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Demonstrating the Validity of the Video Game Functional Assessment-Revised (VGFA-R)

Frank D. Buono[1], Thomas D. Upton[1], Mark D. Griffiths[2], Matthew E. Sprong[3], & Jim Bordieri[1]

Southern Illinois University[1]

Nottingham Trent University[2]

Northern Illinois University[3]

Author Note:

Address correspondence to Frank D. Buono, PhD, Rehabilitation Institute, Southern Illinois University–Carbondale, IL 62903; fbuono@siu.edu

Matt Sprong is no longer employed at Montana State University - Billings. I need his affiliation updated to reflect his current employer: Matthew E. Sprong, Ph.D., is a Visiting Assistant Professor in the Rehabilitation Services and Rehabilitation Counseling program at Northern Illinois University. He can be contacted at at msprong1@niu.edu.

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Abstract

Problematic video play has been well documented over the course of the last decade. So much so the DSM-5 (APA, 2013) has included problematic video gaming as disorder categorized as Internet Gaming Disorder. The field of applied behavior analysis has been utilizing functional assessments for the last 30 years and has showed evidence of effective results across different populations and environments. Therefore, the purpose of this investigation (comprising three studies) was to validate an indirect functional assessment entitled the Video Game Functional Assessment-Revised (VGFA-R). Using academic experts in the field of video game addiction and applied behavioral analysis (n=6), the first study examined the content validity of the VGFA-R and was able to demonstrate the assessment exceeded the criterion for an established assessment. A second study comprising a survey of 467 gamers examined the factorability by using a confirmatory factor analysis, and found that VGFA-R had an overall variance above .60. Within the third laboratory-based study using gamers (n=11), the VGFA-R was examined for construct validity and found the VGFA-R was able to predict 85% of the appropriate function of behavior. Implications of the study are discussed along with the strengths and limitations of the study and future research directions.

Keywords: Video game addiction, functional assessment, validity, problematic gaming, Internet Gaming Disorder

1. Introduction

The psychological and physical impact of video gaming has received a great deal of research attention over the past two decades (Oggins, & Sammis, 2012). The psychological and physical symptoms that video gamers have experienced include increased tension, anxiety, frustration, and aggression (Desai, Krishan-Sarin, Cavallo, Potenza, 2010; Griffiths, Kuss & King, 2012). These symptoms are not necessarily of concern for individuals that periodically play video games. However, they are prevalent among pathological video game players. Although there is no consensus on the definition of pathological gaming, most scholars in the field would agree that it involves an uncontrollable motivation to play video games, and to spend so much time and effort into it that it impairs other important life areas including their occupation, education and/or personal relationships (Griffiths, King & Demetrovics, 2014). Gentile (2009) reported that 8% of U.S. adolescents and young adults are pathological gamers. Furthermore, Bailey, West, and Anderson (2010) stated that video game play of over 20 hours per week is common and it is not unusual for males to engage in video games for over 40 hours a week.

The video game sector is a multi-billion dollar industry with total revenue in the U.S. of over $22.41 billion [Fiscal Year 2014], and it is anticipated that its growth will increase (Entertainment Software Association [ESA], 2014). For instance, in 2007, total revenues were $9 billion. It is estimated that 8% of massively multiplayer online role-playing game (MMORPG) players spent a minimum of 40 hours engaging in their game per week, with at least 60% spending a minimum of ten continuous hours, and with 50% of the players considering

themselves to be addicted (Yee, 2006). With the large amounts of time devoted to video gaming and the rapid growth of the video game industry, it is essential to further explore how pathological gaming influences an individual's psychological and physical wellbeing. Researchers have attempted to provide information to combat these associated issues, but the behavioral component that explores the reinforcing function of video game has yet to be explored adequately. Therefore, in the present paper, the strengths and limitations of previous research are highlighted. This led to the conducting of three studies to validate a new instrument the Video Game Functional Assessment-Revised (VGFA-R). This instrument will help clinicians identify the game-related functions (i.e. attention, escape, tangible, sensory) that maintain problematic video game play despite psychological and physical consequences. Sprong et al, (2014) provides a more detailed account of how reinforcement can affect the maintaining functions within a functional assessment. By identifying such functions will lead to exploration of applicable behavioral interventions to reduce these behaviors. However the pervasiveness of video gaming and its direct effect on the psychological field needs to be addressed.

1.1. Defining Video Game Addiction

In 2007, in identifying the potential issue involved with continued video game play, the American Medical Association notified the American Psychiatric Association (APA) of the continuing growth of video game addiction and requested the addition of a formal disorder for video game addiction in the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Health Disorders* (*DSM-5*; American Psychiatric Association, 2013). In the same year, the AMA (2007) issued a statement that psychiatrists had concerns about the wellbeing of individuals who spent a large amount of time with video games because they failed to develop friendships, did little appropriate outdoor exercise, and suffered in their schoolwork.

The current *DSM-5* classifies video game addiction in Section III (Emerging Measures and Models) under Internet Gaming Disorder, with the stipulation that it will remain there until further research justifies designating video game addiction as a separate disorder. The *DSM*-5 description of Internet gaming disorder notes:

> The "gamers" play compulsively, to the exclusion of other interests, and their persistent and recurrent online activity results in clinically significant impairment or distress. People with this condition endanger their academic or job functioning because of the amount of time they spend playing. They experience symptoms of withdrawal when pulled away from gaming (p. 796).

The *DSM* working party based their description on literature from Asian countries that showed that the impact of problematic internet gaming on individuals' brains was similar to individuals who were addicted to substances like cocaine. Prior to publication of the *DSM*-5, *DSM-IV-TR* pathological and/or psychoactive substance abuse criteria were adapted to assess problematic video game play. Several research papers classified problematic video game play as being conceptually similar to pathological gambling (e.g., Fisher, 1994; Gentile, 2009; Griffiths & Hunt, 1998).

1.2. Assessments of Video Game Addiction

In 2013, King, Haagsma, Delfabbro, Gradisar and Griffiths critically reviewed all 18 assessment instruments that had been developed for assessing video game addiction (excluding the others that have been developed since 2013 based on the new IGD criteria). Arguably, the three most commonly used are the Game Addiction Scale [GAS] (Lemmens et al, 2009), the Pathological Video-Gaming Scale (Gentile, 2009), and Young's Internet Addiction Scale [YIAS] (Young, 1996). These instruments are self-report measures in which the individual report their

degree of agreement on varying Likert-scales relating to various addiction criteria. Although the differences in internal reliability and validity of these scales have been documented, the questions in each screening instrument use different diagnostic criteria and/or use different questions to assess the same concept. For example, the GAS and the YIAS includes a question to assess salience but are conceptualized in different ways: "Did you think about playing a game all day long" (GAS), and "How often do you feel preoccupied with the Internet when off-line, or fantasize about being on-line" (YIAS).

Kuss and Griffiths (2012) carried out a literature review of studies of online video game addiction in children and adolescents. They identified 30 studies over 11 years (2000 to 2011) in which some children and adolescents met diagnostic criteria for video game addiction. The 30 studies used 13 different assessment instruments. These assessments were based on one of four diagnostic models: the *DSM-IV-TR* criteria for pathological gambling, the *ICD-10* criteria for substance dependence, a combination of criteria for substance dependence and pathological gambling, and Griffiths' (2005) components model of addiction. The array of different conceptual approaches identified highlights the lack of consistency in the field for assessing video game addiction (King et al., 2013).

There are two problems with many of these scales and screening instruments for video game addiction. First, almost all assessments are based on the now outdated *DSM-IV-TR* criteria for substance use disorders or pathological gambling, including the Pathological Video-Gaming Scale (Gentile, 2009) and the Gaming Addiction Scale for Adolescents (Lemmens, Valkenburg, & Peter, 2009). In the *DSM-IV-TR*, a minimum of five of ten criteria had to be endorsed in order to be diagnosed as a pathological video game player. Second, video game addiction is not recognized as a formal diagnostic disorder in the *DSM-5* (as it only appears in Section 3 as a

condition that requires further research). In addition, the paradigm shift from video game addiction to Internet Gaming Disorder creates additional confusion for two reasons: (i) addiction is still not clearly defined in the *DSM-5*, and (ii) the current screeners primarily examine the form and consequences of the behavior and not the function that maintains the behavior.

Research is limited on the motivations for video game addiction. However, Kuss and Griffiths (2012) summarized the potential motivations for video game players and found that based on previous research, the motivations to play included personal satisfaction, coping strategies, and socialization (Caplan, Williams, & Yee, 2009; Hussain & Griffiths, 2009; Williams, Yee, & Caplan, 2008). It should also be noted that the methodology utilized in previous studies to assess 'motivation' has not been derived from the work of Skinner (1954) or the field of applied behavior analysis. Researchers within the field of applied behavior analysis (ABA) have identified that maladaptive or unwanted behaviors can be targeted solely by isolating the maintaining function of the behavior (i.e., a functional analysis).

2. Functional Analysis

Functional analysis is described in applied behavior analysis as an assessment that manipulates antecedent and consequent variables of the target behavior (Schlinger & Normand, 2013). One of the earliest mentions was in Skinner's (1953) book *Science and Human Behavior*, in which he described functional analysis in terms of cause and effect: *"The external variables of which behavior is a function provide for what may be called causal or functional analysis"* (p. 35). Understanding how functional analysis operates requires identification of the maintaining functions of behavior to be measured in different conditions to assess the effect of the contingency.

Earlier behavioral research on treating problem behaviors, such as self-injurious behavior, focused on imposing contingencies of reinforcement for wanted, appropriate behaviors, and punishment or extinction for unwanted behaviors (Mace, 1994). Instead, Iwata, Dorsey, Slifer, Bauman, and Richman (1982, reprinted 1994) argued that it is important to determine the conditions that maintain unwanted behaviors in order to identify interventions that could remove reinforcing consequences for problematic behaviors and provide those reinforcing consequences for more appropriate behaviors. This is critically important because a similar behavior, such as video game playing, could be maintained by different behaviors in different players. For example, one player's behavior could be maintained by attention, while the second player's behavior could be maintained by escape. Iwata and colleagues developed the methodology of experimental functional analysis (EFA) to determine the conditions that maintained self-injurious behavior and suggested that it is essential to identify the conditions in order to apply effective behavioral interventions. The major drawback of EFA is that it is often time consuming to conduct, personnel may lack skill and material resources, and it requires a great deal of training to conduct safely and with procedural fidelity. Other potential issues include the lack of psychometric properties (Matson, Bamburg, Cherry, & Paclawaskyj, 1999), and the low reliability when comparing the EFA to indirect and direct assessments (Toogood & Timlin, 1996). For example, Toogood and Timlin (1996) measured 121 maladaptive behaviors across 20 participants at a developmental center. The results showed that EFA accurately identified 41% of the behaviors, while direct observation and indirect assessment accurately identified 68% and 74% of the behaviors assessed, respectively.

Functional behavioral assessment refers to procedures that can be used to determine the antecedents of the performance of a behavior and the consequences that maintain the behavior

(Gresham, Watson, & Skinner, 2001). *Indirect functional assessments* measure behavior indirectly using interviews, inventories, and archival data. Indirect functional assessments hypothesize a function of behaviors that maintain their occurrence despite differences in forms of behavior. They can greatly aid therapists in designing treatments that directly address the functions of behavior, and that improve treatment outcomes (Vollmer, Northup, Ringdahl, LeBlanc, & Chauvin, 1996). The benefit of using a simple pencil-and-paper task is that it provides a ranking of the targeted behaviors in simplistic structured sentences while allowing the experimenter to quickly determine the maintaining functions of the behavior. In addition, Iwata, Deleon, and Roscoe (2013) state that indirect assessments can be beneficial because they provide a consistent format for conducting an interview, administration requires little skill or preparation, and the process is quick and efficient, taking approximately 15 minutes to complete. Other functional assessments that have been developed and have shown high reliability and validity include the Questions about Behavioral Function (QABF; Matson & Vollmer, 1995) and the Motivation Acceptance Scale (MAS; Durand & Crimmings, 1988).

2.1. Video Game Functional Assessment

Several assessments have been created and validated for problematic video game playing based on the established *DSM-5* criteria. Of those assessments, only a few have discussed motivations behind playing video games (e.g., Wan & Chiou, 2007; Hussain & Griffiths, 2009). Wan and Chiou (2007) attributed motivation solely to escape, which is contrary to research in applied behavior analysis showing that behaviors can be maintained by multiple functions as well as by positive or negative reinforcement (Iwata et al., 2013). The lack of adequately defined functional assessments for video game addiction is potentially problematic because the qualities of addiction for other disorders, such as pathological gambling, or all-inclusive

disorders like Internet Gaming Disorder do not adequately describe the maintaining functions of problematic video game play. Therefore, the present investigation attempted to provide a functional assessment tool for video game addiction. The present authors initially developed the Video Game Functional Assessment (VGFA; Sprong, Buono, Bordieri, Mui, & Upton, 2014), based on responses by 220 video game players to 24 questions across four functions of behavior (i.e., attention, escape, tangible rewards, and sensory effects). The goal in developing the initial assessment was to determine if the VGFA was applicable to video game players, and the results showed very strong evidence that pathological video game play can be influenced by different maintaining functions of behavior.

The primary purpose of the present investigation was to revise and validate the VGFA based on Anastasi's (1986) procedures for validating assessments. The initial process required experimenters to obtain content validity before completing subsequent types of validity. Content validity involves determining if the assessment or examination is a representative sample of the targeted procedure (Anastasi & Urbina, 1997). The approach for the validation of the assessment in the first study was to use experts in the field to provide a systematic overview of the assessment. Anastasi and Urbina emphasize that using expert panels for content validation can help provide a clearer understanding of the assessment with less ambiguity in definitions while ensuring that the assessment is void of irrelevant variables. These goals led the research team to enlist experts in the fields of behavior analysis and video game addiction for feedback and analysis of the VGFA-R in the first study to establish its content validity.

The purpose of the second study was to determine if the VGFA-R was a consistent measure for analyzing the interrelationships among the motivation factors for problematic video gaming by executing a confirmatory factor analysis (CFA). By utilizing a larger group design,

the intention of the study was to assess whether a consistent measure for analyzing the interrelationships among the VGFA-R's four functions of behavior could be established. For that reason, the third and final study was to obtain construct validity. Identifying the gaming functions among pathological video game players is of the utmost importance. Moreover, in an attempt to demonstrate construct validity, the third study assessed whether participants preferred their favorable maintaining function compared to less favorable functions within the VGFA-R across numerous trials.

3. Methods

3.1. Study 1

3.1.1. Participants

Lynn (1986) describes two stages for inspecting content validity: development and judgment. The judgment stage was addressed because the development phase had already been completed in the development of earlier versions of the VGFA. The judgment phase has two requirements: (i) a specific number of experts must be used, and (ii) the assessment in its entirety must be found to be valid. Experts were defined as individuals who had investigated and published papers in their field within the last two years and/or had designed assessments to assess behavior in their field. With the established requirements six academic professionals provided the content validity. Of the six professionals, three were considered experts in the field of behavior analysis and the three others were experts in the field of video game research.

3.1.2. Materials

The test content validation form asked the experts to rate the overall assessment on a 4-point Likert scale (1 = not relevant at all, 2 = unable to be relevant without revision, 3 = relevant but needs revisions, 4 = very relevant and succinct). A 4-point scale was used instead of a 5- or

3-point scale because there is no middle rating, which can possibly increase the ambivalence of the rating (Anastasi, 1986). In addition, the experts were asked to evaluate the individual questions on the assessment. Each question was rated on a 4-point scale (1 = Not a clear and concise question. Grammar and terminology have flaws; 2 = Somewhat clear and concise question. Grammar is correct but terminology is incorrect; 3 = Fairly clear and concise question. Grammar and terminology are correct; 4 = Very clear and concise question).

3.1.3. Procedure

Prior to the completion of the study, approval was granted by the research team's university ethics committee to conduct all three studies. An email request to participate in establishing the content validity of the revised assessment instrument (i.e. VGFA-R) was sent to the several experts. Ten requests for participation across each of the two disciplines (i.e., behavior analysis and video game research) were initially sent out with the intention of utilizing two per discipline, based on recommendations (Lynn, 1986; Anastasi, & Urbina 1997). If the expert agreed to participate then they received a second email that included the revised version of the VGFA, instructions for the validation process, and a test content validation form or they were allowed to complete the validation process via an online survey website (www.surveymonkey.com). The experts were asked to complete the survey within two weeks of the approval email.

3.1.4. Results

The intention of the first study was to use experts in behavior analysis and video gaming to ascertain whether the VGFA-R was an adequate assessment to establish a hypothesized function that maintained video game playing. To answer this question, a content validity index (CVI) was implemented. A CVI is one of the most conservative measures to evaluate content

(Lynn, 1986). CVI is calculated by summing the aggregate scores of the reviewers and dividing the total aggregate of the reviewers by total points allowed. Downie and Heath's (1974) establish a criterion for acceptable content validity based on the number of experts participating in the study. As shown in Table 1, the experts were initially asked to provide their scores on the VGFA-R. The CVI for the assessment was at 74.26%, and the individual questions were rated at 68.04% across six experts. Both scores were far below the 86% for acceptability, based on Downie and Heath's pre-established values. Therefore, the VGFA-R was revised using the feedback from the experts. The newly revised VGFA-R was standardized and reformulated. The experts were again asked to inspect the form using the same methodology. The CVI for the next assessment was 86.47% and the individual questions were rated at 85.83% across five people. One of the experts was unable to make time for the second revision. Therefore, both scores were considered acceptable using five individuals at a criterion level of 83%.

[Enter Table 1 – content validity index (CVI)]

3.1.5. Discussion

In designing and validating an assessment, criterion and construct validity were deemed legitimate constructs. However, the merits of content validity have been all but refuted by many authors (Messick, 1980, 1989, 1995; Cronbach, 1971). Moreover, Messick (1989) stated that content validity does not provide direct evidence that the evaluations made by experts are accepted values or scores. However, content validity provides direct feedback during the development and judgment stages of the assessment. In essence, content validity provides the assessment with a determining and conclusive representation from experts' evaluations (Lynn, 1986). The importance of this stage of the process of validating the VGFA-R can hardly be underestimated. Lawshe (1975) makes the important point that if a panel of experts provide a

judgment about which they all agree, there is little basis for refuting the process. The content validity index (CVI) was used because it is the mostly widely accepted and recognized assessment for evaluating rating scales for content validity (Lynn, 1986). The CVI represents the extent to which there is overlap between capability to function in a defined task performance domain and performance on the test under investigation (Lawshe, 1975). The CVI removes any inherent human errors and provides more reliability of actual value that is based on the formula. The aim was to determine whether the VGFA-R would be approved by a panel of experts in the fields of behavior analysis and video game research. The initial findings by the experts indicated that the VGFA-R was not considered a valid assessment for several reasons based on their initial CVI scores and feedback. Some of the critical feedback provided by the experts included: (i) starting the questions with "I enjoy" forced participants to give a positive response, which made the questions unipolar and not balanced, (ii) the entire assessment tended to be normative, which did not inherently fulfill the purpose of the assessment, (iii) based on the questions, it appeared that there was an overlap across functions and questions, and, the questions were not homogenous by nature, which could have affected the function of behaviors, and (iv) the difference between opinion and function seemed to be evident in some of the questions. By establishing content validity of the VGFA-R, Anastasi (1986) recommends completing a factor analysis to establish that the assessment is a consistent measurement. Therefore the second survey was carried out in order to complete a confirmatory factor analysis.

3.2. Study 2

3.2.1. Participants

A total of 513 participants showed initial interest in completing the survey. Of the total number of participants, 467 completed the entire assessment packet within pre-determined

criteria. The predetermined number of participants was found using a G*Power analysis. To establish a medium effect size is entered into the equation (f = .30), a predetermined alpha level is established at ($\alpha = .05$), and the power is minimally set at ($1 - \beta = .80$) in the G*Power program. The power analysis determined that 300 participants were needed to obtain the necessary power for the current study.

The 46 potential participants who were eliminated were due to inadequately filling out the survey (n = 40), or individuals maliciously attempting to corrupt the data set (n = 6). Examples of inadequately filling out the survey would be an individual stopping two questions into the survey and leaving the rest of the questions blank, and maliciously behavior was defined as an individual placing the same rating score for all answers. Additional demographic information about the sample participants is displayed in Table 2.

[Enter Table 2 – sample demographics]

3.2.2. Materials

The VGFA-R is a 24-question Likert-type scale that was developed to measure four functions that maintain video game playing (i.e., attention, escape, tangible effects, sensory effects). Participants were presented with a question and were able to select one of seven responses (1 = Never, 2 = Almost never, 3 = Seldom, 4 = Half of the time, 5 = Usually, 6 = Almost always, 7 = Always). The questions from the 24 and 18 item scale that loaded in the attention function include question(s): I choose to play video games because I enjoy playing with my friends. The questions from the 24 and 18 item scale that loaded in the escape function include question(s): I choose to play video games after a difficult day at work or school/college. The questions from the 24 and 18 item scale that loaded in the tangible function include question(s): I choose to play video games for longer if I can obtain rare items within the game.

The questions from the 24 item scale that loaded in the sensory function include question(s): I choose to play high graphic quality video games. There were no questions from the 18 item scale for the sensory function. After analyzing the results of factor analysis, the VGFA-R was reduced to 18 questions and formed three complete factors (i.e., attention, escape, tangible effects). The internal consistency was good for both scales (24-question [$\alpha = .928$] and 18-question [$\alpha = .907$]). The scores for each question are combined and may range between (6 points to 42 points), with higher scores indicating the behavioral function is a strong indicator of continued play. In addition, demographic questions were asked relating to age, gender, ethnicity, hours spent playing a video game per week, the type of game typically played, and the day of the week that video games were played the most.

3.2.3. Procedure

Participants were recruited to ensure the VGFA-R was a consistent measure in analyzing the interrelationships among motivational factors via a survey. The survey was accessed by a link posted on several video game forums and blog websites. Potential participants were instructed that the researchers were conducting a survey on online gaming and if they choose to complete the survey, they have the opportunity to win one of four ($50) gift cards. The survey link was re-posted several times on these websites. Participants were also recruited through direct solicitation at a US Midwestern university via classroom presentations following a specific script and by asking students who played video games to visit the secure website and complete the survey.

Upon clicking the hyperlink, potential participants were welcomed to the survey and requested to read the informed consent form that described the study and how the data would be used. For those who chose to continue, the following statement was provided: “Please take the

following questions seriously. If you purposely enter false information, your survey will be omitted." All questions were answered with a single response. If a question was left unanswered, an error message would appear alerting the participant to the missing question. All participants were asked to initially complete a demographic survey in which the questions appeared on a drop-down menu. Upon completing the demographic form, participants were prompted to click the "Next" button at the bottom of the screen. The VGFA-R comprised 24 questions across four functions that may maintain video game playing: attention, escape, tangible effects, and sensory effects. A text box at the top of the screen provided these instructions: "Answer the questions below using the provided scale. Score the corresponding number next to each question."

3.2.4. Results

Initially, factorability of the 24-item VGFA-R was examined using several established criteria. A total of 21 of the 24 correlated at a minimum of .30 with at least one other item, suggesting reasonable factorability. Kaiser-Meyer-Olkin measure of sampling adequacy was .920 above the recommended value of .60. Bartlett's test of sphericity was significant (χ^2 = (276) = 6115.76, p = .000). Diagonals of the anti-image correlation matrix exceeded .4, supporting inclusion of each item in the factor analysis. Communalities showed 21 of the 24 questions above .400, confirming that all other items shared some common variance. Therefore, factor analysis was conducted with all 24 items.

A confirmatory factory analysis (CFA) was performed to examine the data. This was completed by a principal components analysis (PCA). The PCA was used because the primary purpose was to identify and compute scores for the factors underlying the VGFA. The initial PCA forced the number of factors in the extraction to four. The first factor explained 19.27% of

the variance, the second factor explained 15.44% of the variance, the third factor explained 12.51% of the variance, and the fourth factor explained 12.51% of the variance. The four-factor solution, which explained 59.74% of the variance, was preferred because of its previous theoretical support (Hancock & Mueller, 2010) and is displayed in Table 4. Additionally, the internal consistency for the entire scale was examined using Cronbach's alpha, which resulted in highly reliable consistency (24 items; $\alpha = .928$). A varimax rotation provided the best defined factor structure. A total of 16 items had loadings over .4 and resulted in four complete factors.

[Enter Table 3 & 4]

A second PCA was undertaken and forced the number of factors with the extraction to three based on previous findings (Sprong et al, 2014). Similar to the previous findings, the sensory effects questions predominantly loaded on several other factors. In addition, with the current analysis, some current factors loaded on more than one factor. All sensory-related questions were removed due to the cross-loadings. All 18 items correlated at a minimum of .30 with at least one other item, suggesting reasonable factorability. Kaiser-Meyer-Olkin measure of sampling adequacy was .909, above the recommended value of .60 (Garson, 2013). Bartlett's test of sphericity was significant ($\chi^2 = (153) = 4392.47$, $p = .000$). Diagonals of the anti-image correlation matrix exceeded .5 for all questions with the exception of two, which support inclusion of each item in the factor analysis. Communalities were all above .400, confirming that all other items shared some common variance. Therefore, factor analysis was conducted with all 18 items. The internal consistency for the three factors was also examined using Cronbach's alpha, which resulted in highly reliable consistency (18 items; $\alpha = .907$). The first factor (attention) explained 24.77% of the variance, the second factor (tangible effects) explained 18.6% of the variance, and the third factor (escape) explained 16.74% of the variance. The

three-factor solution explained 60.10% of the variance, as seen in Table 4. The varimax rotation had all loadings above .40, and resulted in three complete factors.

3.2.5. Discussion

The initial goal of the second study was to establish an indirect, standardized behavioral assessment to ascertain the maintaining functions for individuals suffering from video game addiction. This was accomplished by carrying out a factor analysis. A factor analysis allows a researcher to understand and identify the constructs of the variables of interest, providing evidence of the validity of the assessment (Bandalos & Finnery, 2010). While both exploratory and confirmatory analyses examine the dichotomous relationship between instruments, it is common to use a confirmatory factor analysis (CFA) when constructing an instrument (van Rooj, Schoenmakers, van den Eijnden, Vermulst, & van de Mheen, 2012; Lemmens, Valkenburg, & Peter, 2009). For the first version of the VGFA (Sprong, Buono, Bordieri, Mui, & Upton, 2014), the factor analysis for overall variance across the three factors of attention, escape, and tangible effects was higher than for the current VGFA-R (51.67% compared to 49.62). However, the rotations of the individual questions were loading at .40 with the original instrument, and (with the exception of one question) all loadings for the revised VGFA-R were above .55. The overall variance is considered acceptable and the scree plot displays only three factors that reinforce the individual questions within each function (i.e., attention, escape, and tangible effects).

The results of the second study yielded two potentially important benefits of the VGFA-R. The first is that unlike other instruments, which have to be modified for different cultures or ethnicities, the VGFA-R is universal in the sense that questions can be identified and classified for individuals across all cultures and ethnicities because the maintaining variables remain the same. Utilizing the VGFA-R, we have the ability to predict the function of the behavior in

individuals who engage in video game play. Moreover, unlike other assessments, which demonstrate video game addiction to be unitary behavior, the VGFA-R can be used to identify multiple functions that maintain the behavior.

Past research may explain why the sensory effect questions did not load effectively in the VGFA-R. Several research studies (e.g., King, Delfabbro & Griffiths, 2011; Wood, Griffiths, Chappell & Davies, 2004; Yee, 2006) have attempted to assess the sensory effect function. However, results of these studies showed that sensory-related items either loaded below .4, or cross-loaded within other functions. Within these studies, the researchers suggested that sensory-related items are difficult to measure for two reasons. First, unlike attention maintained behavior, sensory behavior is not peer-mediated, which inherently makes it harder to measure and describe. Peer-mediation is described as other attending to the individual via positive or negative reinforcement. For example, positive reinforcement within a gaming setting would be getting affirmed by others for completing the appropriate missions. Consequently, negative reinforcement could be ridiculed for their character dying within a gaming setting. Sensory questions can be maintained by both positive and negative reinforcers (Cooper, Heron, & Heward, 2007), which provides some context of why the sensory questions did not initially load with the factor analysis. Second, sensory-related questions can pose questions regarding the stimulation of the game (i.e. the lights or sounds) or the automaticity of the reinforcer. Unlike other functions (escape or tangible), sensory questions have broader and more inconclusive variables in answering questions. The initial interpretation in the original version of the VGFA was that the questions were inadequate due to lack of clarity in the wording of certain questions and of what was being asked. However, even after using more rigorous validation procedures, it appears that the sensory-related questions failed to load appropriately. Caplan, Williams and

Yee (2009) used the Yee Motivation Index (YMI; Yee, 2006) to assess three motivations of video game play: achievement, social, and immersion. The YMI achievement is similar to the tangible effects condition, social is comparable to attention, and immersion is close to escape-maintained behaviors. None of the questions on the YMI measured or dealt with a sensory effect component.

By establishing the VGFA-R as a consistent assessment for measuring motivations of video game players, Anastasi (1986) recommends assessing the novel questionnaire by completing construct validity. Therefore, in study 3, we attempted to demonstrate construct validity of the VGFA-R, within a single-subject methodology.

3.3. Study 3

3.3.1. Participants

To test the construct validity of the VGFA-R, participants were recruited from introductory classes at a US Midwestern university. A total of 12 individuals showed interest in the study. Of the 12 participants, 11 of them completed the entire study. The participants were predominantly male (n=8), and the mean age was 20.3 years. All participants played video games between 6 to 17 hours per week with the mean being 11.8 hours, and each participant played a different genre/type of video game. The recruited participants had no affiliation with the previous experiment of research. Inclusion criteria to participate in the study were (i) actively enrolled student at the university, (ii) ability to competently complete the documentation without the aid of another individual and (iii) legal adult over age 18 years. The research team was granted permission to recruit participants in two introductory classes, accounting and business, by reading the recruiting script in front of the class.

The rationale for utilizing a small sample size was based around two reasons. First, single-subject design methodology requires the experimenter to obtain experimental control of the influence of the independent variable (IV) over the dependent variable (DV). The field of ABA utilizes specific methodologies with small samples to demonstrate experimental control, versus using large group design. Inherently single subject has less external validity but has stronger internal validity. In other words, using smaller sample sizes with specific methodologies can demonstrate direct effects of the independent variable. Second the usage of the single subject design to obtain construct validity was in part due the inability to compare a pre-established assessment to the VGFA-R. Currently there is no other assessment which examines the maintaining function of the motivation for video games. However there are multiple assessments which are utilized for diagnostic purposes, but diagnosing and treatment are two different variables.

3.3.2. Setting/Instrumentation

The setting for the assessment was a 10’ x 10’ office space in which there were two desks, two chairs, and a computer. Each room was climate-controlled and had adequate lighting. A video camera recorded each session and was focused on the cards for the second part of the study. The VGFA-R 24 question assessment was utilized for this study, in the same capacity as for Study 2.

3.3.3. Procedure

Participants were asked to read and sign the consent form, and if questions arose, the first author answered each question until the participant was satisfied with the response. The instructions for the assessment and the Likert rating scale were identical to those of Study 2.

When the participant completed the VGFA-R, it was scored and used for the next part of Study 3. Participants were read the following instructions:

> "You are now going to be asked to make a choice to your preference of playing video games. Please verbally tell me which choice you would prefer between the following two options."

The two options consisted of the highest and lowest summated value functions (HSVF and LSVF) from the VGFA-R. Four additional questions about the two other functions were compared to the HSVF. These provided secondary discriminative stimuli and allowed for easier computation.

The choices were printed on 5"x 7" note cards placed on the desk in front of the participant and the cards were placed equidistant from each other and rotated with every trial to reduce positioning cueing. The video camera faced downward toward the cards so that participants were not videotaped to protect their identities. All questions from the VGFA-R were randomly distributed and presented in a binary choice to the participant. The discriminative stimulus (SD) for the procedure was "Pick one." for example, if the HSVF for the participant was escape and the LSVF was tangible effects, one binary choice could have been, "I often game after a difficult day at work or school" compared to "I will game more if I can obtain rare items within the game." The data were recorded on a data sheet after each response. A total of 10 questions were completed for each participant. After the last question was completed, participants were debriefed using the debriefing script and thanked for their time.

3.3.4. Interobserver Agreement

The first author and two undergraduate students were responsible for conducting the interobserver agreement. Interobserver agreement (IOA) data was collected via the video

recording. Undergraduate students were initially trained by the first author in how to appropriately record, and what was considered correct or incorrect. The undergraduate students had to obtain a 100% on the initial training before, they moved onto the real data set. Agreement was analyzed for each individual along with the overall agreement. Agreement was defined as two observers coding the identical response after the discriminative stimulus was presented. Disagreement was defined when two observers coded a different response after the discriminative stimulus was presented. Coding was operationally defined as the individual selecting the appropriate response based on the corresponding definitions. Interval by interval agreement formula were used to obtain IOA (Fisher et al, 1992), where agreements were divided by agreements plus disagreements multiplied by 100%. The total overall agreement across individuals, and overall was 100%.

3.3.5. Results

The paired stimulus preference assessment is described as the most accurate assessment for attempting to distinguish high and low preference (Paclawskyj & Vollmer, 1995). All participants had an overall percentage above 70% for choosing their preferred maintaining function. The overall average across all individuals was 84.55% with a standard deviation of 9.87%. Table 5 shows the raw data and the choices between distracters and low preferred functions of behavior. The data demonstrated that the individuals' preferred function was predominantly chosen more than the lower maintaining functions.

3.3.6. Discussion

To establish construct validity for a novel assessment, a typical procedure would compare two established protocols measuring the same task to the novel assessment. As seen in Lemmens, Valkenburg, and Peter (2009), a revised and shortened Game Addiction Scale (GAS)

was compared to the standardized GAS, in addition to another aggregate scale. The overall goal was to establish a positive correlation between the two assessment scales, indicating that the shortened GAS is valid as the standardized GAS assessment. However, when a novel assessment has no comparative assessment, this process cannot be applied. In the case of the VGFA-R, there is no current valid instrument examining the potential function of behaviors that maintain video game addiction. Therefore, methodology to assess for construct validity had to be modified for this study.

Behavior analysis research has shown that stimulus preference assessments can be used to determine the relative preference of stimuli by demonstrating a discerning affect (low/high) of the proposed stimuli (Cooper, Heron, Heward, 2007). The paired-stimulus preference assessment is considered the gold standard for determining a hierarchical (top to bottom) preference for reinforcers (Fisher et al., 1992). The paired-stimulus preference assessment found that the preferred maintaining function of video gaming was chosen on average 85% of the time by all 11 participants on the VGFA-R.

These findings provide some meaningful implications for how construct validity is obtained and applied in statistics and behavior analysis. Most importantly, compared to a typical construct validity approach, the Study 3 demonstrated the ability to provide construct validity without comparing the assessment to previously validated assessments. In other words, the assessment provided internal validity for itself by comparing the preferences of the participants. Additionally, the first author interviewed 11 individuals to determine their preferred maintaining functions.

4. General Discussion

Previous studies of video game addiction have attempted to understand and identify pathological use, which in turn led to the development of many screening instruments. Previous assessment screens have predominantly been used to identify the characteristics and consequences of problematic video gaming based on addiction criteria in the *Diagnostic and Statistical Manual for Mental Disorder* (DSM) or the *International Classification for Diseases* (ICD). Some assessments have examined the motivations behind video gaming (e.g., Yee, 2006; Caplan, Williams, & Yee, 2009). However, none of the existing assessment instruments were developed using behavior analytic theory. Moreover, none of these instruments used behavior analysis to examine the maintaining functions of video game play.

Researchers have developed various assessments to identify the problematic characteristics of video gaming based on other disorders (Kuss & Griffiths, 2012). The difference between the other screening instruments and the VGFA-R is the VGFA-R only examines the motivation of problematic video game play, whereas all other screening instruments attempt to 'diagnose' problematic video game playing. The primary rationale of the VGFA-R is to provide the clinician with a behavioral insight of a gamer's playing behavior that they can then use in the form of targeted therapy within a clinical setting. Other studies have yielded information about the motivations for engaging in video game playing based on psychological or sociological principles, such as coping with negative emotions (Hussain & Griffiths, 2009) or empowerment (King & Delfabbro, 2009). However, the other assessment scales have either not yielded validity and/or are not based on behavioral principles. To date, the VGFA-R is the only validated instrument that can evaluate the maintaining functions of video game play.

It has been well documented that behavioral assessments that identify the functions of behavior are critical so that treatment can target the specific causes of maladaptive behavior in individuals (Dixon & Johnson, 2007; Durand & Crimmins, 1988). Providing multiple sources of statistical evidence that a behavioral assessment is validated is even more critical for the research community at large. Messick (1980) commented that that many instruments focus on only one type of validity, implying that one piece of evidence is more significant than using all types of validity. Guion (1980) stated that the three types of validity (i.e., content, criterion, and construct) are the "holy trinity." Guion and Messick emphasized the importance of completing the acrogenous task to ensure that the assessment is valid. By validating the VGFA-R using content and construct validity, the instrument has been proven to be an effective tool for hypothesizing the function of behavior that is maintained by attention, escape, or tangible effects However, it does not appear that sensory effect questions load effectively based on the current and past research.

The present research study concurs with previously published research on the value of recruiting via online gaming blogs and forums sites (Griffiths, Lewis, Ortiz de Gortari, & Kuss, 2014; Wood, Griffiths, & Eatough, 2004). Placing advertisements or research requests online allowed for the specifically targeted population to be recruited. Griffiths et al. (2014) list several advantages to recruiting online including: (i) access to a global population of a specific audience across different cultures, (ii) access to large populations in a relatively short period of time, and (iii) convenience for participants and experimenters. For the present study these advantages outweighed the negatives of recruiting online and concurred with previously published research.

4. 1. Study Limitations

There were some limitations within the procedure section of each of the three studies. One limitation was recruiting of participants. A majority of participants were recruited through online forums and blogs, and several papers discuss the disadvantages of recruiting video game players online (King, Delfabbro, & Griffiths, 2009; Griffiths et al., 2014; Wood et al., 2004). King et al. (2009) discussed some methodological challenges of conductive a study online:

- *Threat responses.* When posting the description and link to the study in several online forums, the research team would occasionally receive aggressive responses similar to "Why the hell would I take this test?" or "What's the purpose of taking this exam, and why do you care?"
- *Dishonesty and seeking social desirability*. A few participants indicated they were very old (e.g. aged 94 years) and they played in *World of Warcraft* for 24 hours a week or more. While highly unlikely, these responses led to removal of their data, based on preexisting criteria for removal. In an attempt to limit dishonesty, a precautionary message was provided asking individuals to take the study seriously or their data would be removed. This was based on previous experience conducting the first version of the VGFA.
- *Lack of awareness.* It could be anticipated that individuals who engaged in long durations of video game play did not see themselves as having an issue, so they underestimated their time.
- *Incentive.* Participants are typically not compensated for their time within research studies. This study attempted to overcome this by offering four gift cards of 50 dollars each in a lottery draw. However, several individuals were even skeptical of obtaining such incentives.

A secondary limitation of the study was attrition. With any group-design research, it is necessary to establish a modest effect size with a larger number of participants. This issue occurred when complying the data sets for the confirmatory factor analysis, when after participants completed the consent form, some would stop inputting information at random points. This was particularly frustrating when processing the information, for example, when an individual would complete all but the last two questions and the data would have to be discarded. Within the construct validity phase, only one individual's data was discarded, due to the individual's time constraint.

4.2. Future Research Directions

Future research on video game addiction should include the VGFA-R and should be conducted across two different domains: behavioral therapy, and validity. Research using Cognitive Behavior Therapy (CBT) or Acceptance and Commitment Therapy (ACT) is not novel for video game addiction (King et al., 2010; Du, Jiang, & Vance, 2010). Therefore, future research could use the VGFA-R as an assessment tool to target the potential maintaining function of pathological gaming. The VGFA-R can also be used by therapists alongside more traditional screens for assessing problematic gaming as the VGFA-R provides insights about the functions of gaming whereas almost all other screens concern the consequences in gaming. Permutations of therapeutic research should examine individual therapy with and without the VGFA-R and contrast the results with the two populations. In addition, future research studies should examine the pre/post-values of the VGFA-R in a clinical study. In other words, the pre-score should be compared to the post-score assessment after therapy has been completed to identify whether the function of video gaming has decreased, increased, or stayed the same.

Previously established validated assessment scales have been revised to target novel populations (Chan & Rabinowich, 2006; Thomas & Martin, 2010). Future research could investigate different cohorts to truly assess the validity of the VGFA-R. For instance, one target population that would be highly recommended is teenagers. Gentile's (2009) national study reported that 8% of the population between the ages of 8 and 18 years play video games at a pathological level. Another method within establishing the validity of the VGFA-R would be to condense the VGFA-R from its current format to a shortened format. By eliminating questions, it is possible to obtain the same Cronbach's alpha score while reducing the amount of time it takes to complete the assessment.

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Table 1

Approved Content Validity Index

Content Validity Index						
Content Validity Form- Assessment						
sum	55	57	61	60	61	294
total points	68	68	68	68	68	340
					CVI=	**0.864706**
Content Validity Form- Questions						

sum	83	83	88	75	80	409
total points	96	96	96	96	96	480
					CVI=	**0.852083**

Note. CVI= Content Validity Index

Table 2

Demographics of Study 2

	N	% of population
Gender		
Male	334	71.52%
Female	133	28.48%
Ethnicity		
Caucasian	399	85.44%
Black	9	1.93%
Hispanic	24	5.14%
Asian	20	4.28%
Indian	4	0.86%
Other	11	2.36%
Hours Played/Week		
0 to 5	148	31.69%
6 to 11	123	26.34%
12 to 17	94	20.13%
18 to 23	58	12.42%
24+	44	9.42%
Type of Games		
Facebook	77	16.49%
First Person	81	17.34%
Real-Time	29	6.21%
Role-Playing	145	31.05%
Simulation	21	4.50%
Sports	19	4.07%
Turn-Based	21	4.50%
Other	74	15.85%

Note. N= number of individuals.

Table 3

Total Variance Explained for Four Factors

	Initial Eigenvalues			Extraction Loadings			Rotation Loadings		
Comp	Total	% of Varianc	Cumlat %	Total	% of Varianc	Cumlat %	Total	% of Varianc	Cumlat %
1	9.255	38.564	38.564	9.255	38.564	38.564	4.626	19.277	19.277
2	2.107	8.777	47.341	2.107	8.777	47.341	3.706	15.44	34.717
3	1.751	7.294	54.635	1.751	7.294	54.635	3.002	12.509	47.227
4	1.224	5.1	59.735	1.224	5.1	59.735	3.002	12.509	59.735
5	1.118	4.659	64.394						
6	0.929	3.872	68.267						
7	0.784	3.266	71.532						
8	0.766	3.19	74.723						
9	0.653	2.72	77.443						
10	0.582	2.425	79.867						
11	0.544	2.266	82.133						
12	0.479	1.995	84.128						
13	0.46	1.916	86.044						
14	0.427	1.779	87.824						
15	0.418	1.742	89.565						
16	0.375	1.563	91.129						
17	0.36	1.501	92.63						
18	0.34	1.415	94.045						
19	0.312	1.3	95.344						
20	0.287	1.195	96.54						
21	0.255	1.062	97.602						
22	0.221	0.922	98.524						
23	0.203	0.846	99.37						
24	0.151	0.63	100						

Note: Extraction Method Principal Component Analysis; Comp = Componet; Cumlat % = Cumlative Percentage.

Table 4

Total Variance Explained for Three Factors

Component	Initial Eigenvalues			Loadings			Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.175	39.860	39.860	7.175	39.860	39.860	4.458	24.766	24.766
2	1.995	11.085	50.945	1.995	11.085	50.945	3.348	18.597	43.363
3	1.648	9.157	60.101	1.648	9.157	60.101	3.013	16.738	60.101
4	1.016	5.647	65.748						
5	.824	4.576	70.324						
6	.789	4.384	74.708						
7	.609	3.381	78.089						
8	.558	3.102	81.191						
9	.468	2.602	83.793						
10	.438	2.433	86.226						
11	.422	2.342	88.568						
12	.382	2.125	90.693						
13	.358	1.987	92.680						
14	.340	1.887	94.567						
15	.316	1.753	96.320						
16	.269	1.494	97.815						
17	.223	1.241	99.055						
18	.170	.945	100.000						

Note. Extraction Method: Principal Component Analysis.

Table 5

Paired Stimulus Preference Assessment of Video Game Players

	Most/Least Preferred		Distractor		Aggregate	
ID	# Correct	% Correct	# Correct	% Correct	# Correct	% Correct
1110	4/6	66.70%	1	100.00%	8/10	80.00%
1119	5/6	83.33%	1	100.00%	9/10	90.00%
1120	1	100.00%	3/4	75.00%	9/10	90.00%
1122	1	100.00%	1/4	25.00%	7/10	70.00%
1121	5/6	83.33%	2/4	50.00%	7/10	70.00%
1117	1	100.00%	1	100.00%	1	100.00%
1118	1	100.00%	3/4	75.00%	9/10	90.00%
1114	1	100.00%	2/4	50.00%	8/10	80.00%
1116	1	100.00%	1	100.00%	1	100.00%
1113	5/6	83.33%	3/4	75.00%	8/10	80.00%
1112	4/6	66.70%	1	100.00%	8/10	80.00%
Avg.	**5/6**	**89.33%**	**3/4**	**77.29%**	**8/10**	**84.55%**