Using the Multiple-Choice Procedure to Measure Video Game Playing

by

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Abstract

Video gaming shares many similarities with substance use and gambling including neural mechanisms, motivations, and negative consequences. Behavioral economic models have been used to inform conceptual models of addictive behaviors, and may have a similar impact on our understanding of video gaming. The current study used the Multiple-Choice Procedure (MCP) to measure the relative reinforcing value of video game playing for different temporal magnitudes (i.e., 10, 30, and 90 minutes with which to play a video game) relative to alternative monetary reinforcers available immediately or after a 1-week delay. Participants completed the MCP and the Video Game Dependency Scale (VGDS) to assess problems associated with pathological video gaming. Similar to other addictive behaviors measured with the MCP, mean crossover points increased as temporal magnitudes increased and as delay was introduced to the alternative monetary reinforcer. MCP crossover points added to the variance accounted for in VGDS scores, and differed as a function of VGDS scores. The current study is the first to investigate a behavioral economics model of video game playing. Recommendations for future assessment and intervention efforts are provided.

Table of Contents

List of Tables

List of Figures

Using the Multiple-Choice Procedure to Measure Video Game Playing

Video games have continually progressed from simple graphics on dedicated gaming consoles to the mass medium it is today with complicated graphics and multiple devices (e.g., mobile phones, standalone consoles, computers, internet browsers) on which to play. According to the Entertainment Software Association (2014), approximately 59% of individuals in the United States play computer games or video games, among whom 52% are male. In addition, the National Purchase Diary Group (2013) found that approximately 72% of video game players report playing at least one game online. The popularity of playing video games on the Internet has created a greater need for online video gaming research to understand the phenomenon.

The inclusion of internet gaming disorder (IGD) in the *Diagnostic and Statistical Manual* (5th ed.; DSM-5) as a condition which warranted future study in the Substance-Related and Addictive Disorders category has brought increased attention to the construct. The DSM-5 conceptualizes IGD as "a pattern of excessive and prolonged Internet gaming that results in a cluster of cognitive and behavioral symptoms, including progressive loss of control over gaming, tolerance, and withdrawal symptoms" (American Psychiatric Association, 2013, p. 796). The cognitive and behavioral symptoms for IGD align closely with criteria for other recognized addictions, including gambling and substance-related disorders. Individuals must present with five or more of the following proposed criteria for IGD to be diagnosed: (1) preoccupation with Internet games, (2) withdrawal, (3) tolerance, (4) unsuccessful attempts to control participation in Internet games, (5) loss of interest in other hobbies, (6) continued excessive use despite knowledge of psychosocial problems, (7) deceiving others regarding amount of time spent playing, (8) using online gaming to escape or relieve negative mood, and (9) jeopardizing or loss of a significant relationship, job, or educational or career opportunity (American Psychiatric Association, 2013).

Although the DSM-5 authors have proposed criteria and rules for diagnosing IGD, researchers have used multiple conceptual definitions based on the criteria of both substance dependence and impulse control disorder in the DSM-IV-TR for pathological video gaming (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013). In addition to IGD, a literature review conducted by Kuss and Griffiths (2012a) revealed several other terminologies for similar phenomena including compulsive Internet use, problem video game playing, problematic online game use, video game addiction, and online gaming addiction. For the purpose of this paper, the construct will be referred to as pathological video gaming.

Several studies have revealed large variability in the estimated prevalence of pathological video gaming in different populations, ranging from 1.16% of 11,003 German adolescents using DSM-5 criteria (Rehbein, Kliem, Baier, Mößle, & Petry, 2015) to 15.6% of 503 adolescents from Hong Kong (Wang et al., 2014). Another study of 15,168 German adolescents found prevalence rates of 3% among males and 0.3% among females (Rehbein et al., 2010). In addition, 8% of 1,945 international video gamers endorsed problematic gaming behaviors in a self-report survey (Porter, Starcevic, Berle, & Fenech, 2010). Although prevalence rates vary greatly among studies, data suggest that a substantial number of individuals across cultures and age ranges either meet criteria for the DSM-5 definition of IGD or meet criteria for pathological video gaming according to other measures.

Although some studies reveal similarities in prevalence rates across genders, most suggest large differences between males and females in prevalence rates of pathological video gaming. The gender differences in rates of pathological gambling are analogous to gender differences in substance use disorder prevalence rates. A literature review conducted by Kuss and Griffiths (2012b) found that male adolescents were significantly more likely to exhibit pathological video gaming behavior than female adolescents. Another literature review conducted across age ranges found very similar results; males were more likely than females to meet criteria for pathological video gaming (Kuss & Griffiths, 2012a). Substance use disorder epidemiological studies show similar differences between genders such that males are approximately twice as likely as females to be diagnosed with a substance use disorder (Merikangas & McClair, 2012).

Individuals who show problematic behaviors related to pathological video gaming may experience a variety of negative consequences associated with the disorder. A study of 1,068 Austrian adolescents revealed that pathological video gaming was correlated with stress, inattention, maladaptive coping behavior, and psychosomatic challenges (Batthyány, Müller, Benker, & Wölfling, 2009). Peng and Liu (2010) found that pathological video gaming was related to maladaptive cognitions and depression. Several studies reveal further problems, including problems with physical well-being, personal life, and academic/professional performance (Batthyány et al., 2009; Liu & Peng, 2009; Peng & Liu, 2010, Rehbein et al., 2010). Sleep patterns also appear to be negatively affected, such that students identified as pathological video game players reported more sleep problems (Rehbein et al., 2015) and reduced sleep time (Rehbein et al., 2010) compared to others. Delayed sleep-onset and reduced slow-wave sleep was also linked to pathological video gaming behaviors among children (Dworak, Schierl, Bruns, & Struder, 2007). Rehbein and colleagues (2010) found that German adolescents who qualified for pathological video gaming were more likely to endorse often having thoughts of suicide on a 4-point scale (1 ‘no, never’ to 4 ‘yes, often’). Another study found that individuals who play

Massive Multiplayer Online Roleplaying Games (MMORPGs) were more likely than other game players to experience problems associated with game playing (Kuss, Louws, & Wiers, 2012). Further, German adolescents who endorsed playing online games had significantly higher pathological video gaming scores (Rehbein, Kleimann, Mediasci, & Mößle, 2010). Though researchers have employed various conceptual frameworks when developing pathological video gaming measures to assess related problematic behavior, data consistently suggest numerous potential negative effects on various life functions.

Despite negative consequences associated with pathological video gaming, individuals continue to play. Motivations behind pathological video gaming have been reported, including three overarching themes: dysfunctional coping, personal satisfaction, and socialization (Kuss & Griffiths, 2012a). Specifically, dysfunctional coping motivations can include escape, dealing with stress, and coping with problems (Hussain & Griffiths, 2009; King & Delfabbro, 2009; Kuss et al., 2012). Personal satisfaction motivations include perceived playfulness and loyalty (Lu & Wang, 2008), enjoyment, completion, and overcoming challenges (King & Delfabbro, 2009; King, Delfabbro, & Griffiths, 2011). Socialization motivations include social recognition (King & Delfabbro, 2009) and online relationships (Caplan, Williams, & Yee, 2009). Kuss and colleagues (2012) found that motivations related to improving performance and mastering the mechanics of MMORPGs are also associated with pathological video gaming. Consistent with the similarities between DSM-5 diagnostic criteria for substance use and gambling with IGD, several of these identified motivations to play video games are the same as motivations associated with substance use (Terry-McElrath, O'Malley, & Johnston, 2009) and gambling (Lightsey Jr. & Hulsey, 2002).

In addition to motivations, video gaming shares similarities with both substance use and gambling in neural processes and brain area activity. Several fMRI studies identified significant brain activation in regions typically associated with reward and addiction while playing video games (Hoeft, Watson, Kesler, Bettinger, & Reiss, 2008; Han, Hwang, & Renshaw, 2010; Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2014). Activation in these brain areas overlaps with findings of the neural basis of substance addiction (Kalivas & Volkow, 2005). Further, several of the brain areas activated are recognized as a component of most brain circuits of addiction (Franken, 2003). A literature review conducted by Weinstein and Lejoyeux (2013) studying brain imaging, brain activation, brain structure, and brain mechanisms behind pathological video gaming also supports the similarities between video game playing and drug abuse. Additional evidence suggests that video game cues appear to activate brain regions often found in cue presentations for individuals with pathological gambling or substance dependence (Han et al., 2011; Weinstein & Lejoyeux, 2013). Taken together, these data suggest that the neural mechanisms underlying drug abuse and pathological gambling are similar to the neural mechanisms associated with video game playing.

Behavioral economics

Understanding video gaming through the same behavioral principles that have been applied to understanding substance use and gambling may be a useful approach given that video gaming shares many similarities with these addictive behaviors. More specifically, theory driven research utilizing a behavioral economics approach to understanding video gaming could assist in gaining more insight into the phenomenon. Behavioral economics combines economic theory with behavior analysis to help explain decision-making. The theory uses economic principles to describe how individuals allocate their behavior among reinforcers (Correia, Murphy, & Butler, 2011). Behavioral economics helps explain what variables influence decision-making and choice behavior among concurrently available reinforcers. Behavioral economics models have been used to understand a range of addictive behaviors, including substance use and gambling (Heinz, Lilje, Kassel, & de Wit, 2012), and sexual behavior (Lawyer, 2008).

Past research on alcohol self-administration has shown that the availability of additional reinforcers and constraints on access to them significantly affect preferences for drugs and alcohol in animals and humans (Vuchinich & Tucker, 1988). Specifically, delayed access to alternative reinforcers, smaller alternative reinforcers, and price increases of alternative reinforcers led to increases in alcohol consumption. Further, alternative reinforcers are important for determining the relative reinforcing value of a stimulus—the strength of preference for a reinforcer relative to a concurrently available alternative reinforcer (Bickel, Marsch, & Carroll, 2000).

Although several self-report measures for assessing pathological video gaming exist, many lack supporting reliability and validity evidence. Studies supporting the psychometric evidence of many pathological video gaming measures often use different diagnostic cutoffs and different factor structures; thus, determining if the data across studies support the same construct is difficult (King et al., 2013). A measure based on behavioral economics theory capable of assessing the reinforcing value of video gaming would provide objective information for understanding pathological video gaming. To the author's knowledge, there are currently no behavioral measures of video gaming. Hence, at this time, the use of a behavioral measure typically used in substance use research could aid in fully understanding pathological video gaming as well as aid assessment and intervention.

Multiple-Choice Procedure

The Multiple-Choice Procedure (MCP) was first developed as a measure for efficiently investigating drug reinforcement (Griffiths, Troisi, Silverman & Mumford, 1993). It has been used with many substances, including alcohol, cocaine, sedatives, caffeine, cigarettes, MDMA, opiates, marijuana, methylphenidate, IV nicotine (Heinz et al., 2012), as well as gambling (Butler, Irons, Bassett, & Correia, 2016). The MCP is a reliable and valid measure for assessing the relative reinforcing value of a reinforcer (i.e., substances and money with which to gamble) compared to alternative reinforcers (Griffiths et al., 1993; Griffiths, Rush, & Puhala, 1996).

The MCP provides participants with two or more separate and distinct choices between a substance and an alternative reinforcer of varying magnitudes and/or delays. Past MCP studies have examined drug vs. drug choices as well as drug vs. money. The datum of interest from the MCP is the crossover point—the point at which the individual ceases to choose the reinforcer of interest (e.g., substance) and begins choosing the alternative reinforcer (e.g., money). The relative reinforcing value for each participant is operationalized as the money value at the crossover point. Higher money values indicate higher relative reinforcement value for the reinforcer of interest.

Although the MCP was initially designed for use in the laboratory such that consequences could be provided for real choices, it has also been used in online surveys with hypothetical choices (i.e., participants do not receive their choices; e.g., Butler et al., 2016; Correia & Little, 2006). For example, Correia and Little (2006) conducted two MCP studies to find the relative reinforcing value of alcohol among a college student sample. The first study presented participants with hypothetical choices on an online survey and the second study presented real choices in a laboratory setting. Results from the studies were similar; MCP crossover points were higher when the monetary reinforcer was available immediately. Results from the survey version suggested that when the magnitude of the alcohol reinforcer was larger, MCP crossover points were higher. Similar results have been demonstrated using hypothetical choices in a survey version of the MCP to measure gambling in a college student sample (Butler et al., 2016). Participants were presented with hypothetical choices between money with which to gamble (reinforcer of interest) and escalating monetary values of guaranteed money (alternative reinforcer). The mean crossover point was positively correlated with frequency of gambling and number of items endorsed on the South Oaks Gambling Screen, a measure of gambling pathology severity. Mean crossover points were higher for larger reinforcer magnitude and mean crossover points for a one-week delay relative to an immediate delay were statistically significantly higher, but only for $10 with which to gamble. Results from these studies provide psychometric evidence supporting the use of a survey version of the MCP to measure both a substance reinforcer and non-substance reinforcer. In addition, hypothetical choices have been shown to be a valid representation of how participants would actually respond (e.g., Johnson & Bickel, 2002).

Because playing video games shares many similarities with using substances and gambling, the MCP is likely an effective instrument to find the relative reinforcing value of playing video games. Thus, the current study aimed to assess the validity of using the MCP adapted to compare playing video games to concurrently available alternative reinforcers in an effort to quantify the relative reinforcing value of playing video games. To capture the relative reinforcing value of video gaming, a specific amount of time to play a video game was presented as the target behavior, analogous to a drug dose or amount of money with which to gamble. The crossover point was the dollar amount at which the participant ceased to choose time to play a video game and began choosing money. We hypothesized that the MCP would be a valid measure of video game playing: the crossover point will increase when a) the magnitude of the reinforcer is increased and b) when there is a delay associated with the alternative reinforcer. We also hypothesized that the MCP crossover point would correlate with participants' frequency of playing video games and with scores on the Video Game Dependency Scale (VGDS). In addition, we hypothesized that players with larger VGDS scores would value playing video games more than players with smaller VGDS scores. Finally, we hypothesized that the MCP crossover point would contribute to the prediction of pathological video gaming severity (VGDS scores), while also accounting for gender and frequency of play.

Method

Participants

Eight hundred and eighteen participants enrolled in psychology and statistics courses at a large southern public university completed the online survey in exchange for extra credit in their courses. Of the 818 participants, 321 were excluded from analyses due to not playing a video game within the past 28 days as their MCP responses may not have been an accurate representation of the reinforcing value of video game playing due to a lack of recent activity. Of the remaining 497 participants, 56 were excluded due to inconsistencies within their data. Specifically, these 56 individuals reported multiple crossover points on the MCP despite instructions to crossover only one time or had missing data on at least one version of the MCP. Finally, one other participant was excluded from analyses due to being less than 18 years old (17).

The remaining 440 participants were 55.7% female with an average age of 20.12 and an age range of 18 to 55. Participants identified their racial and ethnic background by selecting one or more racial category, which is why the following numbers add up to more than 100%. The sample was 88.6% White, 9.8% Black or African American, 3.9% Asian, 3.4% Hispanic or Latino, 2.7% American Indian or Alaska Native, and 0.5% Native Hawaiian or Other Pacific Islander. In addition, 35% of participants reported being a member of a fraternity of sorority. The majority (64.1%) of participants lived in an off campus house or apartment and 29.1% lived in a campus dormitory.

Measures

Demographics. Participants first completed a brief demographics questionnaire that included gender, age, ethnicity, year in school, current residence, religious preference, and Greek affiliation.

Video Game Survey (*VGS*). The VGS was adapted from the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985), a commonly used method to assess daily drinking behaviors over the past month. We adapted the DDQ to assess the amount of time participants typically played video games each day of the week for the past month. Participants were asked to describe their recent pattern of playing video games. Video games were defined as any game that is played on a computer, a console (e.g. PlayStation, Xbox), a tablet, a phone, or any other mobile device. Examples of videos games would include World of Warcraft, Call of Duty, League of Legends, sports-based games, and games that are primarily played on mobile devices such as Clash of Clans, Words with Friends, and Candy Crush. In addition, participants were asked to report during the last 28 days, on how many days they played any video games, on how many days they played games on specific gaming machines (i.e., PC, console, mobile device), what video game they played the most, what genre of video game they played the most, and on how many days they played for longer than 2 hours. Participants were also asked if they identify as a "hardcore gamer" and what they consider their favorite video game.

Multiple-Choice Procedures (MCP; Griffiths et al., 1993). Participants were asked to make hypothetical choices between fixed magnitude reinforcers (video game playing time) and ascending amounts of a monetary reinforcer (i.e., dollar values). Participants were instructed to imagine the following hypothetical situation: participants were completing a laboratory study and would be in the lab for 120 minutes. During that time, the participants were informed that they would be alone completing surveys to earn extra credit and would not have access to their cellphone or to any other forms of media or communication. After 15 minutes of completing surveys, a researcher tells the participant that they could choose between earning money or having access to their favorite video game for a fixed amount of time. The participants were then instructed to imagine that the researcher placed a total of $20 on the table and their favorite video game and asked them to complete a series of choices (i.e., the MCP). They were told that regardless of their choice, they would still gain the 2 hours of extra credit for completing the hypothetical study. For each version of the MCP, participants were instructed that once they had selected money, they should continue to do so for the remainder of that version of the MCP. After instructing participants to imagine this hypothetical laboratory study, they were presented with the six versions of the MCP, including three different reinforcer magnitudes (i.e., 10 minutes of video game play time, 30 minutes of video game play time, and 90 minutes of video game play time) and two different time points to receive the alternative monetary reinforcer (i.e., immediately or 1-week delay). The playing times were selected with average game playing session lengths in mind. One study found that gamers who play a casual game (Happy Farm) have average play sessions of approximately 10 minutes (Hou, 2011). In contrast, gamers who play a more involved and intense game (World of Warcraft) have average gaming sessions of 2.8 hours, with a median of 1.8 hours (Tarng, Chen, Huang, 2008). Therefore, we selected 10 minutes, 30 minutes, and 90 minutes for primary reinforcer magnitude to accurately represent different gaming levels. Each magnitude of the primary reinforcer was paired with both time points to receive the monetary reinforcer (i.e., 10 minutes vs. immediate money, 10 minutes vs. 1-week delayed money; 30 minutes vs. immediate money, 30 minutes vs. 1-week delayed money; 90 minutes vs. immediate money, 90 minutes vs. 1-week delayed money). Dollar values started at $0 and increased by $0.25 up to $2.00. After $2.00, the dollar values increased by $0.50 up to $10.00, and then increased by $1.00 up to $20.00, for a total of 35 choices on each survey version. Each version of the MCP yielded a single crossover point, which was conceptualized as the relative reinforcing value of playing video games compared to an alternative monetary reinforcer.

Video Game Dependency Scale (*VGDS;* adapted from Computerspielabhängigkeitsskala; Rehbein et al., 2015). The VGDS was originally adapted from the Internet Addiction Scale (Rehbein et al., 2010) and then updated in order to assess all nine DSM-5 criteria of internet gaming disorder. Each of the 9 DSM-5 criteria for IGD is assessed by two items, resulting in an 18-item, 4-point Likert-type scale (1 ‘strongly disagree’, 2 ‘somewhat disagree’, 3 ‘somewhat agree’, 4 ‘strongly agree’). A criterion is only considered endorsed by the participant if at least one item was answered ‘strongly agree.’ Since the current study was not focused on diagnosis, analyses were conducted using the total VGDS score, which was derived by adding each item’s score into a total score. In a literature review of pathological video gaming scales, the original version of the VGDS was found to have evidence of validity and reliability (King et al., 2013). It was associated with three clinical indicators (i.e., truancy, sleep difficulties, suicide risk) indicating convergent validity. The measure also demonstrated criterion validity, with a statistically significant association (.59) between the number of symptoms endorsed and severity level. An internal consistency correlation of .92 provides some evidence of reliability.

Procedure

Participants logged in to Sona Systems to complete an informed consent process (an information letter) and the battery of measures via Qualtrics. Participants were asked to complete each version of the MCP and the additional measures, which took approximately 15 minutes. Data collected were not linked to participants' identifying information to ensure the data were anonymous.

Results

Each of the 440 participants answered several questions related to the frequency of their video game playing behavior. Participants reported the number of minutes they typically played video games each week (M = 482.78, SD = 571.56, Mdn = 330). Participants also reported the number of days they played a video game on several gaming devices in the past 28 days; 35.23% of participants played video games at least one day on a personal computer (M = 3.64, SD = 7.32), 38.41% of participants played video games at least one day on a video game console (e.g., PlayStation, Xbox; M = 5.6, SD = 7.46), and 78.64% of participants played video games at least one day on a mobile device (M = 9.65, SD = 10.24). Participants also reported the number of days they played video games for longer than 2 hours (M = 4.95, SD = 7.35). Participants were also asked to identify the genre of video games they played over the past 28 days: 42.95% played a Strategy game, 35.91% played an Action game, 35.91% played a Shooting game, 32.73% played a Sports game, 29.55% played an Adventure game, 27.05% played a Trivia game, 23.64 played a Role-playing game, 17.95% played a Board game-style video game, 16.14% played a

Simulation game, 8.64% played a Music game, and 7.73% reported playing a game from an "Other" category. Examples of "Other" games included Multiplayer Online Battle Arena, Racing/Driving, and Card games. Participants also identified the genre of game they played the most over the past 28 days and the three most frequently endorsed genres were Strategy games (19.32%), Shooting games (16.36%), and Sports games (16.36%). Participants also identified whether they considered themselves a "hardcore video game player," of which 8.4% did.

In order to test whether the MCP was sensitive to reinforcer magnitude and/or delay, a 2x3 repeated measures factorial ANOVA (Delay [immediate, delay] x Magnitude [10 minutes to play video games, 30 minutes to play video games, 90 minutes to play video games]) using MCP crossover points as the dependent variable was conducted. Mean crossover points for the six MCP forms are presented in Table 1 and Figure 1. There was a statistically significant main effect of reinforcer delay, $F(1, 439) = 296.95$, $p < .001$, $\eta_\rho^2 = .403$ with average crossover points increasing when the monetary reinforcer was delayed 1 week ($M = 7.27$) compared to the monetary reinforcer being delivered immediately ($M = 5.25$) This indicates that the relative reinforcing value of playing video games increased when the monetary reinforcer was delayed.

Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of reinforcer magnitude, $\chi^2(2) = 283.06$, $p < .001$ and had been violated for the interaction effect between reinforcer delay and reinforcer magnitude, $\chi^2(2) = 8.47$, $p = .014$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .68$ for the main effect of reinforcer magnitude and .98 for the interaction effect). There was a statistically significant main effect of reinforcer magnitude, $F(1.355, 594.85) = 107.68$, $p < .001$, $\eta_\rho^2 = .197$, with average crossover points increasing as the time to play video games rose from 10 minutes ($M = 4.93$), to 30 minutes ($M = 6.28$), and to 90 minutes ($M = 7.57$), demonstrating that the relative reinforcing value of playing video games increased as the length of time to play rose. To clarify the differences between the levels of reinforcer magnitude, contrasts were performed with the Bonferroni adjustment comparing each level of reinforcer magnitude. Contrasts revealed that average participant crossover points at 30 minutes, $F(1, 439) = 103.31$, $p < .001$, $\eta_p^2 = .191$, and at 90 minutes, $F(1, 439) = 128.42$, $p < .001$, $\eta_p^2 = .226$, were statistically significantly higher than at 10 minutes. In addition, average crossover points at 90 minutes were statistically significantly higher than at 30 minutes, $F(1,439) = 66.05$, $p < .001$, $\eta_p^2 = .131$.

In addition to the main effects, there was a statistically significant interaction effect between reinforcer magnitude and delay, $F(1.962, 861.51) = 25.56$, $p < .001$, $\eta_p^2 = .055$, indicating that reinforcer magnitude had different effects on crossover points depending on when the monetary reinforcer was delivered (delayed vs. immediate; See Figure 2). Using the Bonferroni adjustment, contrasts revealed that participant crossover points when money was delivered immediately at 10 minutes ($M = 3.66$) were statistically significantly lower than average participant crossover points when money was delivered a week later at 10 minutes ($M = 6.21$), $F(1, 439) = 257.46$, $p < .001$, $\eta_p^2 = .37$. Contrasts also revealed a statistically significant difference between immediate money at 30 minutes ($M = 5.26$) and delayed money at 30 minutes ($M = 7.31$), $F(1, 439) = 190.44$, $p < .001$, $\eta_p^2 = .303$. Finally, contrasts revealed a statistically significant difference between participant crossover points with immediate money at 90 minutes ($M = 6.84$) and delayed money at 90 minutes ($M = 8.30$), $F(1, 439) = 124.49$, $p < .001$, $\eta_p^2 = .221$. The significant interaction and contrasts suggest that as the magnitude of the reinforcer increases, the effect of delay decreases.

In order to test whether individuals with higher VGDS scores ($n = 228$) had different MCP crossover points than individuals with lower VGDS scores ($n = 212$), we divided the sample by VGDS scores (*Mdn* = 22) into groups using a median split and then conducted multiple *t*-tests comparing the two groups for each of the six MCP versions. As displayed on Table 2, all of the t-tests were statistically significant and indicated that, on average, participants with higher VGDS scores had higher MCP crossover points.

In order to test the hypothesis that participants' crossover points from each of the six versions of the MCP would correlate with each other, with participants' frequency of playing video games, and with total scores on the VGDS, we ran multiple bivariate correlation tests between the crossover points of each MCP version, average MCP crossover point, total VGDS scores, and with weekly participant video game play time (in minutes). All variables were significantly correlated with each other (all *p*s $< .001$ aside from the correlation between 10 minute MCP crossover point and weekly participant video game play time, $p = .006$; See Table 1).

Finally, in order to test the hypothesis that the MCP crossover point would contribute to the prediction of pathological video gaming (total VGDS score), a hierarchical multiple regression analysis was conducted. Weekly participant play time (in minutes) and gender were used as control variables to see if the addition of the average MCP crossover point would produce a significant change in variance accounted for (See Table 3). The first model of the regression analysis included both control variables of weekly participant playtime and gender. At the second stage of the regression analysis, average MCP crossover point was added to the model. The hierarchical multiple regression revealed that weekly participant play time and gender were significant predictors of total VGDS score, $F(2, 437) = 95.48$, $p < .001$ and accounted for approximately 30.41% of the variance of total VGDS scores. In the second model, average MCP crossover point was introduced to the regression model with weekly participant play time and gender. This model was also a significant predictor of total VGDS score, $F(3, 436) = 68.55$, $p < .001$ and explained an additional 1.64% of the variation in VGDS scores. This change in R^2 was significant, $F(1, 436) = 10.52$, p = .001. Together, the three variables accounted for 32.05% of the variance in VGDS scores. Thus, adding the average MCP crossover point in the second model of the regression analysis increased the amount of variance accounted for beyond weekly participant play time and participant gender.

Discussion

The MCP has been used to measure the relative reinforcing value of several drugs, including caffeine (Garrett & Griffiths, 1998), cigarettes (Griffiths et al., 1996), cocaine (Jones, Garrett, & Griffiths, 1999), alcohol (Correia & Little, 2006), MDMA (Tancer & Johanson, 2007), opiates (Greenwald & Hursh, 2006), marijuana (Greenwald & Stitzer, 2000), and gambling (Butler et al., 2016). The current study represents the first use of the MCP to measure the relative reinforcing value of video game playing. In order to test the potential validity of the survey version of the MCP to measure the relative reinforcing value of playing video games, the sensitivity of the MCP to the effects of reinforcer magnitude and delay associated with an alternative reinforcer were assessed. In addition, the average MCP crossover point's ability to account for variance in pathological video game dependency was examined. MCP crossover points were also examined to test for differences based on pathological video gaming scores. Finally, the relationships between the MCP, amount of video game play time, and video game dependency were examined.

According to behavioral economic theory and previous research, a number of factors influence the reinforcing value of a stimulus. Examples include the magnitude of the stimulus (e.g., quantity and quality) and the presence of alternative reinforcers (e.g., magnitude, costs, constraints; Correia et al., 2011; Vuchinich & Tucker, 1988). The current study demonstrated that the reinforcing value of video game playing, as assessed by the MCP, is impacted by these same factors. As the amount of time (i.e., temporal magnitude) to play video games increased from 10 minutes to 30 minutes and to 90 minutes, MCP crossover points (i.e., reinforcing value) also increased. Similar reinforcer magnitude effects have been found in past MCP studies on substances (Benson, Little, Henslee, & Correia, 2009; Griffiths et al., 1996; Jones et al., 1999; Correia & Little, 2006) and gambling (Butler et al., 2016). When delay was introduced to the alternative monetary reinforcer, mean crossover points were significantly higher compared with when the alternative monetary reinforcer was available immediately. Delay effects on relative reinforcing value have also been shown in past MCP studies on substances (Benson et al., 2009; Jones et al., 1999; Correia & Little, 2006) and gambling (Butler et al., 2016).

In addition to the reinforcer magnitude and alternative reinforcer delay effects, there was an interaction between the two, such that as time to play video games increased, the effect of delay decreased. A very similar interaction effect was found in a laboratory study using the MCP to investigate the relative reinforcing value of alcohol across different magnitudes (i.e., 12 oz., 24 oz., 36 oz.) and a delay associated with the alternative monetary reinforcer (i.e., immediately available, 1-week delay; Benson et al., 2009). The MCP's sensitivity to both reinforcer magnitude and delay associated with an alternative monetary reinforcer provide evidence for the validity of its use to measure the reinforcing value of playing video games. Once again, these results suggest that behavioral economic theory can applied to video game playing.

Other validity evidence for using the MCP to measure the relative reinforcing value of video game playing was found by examining the relation between several variables meant to assess aspects of video game playing behavior in the natural environment. Both weekly participant play time and total VGDS scores were correlated with all six versions of the MCP as well as the average MCP crossover point. Past studies have also shown positive correlations between the MCP and measures of alcohol use and problems (Correia & Little, 2006) and positive correlations between the MCP and gambling frequency and problematic gambling (Butler et al., 2016). These positive associations demonstrate that the MCP is related to behaviors in natural environments in a meaningful and predictable way.

Further analyses revealed that there was a relationship between MCP crossover points and pathological video gaming scores (VGDS), and that average MCP crossover points contributed to the prediction of pathological video gaming scores. That is, the MCP contributed to the amount of variance accounted for in VGDS scores above and beyond what weekly participant play time and gender accounted for. Similarly, MCP scores differed as a function of pathological video gaming scores; participants with higher VGDS scores reported higher crossover points than those with lower VGDS scores. This difference in MCP crossover points between lower and higher scores of pathological video gaming is similar to findings of a previous study in which individuals with subclinical or probable gambling problems had higher crossover points than individuals without gambling problems (Butler et al., 2016). These findings also provide evidence supporting the validity of using the MCP as marker of impairment related to playing video games.

The similarities between the current findings and those reported in previous studies provide support for the notion that pathological video gaming is a disorder that shares many features with other addictive behaviors. More specifically, the consistent findings suggest a common behavioral mechanism across a wide range of addictive behaviors. Treatment outcomes studies also lend support to this notion. Several researchers have used DSM-5 criteria for internet gaming disorder to find the treatment efficacy of cognitive-behavioral therapy (CBT; Du, Jiang, & Vance, 2010; Li & Wang, 2013), reality therapy (Kim, 2008), multimodal counseling (Shek, Tang, & Lo, 2009), online self-help (Su, Fang, Miller, & Wang, 2011), drug therapy (Han et al., 2010), and a combination of CBT and bupropion (Kim, Han, Lee, & Renshaw, 2012). In a review of these treatment studies, King and Delfabbro (2014) observed that many of these studies and treatments lacked consistent assessment and that there was a large need for follow-up outcome measures in identifying the benefits of treatment long-term. The MCP represents a behavioral economic measure that would be simple to add to any clinical treatment in order to assess the initial relative reinforcing value of playing video games at intake and then again at follow-up, allowing clinicians and researchers one way to assess the efficacy of treatment.

The current study provides initial validity evidence for using the MCP as a measure of the relative reinforcing value of playing video games as well as the MCP's utility in helping explain pathological video gaming. However, there are several limitations that must be considered when interpreting the results. First, the study's sample was composed of college students, of which the vast majority were between 18 and 22 years of age. A more diverse sample is necessary in order to test for generalizability of results. In addition, very few participants met diagnostic criteria for any pathological video gaming diagnosis. Therefore, a sample with more severe video gaming behaviors should be recruited and studied. Another limitation is present in how data were collected: through self-report measures online. The MCP is typically used as a measure of real choices in a laboratory, which allows for participants to draw a random number and be given the reinforcer they had chosen for that specific choice number. However, two other studies (i.e., Butler, 2016; Correia & Little, 2006) used hypothetical choices in an online version of the MCP. Similar to those findings, the current study provided initial validity evidence for the use of the MCP for measuring the relative reinforcing value of video game playing with hypothetical choices. However, in order to further distinguish the validity of the MCP to measure the reinforcing value of video game play, the study should be replicated in a laboratory environment. Past studies have provided evidence that the MCP is useful in assessing pathological substance use, sexual behavior, and gambling. The current study provides the exploratory first step in finding how useful the MCP is for assessing video gaming behaviors and understanding the construct of pathological video gaming through behavioral economics theory.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Batthyány, D., Müller, K. W., Benker, F., & Wölfling, K. (2009). Computer game playing: clinical characteristics of dependence and abuse among adolescents. *Wiener Klinsche Wochenschrift, 121(15–16),* 502–509.

Benson, T. A., Little, C. S., Henslee, A. M., & Correia, C. J. (2009). Effects of reinforcer magnitude and alternative reinforcer delay on preference for alcohol during a multiple-choice procedure. *Drug and Alcohol Dependence, 100,* 161-163.

Bickel, W. K., Marsch, L. A., & Carroll, M. E. (2000). Deconstructing relative reinforcing efficacy and situating the measures of pharmacological reinforcement with behavioral economics: A theoretical proposal. *Psychopharmacology, 153,* 44−56.

Butler, L. H., Irons, J. G., Bassett, D.T. & Correia, C. J. (2016). Using the Multiple-Choice Procedure to Measure College Student Gambling. *Manuscript in preparation*.

Caplan, S. E., Williams, D., & Yee, N. (2009). Problematic internet use and psychosocial well-being among MMO players. *Computers in Human Behavior, 25(6),* 1312–1319.

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social Determinants of Alcohol Consumption: The Effects of Social Interaction and Model Status on the Self-Administration of Alcohol. *Jounal of Consulting and Clinical Psychology, 53(2),* 189-200.

Correia, C. J. & Little, C. (2006). Use of a Multiple-Choice Procedure With College Student Drinkers. *Psychology of Addictive Behaviors, 20(4),* 445-452.

Correia, C. J., Murphy, J. G. and Butler, L. H. (2011) Behavioral Economics: Basic Concepts and Clinical Applications. In W. M. Cox & E. Klinger (Eds.), *Handbook of Motivational Counseling: Goal-Based Approaches to Assessment and Intervention with Addiction and Other Problems*. Chichester, UK: John Wiley & Sons. doi: 10.1002/9780470979952.ch2

Du, Y., Jiang, W., & Vance, A. (2010). Longer term effect of randomized, controlled group cognitive behavioral therapy for Internet addiction in adolescent students in Shanghai. Australian and New Zealand Journal of Psychiatry, 44, 129–134.

Dworak, M., Schierl, T., Bruns, T., & Struder, H. K. (2007). Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. *Pediatrics, 120 (5),* 978–985.

Entertainment Software Association. (2014, April). *Essential Facts About the Computer and Video Game Industry*. Retrieved from http://www.theesa.com/wp-content/uploads/2014/10/ESA_EF_2014.pdf

Franken, I. H. A. (2003). Drug craving and addiction: integrating psychological and neuropsychopharmalogical approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 27(4),* 563-579.

Garrett, B. E., & Griffiths, R. R. (1998). Physical dependence increases the relative reinforcing effects of caffeine versus placebo. *Psychopharmacology, 139(3),* 195-202.

Greenwald, M. K. & Hursh, S. R. (2006). Behavioral economic analysis of opioid consumption in heroin-dependent individuals: Effects of unit price and pre-session drug supply. *Drug Alcohol Dependence, 85(1),* 35-48.

Greenwald, M. K. & Stitzer, M. L. (2000). Antinociceptive, subjective and behavioral effects of smoked marijuana in humans. *Drug Alcohol Dependence, 59(3),* 261-275.

Griffiths, R. R., Troisi, J. R., Silverman, K., & Mumford, G.K. (1993). Multiple-choice procedure: an efficient approach for investigating drug reinforcement in humans. *Behavioral Pharmacology, 4,* 3-13.

Griffiths, R. R., Rush, C. R., & Puhala, K. A. (1996). Validation of the Multiple-Choice Procedure for Investigating Drug Reinforcement in Humans. *Experimental and Clinical Psychopharmachology, 4(1),* 97-106.

Griffiths, M. D. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use, 10(4),* 191-197.

Han, D. H., Lee, Y. S., Na, C., Ahn, J. Y., Chung, U. S. Daniels, M. A., … Renshaw, P. F. (2009). The effect of methylphenidate on Internet video game play in children with attention-deficit/hyperactivity disorder. *Comprehensive Psychiatry, 50,* 251-256.

Han, D. H., Hwang, J. W., & Renshaw, P. F. (2010). Bupropion sustained release treatment decreases craving for video games and cue-induced brain activity in patients with Internet video game addiction. *Experimental and Clinical Psychopharmacology, 18(4),* 297–304.

Heinz, A. J., Lilje, T. C., Kassell, J. D., & de Wit, H. (2012). Quantifying Reinforcement Value and Demand for Psychoactive Substances in Humans. *Current Drug Abuse Reviews, 5(4),* 257-272.

Hoeft, F., Watson, C. L., Kesler, S. R., Bettinger, K. E., & Reiss, A. L. (2008). Gender differences in the mesocorticolimbic system during computer game-play. *Journal of psychiatric research, 42(4),* 253-258.

Hou, J. (2011). Uses and gratifications of social games: Blending social networking and game play. *First Monday, 16(7).* Retrieved from http://journals.uic.edu/ojs/index.php/fm/article/view/3517/3020

Hussain, Z., & Griffiths, M. D. (2009). Excessive use of massively-multi-player online role-playing games: a pilot study. *International Journal of Mental Health and Addiction, 7,* 563–571.

Johnson, M. W. & Bickel, W. K. (2002). Within-subject comparison of real and hypothetical money rewards in delay discounting. *Journal of the Experimental Analysis of Behavior, 77(2),* 129-146.

Jones, H. E., Garrett, B. E., & Griffiths, R. R. (1999). Subjective and physiological effects of intravenous nicotine and cocaine in cigarette smoking cocaine abusers. *Pharmacology and Experimental Therapeutics, 288(1),* 188-197.

Kalivas, P. W. & Volkow N. D. (2005). The neural basis of addiction: a pathology of motivation and choice. *American Journal of Psychiatry*, *162(8)*, 1403–1413.

Kim, J. (2008). The effect of a R/T group counselling program on the Internet addiction level and self-esteem of Internet addiction university students. *International Journal of Reality Therapy, 17*, 4–12.

Kim, S. M., Han, D. H., Lee, Y. S., & Renshaw, P. F. (2012). Combined cognitive behavioral therapy and bupropion for the treatment of problematic on-line game play in adolescents with major depressive disorder. *Computers in Human Behavior, 28*, 1954–1959.

King, D. L. & Delfabbro, P. H. (2009). Motivational differences in problem video game play. *Journal of CyberTherapy & Rehabilitation*, *2(2),* 139–149.

King, D. L. & Delfabbro, P. H. (2014). Internet gaming disorder treatment: A review of definitions of diagnosis and treatment outcome. *Journal of Clinical Psychology, 70(10),* 942-955.

King, D. L., Delfabbro, P. H., & Griffiths, M. D. (2011). The role of structural characteristics in problematic video game play: an empirical study. *International Journal of Mental Health and Addiction, 9(3),* 320-333.

King, D. L., Haagsma, M. C., Delfabbro, P. H., Gradisar, M., & Griffiths, M. D. (2013). Toward a consensus definition of pathological video-gaming: a systematic review of psychometric assessment tools. *Clinical Psychology Review, 33(3),* 331–342.

Kühn, S., Gleich, T., Lorenz, R. C., Lindenberger, U., & Gallinat, J. (2014). Playing Super Mario induces structural brain plasticity: gray matter changes resulting from training with a commercial video game. *Molecular Psychiatry, 19,* 265-271.

Kuss, D. J. & Griffiths, M. D. (2012a). Internet Gaming Addiction: A systematic Review of Empirical Research. *International Journal of Mental Health and Addiction, 10(2),* 278-296.

Kuss, D. J. & Griffiths, M. D. (2012b). Online gaming addiction in children and adolescents: A review of empirical research. *Journal of Behavioral Addictions, 1(1),* 3-22. doi: 10.1556/JBA.1.2012.1.1

Kuss, D. J., Louws, J. & Wiers, W. W. (2012). Online Gaming Addiction? Motives Predict Addictive Play Behavior in Massively Multiplayer Online Role-Playing Games. *Cyberpsychology, 15(9),* 480–485.

Lawyer, S. R. (2008). Probability and delay discounting of erotic stimuli. *Behavioural Processes 79(1),* 36-42.

Li, H. & Wang, S. (2013). The role of cognitive distortion in online game addiction among Chinese adolescents. *Children and Youth Services Review, 35,* 1468–1475.

Lightsey Jr., O. R. & Hulsey, D. C. (2002). Impulsivity, coping, stress, and problem gambling among university students. *Journal of Counseling Psychology, 49(2),* 202-211.

Liu, M. & Peng, W. (2009). Cognitive and psychological predictors of the negative outcomes associated with playing MMOGs (massively multiplayer online games). *Computers in Human Behaviors, 25,* 1306-1311.

Lu, H. & Wang, S. (2008). The role of internet addiction in online game loyalty: an exploratory study. *Internet Research, 18(5),* 499-519.

Merikangas, K. R. & McClair, V. L. (2012). Epidemiology of substance use disorders. *Human Genetics, 131(6),* 779–789.

National Purchase Diary Group. (2013, May 2). *The NPD Group: Report Shows Increased Number of Online Gamers and Hours Spent Gaming [Press release]*. Retrieved from https://www.npd.com/wps/portal/npd/us/news/press-releases/the-npd-group-report-shows-increased-number-of-online-gamers-and-hours-spent-gaming/

Peng, W., & Liu, M. (2010). Online gaming dependency: a preliminary study in China. *CyberPsychology, Behavior and Social Networking, 13(3),* 329–333.

Porter, G., Starcevic, V., Berle, D., & Fenech, P. (2010). Recognizing problem video game use. *The Australian and New Zealand Journal of Psychiatry, 44(2),* 120–128.

Rehbein, F., Kleimann, M., Mediasci, G., & Mößle, T. (2010). Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. *CyberPsychology, Behavior and Social Networking, 13(3),* 269–277.

Rehbein, F., Kliem, S., Baier, D., Mößle, T. & Petry, N. (2015). Prevalence of internet gaming disorder in German adolescents: diagnostic contribution of the nine DSM-5 criteria in a state-wide representative sample. *Addiction, 110(5),* 842-851. doi: 10.1111/add.12849

Shek, D. T. L., Tang, V. M. Y., & Lo, C. Y. (2009). Evaluation of an Internet addiction treatment program for Chinese adolescents in Hong Kong. *Adolescence, 44*, 359–373.

Su, W., Fang, X., Miller, J. K., & Wang, Y. (2011). Internet-based intervention for the treatment of online addiction for college students in China: A pilot study of the Healthy Online Self-Helping Center. *Cyberpsychology, Behavior, & Social Networking, 14,* 497–503.

Tancer, M. & Johanson, C. E. (2007). The effects of fluoxetine on the subjective and physiological effects of 3, 4- methylenedioxymethamphetamine (MDMA) in humans. *Psychopharmacology, 189(4),* 565-573.

Tarng, P-Y., Chen, K-T., & Huang, P. (2008) An analysis of WoW players' game hours [Presented at the ACM SIGCOMM workshop on Network and system support for games]. doi: 10.1145/1517494.1517504

Terry-McElrath, Y. M., O'Malley, P. M., Johnston, L. D. (2009). Reasons for Drug Use among American Youth by Consumption Level, Gender, and Race/Ethnicity: 1976-2005. *Journal of Drug Issues, 39(3),* 677-713.

Vuchinich, R. E. & Tucker, J. A. (1988). Contributions From Behavioral Theories of Choice to an Analysis of Alcohol Abuse. *Journal of Abnormal Psychology, 97(2),* 181-195.

Wang, C.W., Chan, C.L.W., Mak, K.K., Ho, S.Y., Wong, P.W.C., & Ho, R.T.H. (2014). Prevalence and correlates of video and internet gaming addiction among Hong Kong adolescents: A pilot study. *Scientific World Journal, 2014*. doi: 10.1155/2014/874648

Weinstein, A. & Lejoyeux, M. (2013). New developments on neurobiological and pharmaco-genetic mechanisms underlying internet and videogame addiction. *The American Journal on Addictions.* doi: 10.1111/j.1521-0391.2013.12110.x

Table 1

Correlations, Means, and Standard Deviations of the Six MCP Crossover Points and Selected Independent Variables

Correlations, Means, and Standard Deviations of the Six MCP Crossover Points and Selected Independent Variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. MCP10i	3.65	3.87	---								
2. MCP30i	5.26	4.71	.77***	---							
3. MCP90i	6.83	6.30	.56***	.82***	---						
4. MCP10w	6.21	5.28	.78***	.73***	.59***	---					
5. MCP30w	7.31	5.78	.68***	.84***	.77***	.83***	---				
6. MCP90w	8.30	6.75	.54***	.78***	.91***	.67***	.84***	---			
7. MCP Avg	6.26	4.85	.78***	.93***	.89***	.85***	.94***	.92***	---		
8. VGDS	24.93	8.29	.20***	.22***	.26***	.24***	.24***	.30***	.28***	---	
9. Week Freq	482.78	571.56	.13**	.24***	.28***	.19***	.25***	.31***	.27***	.54***	---

Note. $N = 440$. MCP10 = MCP version with 10 minutes of play; MCP30 = MCP version with 30 minutes of play; MCP90 = MCP version with 90 minutes of play; i = immediate reinforcement; w = one week delay of reinforcement; i.e. MCP10i = MCP version with 10 minutes of play and an immediate monetary reinforcement. MCP Avg = average crossover point across all MCP versions. VGDS = Video Game Dependency Scale. Week Freq = reported weekly number of minutes playing video games.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 2

Comparison of VGDS Total Score Median-split Groups on the Six MCP Versions

	VGDS < 22 (*n* = 212)		VGDS ≥ 22 (*n* = 228)			95% CI		
Variable	*M*	*SD*	*M*	*SD*	*t*(438)	*Lower*	*Upper*	*Cohen's d*
MCP10i	3.00	3.32	4.27	4.23	-3.48**	-1.98	-0.55	0.33
MCP30i	4.28	4.55	6.17	4.69	-4.29***	-2.76	-1.03	0.41
MCP90i	5.01	5.90	8.53	6.20	-6.09***	-4.65	-2.38	0.58
MCP10w	5.24	4.93	7.12	5.44	-3.79***	-2.85	-0.90	0.36
MCP30w	6.01	5.69	8.51	5.61	-4.65***	-3.57	-1.45	0.44
MCP90w	6.16	6.33	10.30	6.51	-6.75***	-5.35	-2.94	0.65
MCP Avg	4.95	4.48	7.48	4.87	-5.67***	-3.41	-1.66	0.54

Note. MCP10 = MCP version with 10 minutes of play; MCP30 = MCP version with 30 minutes of play; MCP90 = MCP version with 90 minutes of play; i = immediate reinforcement; w = 1 week delay of reinforcement; i.e. MCP10i = MCP version with 10 minutes of play and an immediate monetary reinforcement. MCP Avg = average crossover point across all MCP versions. VGDS = Video Game Dependency Scale.
**p* < .05. ***p* < .01. ****p* < .001.

Table 3

Hierarchical Multiple Regression Analyses Predicting VGDS Total Score

Variable	*B*	*SE B*	β	*T*	Model R^2	R^2 Change	*F* Change
Model 1					.304***	.304	95.48***
Week Freq	.007	.001	.508	12.12***			
Gender	-1.84	.698	-.11	-2.64**			
Model 2					.32***	.016	10.52**
Week Freq	.007	.001	.475	11.14***			
Gender	-1.63	.693	-.098	-2.35*			
MCP Avg	.228	.070	.134	3.24**			

Note. *N* = 440. Week Freq = reported weekly number of minutes playing video games. MCP Avg = Average crossover point across all MCP versions. VGDS = Video Game Dependency Scale. All significance testing for Model R^2 are for the full model.
*$p < .05$. **$p < .01$. ***$p < .001$.

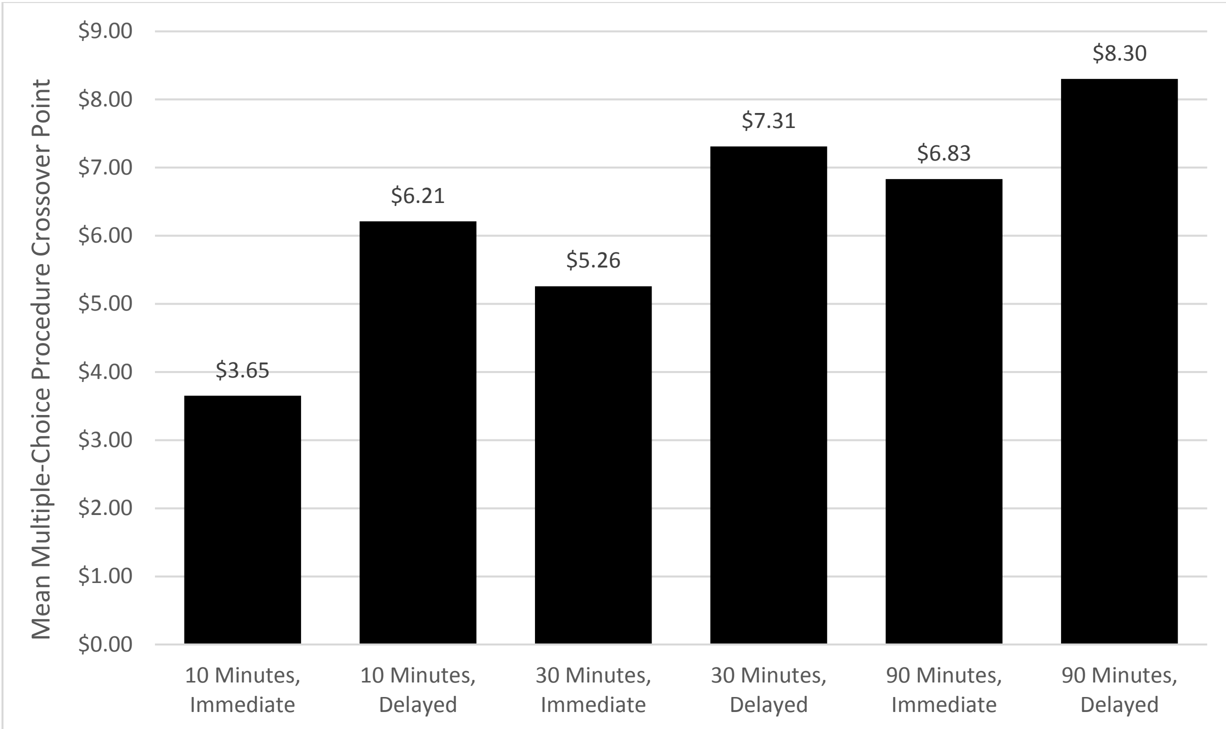

Figure 1. Mean Multiple-Choice Procedure crossover points for each of the six versions. Minutes played refers to the amount of time available to play. Immediate and delayed refer to delivery time of the alternative monetary reinforcer.

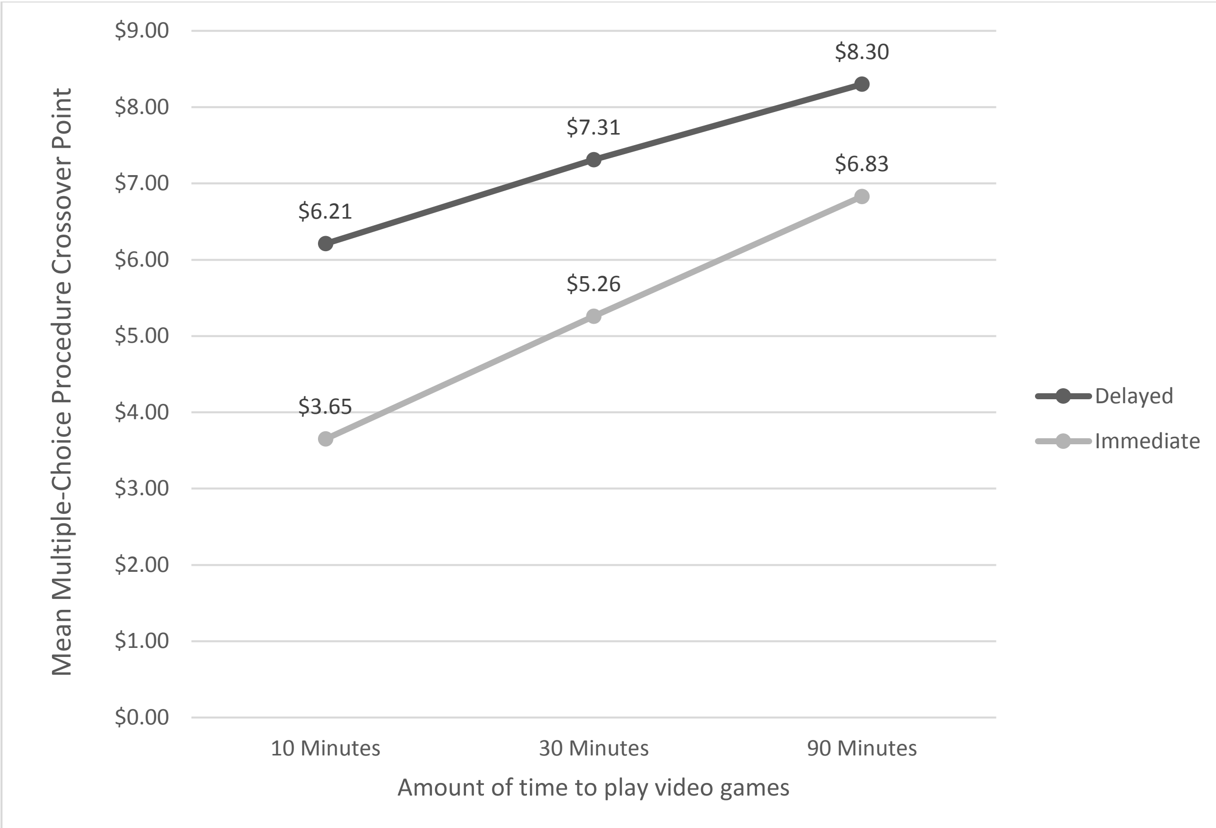

Figure 2. Mean Multiple-Choice Procedure crossover points across temporal magnitudes of video game play time as a function of the delay associated with the alternative monetary reinforcer.