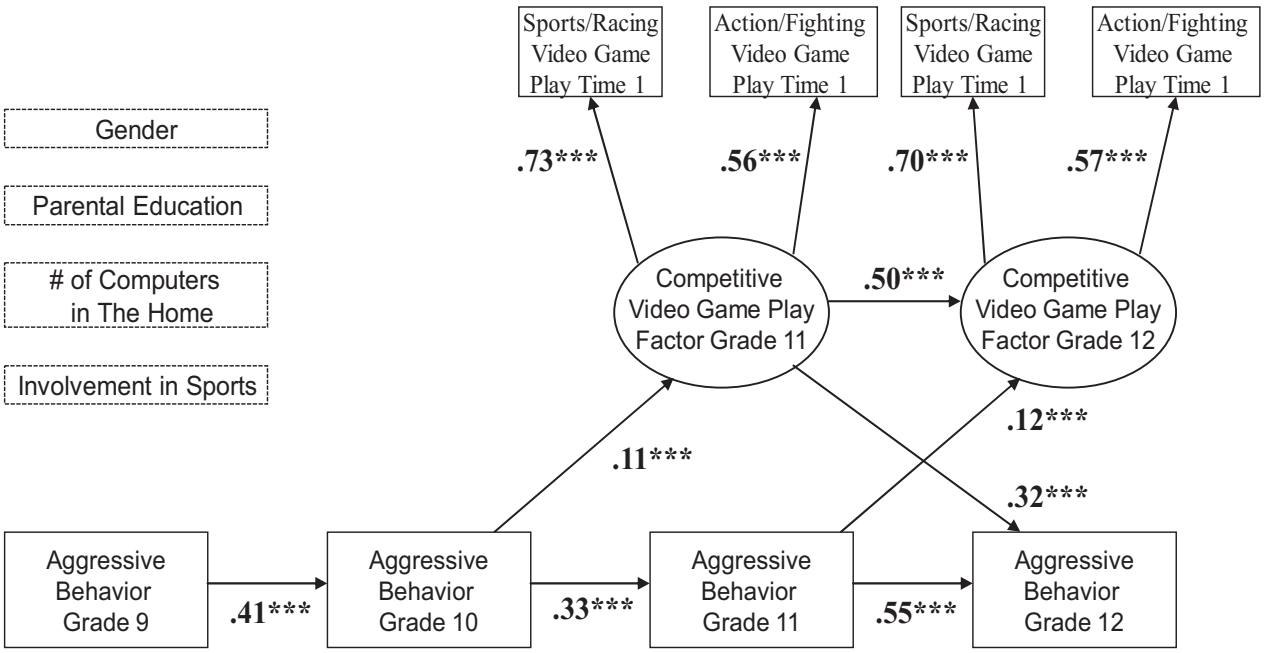

Figure 3. Final model results for adolescents for analysis assessing the longitudinal bidirectional associations between the competitive video game play factor and aggressive behavior, between sports/racing video game play and aggressive behavior, and between action/fighting video game play and aggressive behavior, controlling for the third variables.
Note. Third variables are indicated with dashed lines. Not shown are covariances among variables within each time point or paths related to the third variables. Standardized coefficients are reported.
***$p < .001$.

Figure 3). Model fit was adequate, $\chi^2(19) = 196.26$, $p < .001$, CFI = .97, RMSEA = .079 (.069–.089). All factor loadings were significant at $p < .001$. The Grade 11 competitive video game play factor predicted higher levels of aggressive behavior in Grade 12, after controlling for previous levels of aggressive behavior and the third variables. In addition, Grade 10 aggressive behavior predicted higher levels of the Grade 11 competitive video game play factor after controlling for the third variables, and Grade 11 aggressive behavior predicted higher levels of the Grade 12 competitive video game play factor, after controlling for previous levels of the competitive video game play factor and the third variables. Again, examination of the standardized residual covariance matrix in the statistical output indicated that there were no significant unique longitudinal associations between action/fighting video game play and aggression, or between sports/racing video game play and aggression (ps > .05), after controlling for the competitive video game play factor, stability in aggression, and the third variables (see Study 1).

Gender as a Moderator

Gender also was included as a moderator in the analysis and 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).

General Discussion

Overall, the current research makes several important contributions to our understanding of the longitudinal association between competitive video game play and aggression among adolescents and young adults. First, we found that the competitive video game play factor was significantly associated with aggression over time among both adolescents and young adults, even after controlling for stability in aggression and a host of third variables. These results suggest that the competitive video game play factor may be a robust longitudinal predictor of aggression, consistent with an emerging literature on the link between competitive video game play and aggression (e.g., Adachi & Willoughby, 2011a; Adachi & Willoughby, 2013a; Breuer et al., 2015; Carré et al., 2013; Griffiths et al., 2015; Schmierbach, 2010; Shafer, 2012).

We also found that aggressive affect was a mechanism of the predictive effect of the competitive video game play factor on aggressive behavior, consistent with the frustration–aggression hypothesis. Given that the main goal of competitive video games is to win the competition (e.g., to win the violent shooting battle or to win the nonviolent race) against either real opponents (i.e., a human opponent) or fantasy opponents (i.e., a computer-generated opponent), competitive video games involve the threat of deliberate goal thwarting, which may elevate levels of aggressive affect and, in turn, aggressive behavior. In addition, we found that aggression predicted the competitive video game play factor over time among both age groups. This self-selection effect suggests that more aggressive people may seek out competitive video games to a greater extent than less aggressive people, and it is consistent with the selection hypothesis posited by Ferguson et al.'s (2008) Catalyst Model.

Implications and Directions for Future Research

Evidence of a bidirectional association between competitive video game play and aggression raises important questions for the field. For instance, as more aggressive adolescents and young adults have a greater propensity to play competitive video games than their less aggressive peers, the predictive effect of competitive video game play on increasing aggression may be stronger for more aggressive adolescents and young adults than for those who are less aggressive. Future research could address this question and augment our self-report data, for example, by having youth with different levels of baseline aggression play competitive video games in the laboratory and then complete measures assessing their aggressive behavior. Another potential moderator of this association may be the presence of anger management problems. For example, as aggressive affect was a mechanism through which the competitive video game play factor predicted aggression over time, competitive video game play may have a stronger predictive effect on aggressive behavior for youth who have difficulty managing their anger than for youth who are more adept at regulating it.

There also are developmental questions regarding the link between competitive video game play and aggression that could be addressed in future research, such as whether these associations also are present during later developmental periods. For example, 60% of American adults aged 30–49 years report playing video games (Lenhart et al., 2008), yet video game and aggression research with this older age group is scarce. For example, young adults

may be more likely to behave aggressively after playing a competitive video game than adults, as young adults' sometimes may have greater difficulty in regulating their arousal in comparison to adults (Giedd, 2008; Steinberg, 2010). In contrast, the link between competitive video game play and aggression may be similar among young adults and adults, as researchers suggest that in the presence of strong emotions or high arousal, adults also engage in risky behaviors (e.g., Willoughby, Good, Adachi, Hamza, & Tavernier, 2013). For example, the dual process models of decision making, which have been studied extensively with adult populations in the fields of social/cognitive psychology and behavioral economics (Kahneman, 2011), posit that there is a fast, intuitive, automatic system, which often is reliant on affect and current emotions for making decisions (System 1) versus a slow, controlled, and reflective system (System 2). Importantly, researchers have shown that adults also engage in many errors of judgment and that System 1 often is the source of many of these errors (Kahneman, 2011). Because competitive video game play may elevate levels of aggressive affect, playing competitive video games may activate adults' System 1, making them more likely to act on their aggressive impulses.

In addition, given that sport/racing and action/fighting video games are inherently competitive and that research has demonstrated an association between competitive video game play and aggression (e.g., Adachi & Willoughby, 2011a; Adachi & Willoughby, 2013a; Breuer et al., 2015; Carré et al., 2013; Griffiths et al., 2015; Schmierbach, 2010), we hypothesized that a propensity to play competitive video games was at least partially, if not fully, responsible for the predictive effect of the competitive video game play factor on aggression. Yet, it is important to note that there may be other common elements between these two types of video game play that also may contribute to this effect. For example, researchers have found that action/fighting and sports/racing video games also may be similar in terms of their pace of action (e.g., Adachi & Willoughby, 2011b; also see Elson, Breuer, Van Looy, Kneer, & Quandt, 2015, for a short-term examination of pace of action). These video game genres also may be similar in terms of their difficulty level, which has been shown to impact aggression (e.g., Pryzbylski et al., 2014). In addition, the competitive video game play factor may include personality elements such as sensation seeking, which may contribute to the effect on aggression. Importantly, however, the EFA in Study 1 demonstrated that the frequency of playing competitive video games (action, fighting, sports, and racing games) loaded onto a competitive video game play factor, and the frequency of playing noncompetitive video games (puzzle, arts/design, quiz, and building models worlds games) loaded onto a noncompetitive video game play factor, suggesting that the covariance between the frequency of action/fighting and sports/racing video game play does not simply reflect a propensity to play video games in general (i.e., both competitive and noncompetitive video games). Future research should aim to tease apart the common elements between action/fighting and sports/racing video game play, beyond competition, and test whether these common elements predict aggression.

Overall, the present research suggests that, on average, competitive video game play is associated with aggression over time and that aggressive affect is a mechanism of this link. The results also highlight two important potential moderators that should be addressed by future research, namely initial level of aggression and the presence of anger management problems. Specifically, competitive video game play may be a greater risk factor for aggression among adolescents and young adults with higher (vs. lower) initial levels of aggression or with the presence (vs. absence) of anger management problems. However, it is important to note that there also may be positive outcomes related to competitive video game play. For example, research has shown that there are elements of competition that are enjoyable (Griffiths et al., 2015) and important for intrinsic motivation (e.g., Reeve & Deci, 1996). In addition, there may be significant opportunities in competitive video game situations for developing emotion regulation or becoming a gracious winner or loser. Yet, research on competitive video game play is still in its infancy, and there is a dearth of research examining potential positive outcomes (see Adachi & Willoughby, 2013c; Granic, Lobel, & Engels, 2014, for a discussion of positive effects of video game play). Hence, researchers should investigate both maladaptive and adaptive outcomes of competitive video game play in order to elucidate a holistic big-picture understanding of the implications for youth.

Limitations

An important limitation of the present research stems from the reliance on self-report measures. Reports of video game use and aggression would benefit from corroboration from other informants (e.g., friends). It is not clear, however, whether anyone other than the young adult can provide an

accurate assessment of their video game use given that much of the activity may be conducted alone. In addition, although the video game play measures assessed the number of hours that participants played in an average day, the average duration of a single video game play session or the amount of sessions per day were not assessed. Future research could build upon this work by further teasing apart how different patterns of video game play are associated with aggressive outcomes. It also may be beneficial to use a time-sampling data collection procedure to gain a more detailed assessment of video game play during each year. The video game play measures also did not assess the degree to which the video games were played competitively against other people, either in-person or online, or computer-generated opponents. Furthermore, the degree to which the competitive outcome (losing vs. winning) contributed to the predictive effect on aggression is unclear. These limitations represent interesting avenues for future research.

In addition, the structural paths that were significant in the path models were small in magnitude. However, considering that aggressive affect and aggressive behavior were highly stable over time, controlling for these stability effects removed a large portion of variance in the aggressive affect and aggressive behavior outcome variables that was shared with the video game play predictor variables, and thus small predictive effects of change in levels of these variables were expected (Adachi & Willoughby, 2014b). Indeed, these effect sizes are common in longitudinal models when controlling for stability between adjacent time points of data and accounting for associations among variables within each time point (e.g., Adachi & Willoughby, 2013a; Adachi & Willoughby, 2014a; Adachi & Willoughby, 2013b). It is important to note, however, that we are not suggesting that small effects in autoregressive models are *always* important (see Adachi & Willoughby, 2014b).

Another possible concern may be that, because a few sports/racing games may contain some aggressive content, it may be this aggressive content, rather than the competition, that was associated with aggression in the present studies. We think that this is highly unlikely given that we clearly differentiated between racing games that are nonviolent and games that contain both racing and violence. For instance, Grand Theft Auto, which is a prime example of a game that contains racing and violence, was placed in the category of competitive and violent (i.e., action) video games. In contrast, Gran Turismo, which is an example of a popular racing game that is not violent, was placed in the category of competitive and nonviolent (i.e., racing) video games. Furthermore, sports games that are thought to contain some aggression (e.g., football games) have been shown to be rated by participants as very low in terms of violence (e.g., Griffiths et al., 2015).

Also, although research suggests that the types of video game play (action/fighting and sports/racing games) assessed in our study tend to be matched in terms of competitiveness (e.g., Adachi & Willoughby, 2011a; Valadez & Ferguson, 2012), our measures did not explicitly assess participants' ratings of the competitiveness in these games. Future research could add to our findings by examining whether video game competitiveness ratings are associated with aggression over time. Conversely, the fact that our video game play measures did not explicitly assess participants' ratings of the violence in these games may be an important methodological strength. For example, the use of violence-focused measures of video game play (i.e., having participants rate the level of violence of the video games that they play) may overtly prime the notion that participants are engaging in violent behavior, which may systematically bias their responses to outcome measures of aggression.

Strengths and Conclusion

Overall, the present research represents an important advance in our understanding of the longitudinal link between video game play and aggression. Specifically, we are the first to find evidence of a longitudinal association between competitive video game play and aggression among young adults in addition to adolescents. The longitudinal link between competitive video game play and aggressive behavior, therefore, is not limited to earlier periods of development. In addition, we elucidated that aggressive affect is a mechanism of this link. The fact that we had four time points of longitudinal data of young adults and adolescents is an important strength of the current research, as it allowed us to examine the bidirectional associations between video game play and aggression. Ultimately, our findings suggest that researchers should continue to critically examine elements of video game play that are associated with aggression across the life span.

References

Adachi, P. J. C., & Willoughby, T. (2011a). The effect of video game competition and violence on aggressive behavior: Which characteristic has the greatest

influence? *Psychology of Violence*, *1*, 259–274. doi:10.1037/a0024908

Adachi, P. J. C., & Willoughby, T. (2011b). The effect of violent video games on aggression: Is it more than just the violence? *Aggression and Violent Behavior*, *16*, 55–62. doi:10.1016/j.avb.2010.12.002

Adachi, P. J. C., & Willoughby, T. (2013a). Demolishing the competition: The longitudinal link between competitive video games, competitive gambling, and aggression. *Journal of Youth and Adolescence*, *42*, 1090–1104. doi:10.1007/s10964-013-9952-2

Adachi, P. J. C., & Willoughby, T. (2014a). It's not how much you play, but how much you enjoy the game: The longitudinal associations between adolescents' self-esteem and the frequency versus enjoyment of involvement in sports. *Journal of Youth and Adolescence*, *43*, 137–145. doi:10.1007/s10964-013-9988-3

Adachi, P. J. C., & Willoughby, T. (2013b). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth and Adolescence*, *42*, 1041–1052. doi:10.1007/s10964-013-9913-9

Adachi, P. J. C., & Willoughby, T. (2013c). Do video games promote positive youth development? *Journal of Adolescent Research*, *28*, 155–165. doi:10.1177/0743558412464522

Adachi, P. J. C., & Willoughby, T. (2014b). Interpreting effect sizes when controlling for stability effects in longitudinal autoregressive models: Implications for psychological science. *European Journal of Developmental Psychology*, *12*, 116–128. doi:10.1080/17405629.2014.963549

Anderson, C. A., & Carnagey, N. L. (2009). Causal effects of violent sports video games on aggression: Is it competitiveness or violent content? *Journal of Experimental Social Psychology*, *45*, 731–739. doi:10.1016/j.jesp.2009.04.019

Anderson, C. A., Ihori, N., Bushman, B. J., Rothsetin, H. R., Shibuya, A., Swing, E. L., . . . Saleem, M. (2010). Video Game effects on aggression, empathy, and prosocial behavior and eastern and western countries: A meta-analytic review. *Psychological Bulletin*, *136*, 151–173. doi:10.1037/a0018251

Arbuckle, J. L. (1995–2013). *AMOS 22 user's guide*. Crawford, FL: AMOS Development Corporation.

Bentley, M. J., Lin, H., Fernandez, T. V., Lee, M., Yrigollen, C. M., Pakstis, A. J., . . . Leckman, J. F. (2013). Gene variants associated with antisocial behaviour: A latent variable approach. *Journal of Child Psychology and Psychiatry*, *54*, 1074–1085. doi:10.1111/jcpp.12109

Berkowitz, L. (1989). Frustration-aggression hypothesis: Examination and reformulation. *Psychological Bulletin*, *106*, 59–73. doi:10.1037/0033-2909.106.1.59

Boxer, P., Huesmann, R. L., Dubow, E. F., Landau, S. F., Gvirsman, S. D., Shikaki, K., & Ginges, J. (2013). Exposure to violence across the social ecosystem and the development of aggression: A test of ecological theory in the Israeli-Palestinian conflict. *Child Development*, *84*, 163–177. doi:10.1111/j.1467-8624.2012.01848.x

Breuer, J., Scharkow, M., & Quandt, T. (2015). Sore losers? A reexamination of the frustration-aggression hypothesis for collocated video game play. *Psychology of Popular Media Culture*, *4*, 126–137. doi:10.1037/ppm0000020

Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology*, *63*, 452–459. doi:10.1037/0022-3514.63.3.452

Card, N. A., & Little, T. D. (2007). Studying aggression with structural equation modeling. In D. J. Flannery, A. T. Vazsonyi & I. D. Waldman (Eds.), *The Cambridge handbook of violent behavior and aggression* (pp. 727–739). New York, NY: Cambridge University Press.

Carlo, G., Mestre, M. V., McGinley, M. M., Samper, P., Tur, A., & Sandman, D. (2012). The interplay of emotional instability, empathy, and coping on prosocial and aggressive behaviors. *Personality and Individual Differences*, *54*, 675–680. doi:10.1016/j.paid.2012.05.022

Carnagey, L. N., & Anderson, C. A. (2005). The effects of reward and punishment in violent video games on aggressive affect, cognition, and behavior. *Psychological Science*, *16*, 882–889. doi:10.1111/j.1467-9280.2005.01632.x

Carré, J. M., Campbell, J. A., Lozoya, E., Goetz, S. M. M., & Welker, K. M. (2013). Changes in testosterone mediate the effect of winning on subsequent aggressive behavior. *Psychoneuroendocrinology*, *38*, 2034–2041. doi:10.1016/j.psyneuen.2013.03.008

Diamond, P. M., & Magaletta, P. R. (2006). The Short-Form Buss-Perry Aggression Questionnaire (BPAQ-SF): A validation study with federal offenders. *Assessment*, *13*, 227–240. doi:10.1177/1073191106287666

Dodge, K. A., Coie, J. D., & Lynam, D. (2006). Aggression and antisocial behavior in youth. In N. Eisenberg, W. Damon, & R. M. Lerner (Eds.), *Handbook of child psychology: Social, emotional, and personality development* (Vol. 3, 6th ed., pp. 719–788). Hoboken, NJ: Wiley.

Dollard, J., Miller, N. E., Doob, L. W., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression*. New Haven, CT: Yale University Press.

Donovan, J. E., Jessor, R., & Costa, F. M. (1993). Structure of health-enhancing behavior in adolescence: A latent-variable approach. *Journal of Health and Social Behavior*, *34*, 346–362. doi:10.2307/2137372

Elson, M., Breuer, J., Van Looy, J., Kneer, J., & Quandt, T. (2015). Comparing apples and oranges? Evidence for pace of action as a confound in research on digital game and aggression. *Psychology of Popular Media Culture*, *4*, 112–125. doi:10.1037/ppm0000010

Engelhardt, C. R., Mazurek, M., Hilgard, J., & Bartholow, B. D. (2015). Effects of violent-video-game exposure on aggressive behavior, aggressive-thought accessibility, and aggressive affect among adults with and without autism spectrum disorder. *Psychological Science*, *26*, 1187–1200. doi:10.1177/0956797615583038

Ferguson, C. J. (2011). Video games and youth violence: A prospective analysis in adolescents. *Journal of Youth and Adolescence*, *40*, 377–391. doi:10.1007/s10964-010-9610-x

Ferguson, C. J. (2015a). Do angry birds make for angry children? A meta-analysis of video game influences on children's and adolescents' aggression, mental health, prosocial behavior and academic performance. *Perspectives on Psychological Science*, *10*, 646–666.

Ferguson, C. J. (2015b). Does media violence predict societal violence? It depends on what you look at and when. *Journal of Communication*, *65*, E1–E22. doi:10.1111/jcom.12129

Ferguson, C. J., & Dyck, D. (2012). Paradigm change in aggression research: The time has come to retire the General Aggression Model. *Aggression and Violent Behavior*, *17*, 220–228. doi:10.1016/j.avb.2012.02.007

Ferguson, C. J., Garza, A., Jerabeck, J., Ramos, R., & Galindo, M. (2013). Not worth the fuss after all? Cross-sectional and prospective data on violent video game influences on aggression, visuospatial cognition and mathematics ability in a sample of youth. *Journal of Youth and Adolescence*, *42*, 109–122. doi:10.1007/s10964-012-9803-6

Ferguson, C. J., Ivory, J. D., & Beaver, K. M. (2013). Genetic, maternal, school, intelligence and media use predictors of adult criminality: A longitudinal test of the catalyst model in adolescence through early adulthood. *Journal of Aggression, Maltreatment, and Trauma*, *22*, 447–460. doi:10.108/10926771.2013.785457

Ferguson, C. J., & Kilburn, J. (2010). Much ado about nothing: The misestimation and overinterpretation of violent video game effects in eastern and western nations: Comment on Anderson et al. (2010). *Psychological Bulletin*, *136*, 174–178. doi:10.1037/a0018566

Ferguson, C. J., Rueda, S. M., Cruz, A. M., Ferguson, D. E., Fritz, S., & Smith, S. M. (2008). Violent video games and aggression: Casual relationship or byproduct of family violence and intrinsic violence motivation? *Criminal Justice and Behavior*, *35*, 311–332. doi:10.1177/0093854807311719

Giedd, J. N. (2008). The teen brain: Insights from neuroimaging. *Journal of Adolescent Health*, *42*, 335–343. doi:10.1016/j.jadohealth.2008.01.007

Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *American Psychologist*, *69*, 66–78. doi:10.1037/a0034857

Greitemeyer, T., & Mügge, D. O. (2014). Video games do affect social outcomes: A meta-analytic review of the effects of violent and prosocial video game play. *Personality and Social Psychology Bulletin*, *40*, 578–589. doi:10.1177/0146167213520459

Griffiths, R. P., Eastin, M. S., & Cicchirillo, V. (2015). Competitive video game play: An investigation of identification and competition. *Communication Research*, Advanced online publication. doi:10.1177/0093650214565895

Kahneman, D. (2011). *Thinking, fast and slow*. New York, NY: Farrar, Straus, and Giroux.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: Guilford.

Kulik, J. A., & Brown, R. (1979). Frustration, attribution of blame, and aggression. *Journal of Experimental Social Psychology*, *15*, 183–194. doi:10.1016/0022-1031(79)90029-5

Lenhart, A., Jones, J., & Macgill, A. R. (2008). *Adults and video games*. Washington, DC: Pew Internet and American Life Project.

Little, T. D., Jones, S. M., Henrich, C. C., & Hawley, P. H. (2003). Disentangling the "whys" from the "whats" of aggressive behaviour. *International Journal of Behavioral Development*, *27*, 122–133. doi:10.1080/01650250244000128

Little, R. J. A., & Rubin, D. B. (2002). *Statistical analysis with missing data* (2nd ed.). Hoboken, NJ: Wiley.

MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology*, *58*, 593–614. doi:10.1146/annurev.psych.58.110405.085542

Maldonado-Molina, M. M., Jennings, W., & Komro, K. (2010). Effects of alcohol on trajectories of physical aggression among urban youth: An application of latent trajectory modeling. *Journal of Youth and Adolescence*, *39*, 1012–1026. doi:10.1007/s10964-009-9484-y

Manning, L. G., Davies, P. T., & Cicchetti, D. (2014). Interparental violence and childhood adjustment: How and why maternal sensitivity is a protective factor. *Child Development*, *85*, 2263–2278. doi:10.1111/cdev.12279

Marini, Z., Spear, S., & Bombay, K. (1999). Peer victimization in middle childhood: Characteristics, causes, and consequences of bullying. *Brock Education*, *9*, 32–47.

Markey, P. M., Markey, C. N., & French, J. E. (2014). Violent video games and real world violence: Rhetoric versus data. *Psychology of Popular Media Culture*, *4*, 277–295. doi:10.1037/ppm0000030

Möller, I., & Krahé, B. (2009). Exposure to violent video games and aggression in German adolescents: A longitudinal analysis. *Aggressive Behavior*, *35*, 75–89. doi:10.1002/ab.20290

Pryzbylski, A. K., Deci, E. L., Rigby, C. S., & Ryan, R. M. (2014). Competence-impeding electronic games and players' aggressive feelings, thoughts, and behaviors. *Journal of Personality and Social Psychology*, *106*, 441–457. doi:10.1037/a0034820

Reeve, J., & Deci, E. L. (1996). Elements of the competitive situation that affect intrinsic motivation. *Personality and Social Psychology Bulletin*, *22*, 24–44. doi:10.1177/0146167296221003

Schmierbach, M. (2010). "Killing spree": Exploring the connection between competitive game play and aggressive cognition. *Communication Research*, *37*, 256–274. doi:10.1177/0093650209356394

Shafer, D. M. (2012). Causes of state hostility and enjoyment in player versus player and player versus environment video games. *Journal of Communication*, *62*, 719–737. doi:10.1111/j.1460-2466.2012.01654.x

Statistics Canada. (2006a). *Population by selected ethnic origins*. Retrieved from http://www40.statcan.ca/101/cst01/demo27i-eng.htm

Statistics Canada. (2006b). *Population by selected ethnic origins*. Retrieved from http://www40.statcan.ca/101/cst01/demo27i-eng.htm

Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology*, *52*, 216–224. doi:10.1002/dev.20445

Tear, M. J., & Nielsen, M. (2013). Failure to demonstrate that playing violent video games diminishes prosocial behavior. *PLoS ONE*, *8*, 1–7. doi:10.1371/journal.pone.0068382

Valadez, J. J., & Ferguson, C. J. (2012). Just a game after all: Violent video game exposure and time spent playing effects on hostile feelings, depression, and visuospatial cognition. *Computers in Human Behavior*, *28*, 608–616. doi:10.1016/j.chb.2011.11.006

Willoughby, T., Adachi, P. J. C., & Good, M. (2012). A longitudinal study of the association between violent video game play and aggression among adolescents. *Developmental Psychology*, *48*, 1044–1057. doi:10.1037/a0026046

Willoughby, T., Good, M., Adachi, P. J. C., Hamza, C., & Tavernier, R. (2013). Examining the link between adolescent brain development and risk taking from a social–developmental perspective. *Brain and Cognition*, *83*, 315–324. doi:10.1016/j.bandc.2013.09.008

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*, 197–206. doi:10.1086/651257