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The development of the Game Engagement Questionnaire: A measure of engagement in video game-playing

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ABSTRACT

Deep engagement in video game-playing has the potential to be to be one important determinant of the impact of playing violent video games, but there are currently no reliable measures of this subjective experience. To fill this gap, the Game Engagement Questionnaire (GEQ) was developed using both classical and Rasch analyses. In Study 1 Rasch analyses provide support for the reliability and functionality of the GEQ scores. Rasch analyses also demonstrate that the GEQ has adequate separation, fit, rating scale functioning, and dimensionality, suggesting that one's tendency to become engaged in video game-playing is a quantifiable construct. In Study 2, behavioral and questionnaire data supported the reliability and validity of the GEQ for predicting engagement in violent video games. The GEQ provides a psychometrically strong measure of levels of engagement specifically elicited while playing video games, and thus shows promise for future research examining risk and protective factors for negative game impact.

Introduction

Playing video games occupies the leisure time of children and adults across demographic levels. In particular, violent video games are popular with many (Funk, 2008). Some have argued that exposure to violent video games could result in increased aggression (Anderson, Gentile, & Buckley, 2007), and desensitization to violence (Carnagey, Anderson, & Bushman, 2007; Funk, 2005). There is agreement that individual risk and protective factors can moderate game impact, but little progress has been made in identifying specific factors. Anderson, Bushman, and colleagues' General Aggression model suggests that individual differences may be important in determining the impact of exposure to violent media (Anderson & Bushman, 2001; Anderson et al., 2007). The tendency to become engaged in video game-playing has been proposed as one individual variable that is worthy of further study (Funk, 2002). This paper describes the development of a theoretically-based measure of engagement in playing video games that should be useful in assessing the potential impact of playing video games, particularly violent games. We begin by defining terms that are used to represent subjective experience relevant to this issue, and then explain the theoretical base for concern about the effects of playing violent games as this relates to game engagement. The process of measure development is then described and a behavioral study supporting the validity of the measure is presented.

Definitional issues

Definitional agreement regarding how to label subjective experience during video game-playing has not yet been achieved (Wirth et al., 2007). In this paper, the term 'engagement' will be used as a generic indicator of game involvement. Other relevant and more technical terms include immersion, presence, flow, psychological absorption, and dissociation. These can be conceptualized as representing a progression of ever-deeper engagement in game-playing.

Immersion

Immersion is typically used to describe the experience of becoming engaged in the game-playing experience while retaining some awareness of one's surroundings (Banos et al., 2004; Singer & Witmer, 1999). Immersion has also been defined in terms of a game's capacity to induce the feeling of actually being a part of, or "present" in the game environment (Wirth et al., 2007). It is likely that most regular video game players experience some degree of immersion.

Presence

Definitional consensus is still emerging, but presence has been commonly defined in the following terms: (1) being in a normal state of consciousness and (2) having the experience of being in-

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side a virtual environment (Mania & Chalmers, 2001; Mikropoulos & Strouboulis, 2004; Ryan, Rigby, & Przybylski, 2006; Tamborini & Skalski, 2006). Wirth et al., 2007 propose the term "spatial presence" to describe the experience of being integrated into a mediated environment. Unlike prior formulations, this definition includes both "new" media such as video games and virtual reality and conventional media such as books. Specifically regarding the experience of presence while playing video games, it has been argued that the mental models (called scripts in other research traditions) that are developed when presence is achieved during a game-playing experience could be played out in related life situations (Tamborini & Skalski, 2006). Most, but not all video game players are likely to have the capacity to experience presence, given the appropriate conditions. Citing research on therapeutic desensitization using virtual reality, Lombard and Ditton (1997) suggested that even the relatively lower engagement that occurs during the experience of presence can enhance desensitization.

Flow

Flow is the term used to describe the feelings of enjoyment that occur when a balance between skill and challenge is achieved in the process of performing an intrinsically rewarding activity (Csikszentmihalyi & Csikszentmihalyi, 1988; Moneta & Csikszentmihalyi, 1996, 1999). Having a specific goal and an immediate performance feedback structure increase the likelihood of flow, and being in a flow state seems to enhance learning (Csikszentmihalyi & LeFevre, 1989; Moneta & Csikszentmihalyi, 1996). Flow states also include a feeling of being in control, being one with the activity, and experiencing time distortions. These characteristics are quite similar to some of the anecdotal reports of committed video game players. Because it involves experiencing an altered state, the flow experience may be somewhat less common than immersion or presence.

Psychological absorption

Psychological absorption is the term used to describe total engagement in the present experience (Irwin, 1999). In contrast to immersion and presence, and in common with flow, being in a state of psychological absorption induces an altered state of consciousness. In this altered state there is a separation of thoughts, feelings, and experiences and affect is less accessible to consciousness (Glicksohn & Avnon, 1997). One's general tendency to become psychologically absorbed can be conceptualized as a trait, while the experience of becoming psychologically absorbed in a specific activity is best viewed as a state (Roche & Mc Conkey, 1990).

Type of affect experienced is one of the ways to distinguish between flow and psychological absorption during video game-playing. Some reports suggest that video game-playing can be accompanied by negative affect, including anxiety and frustration (Funk, Chan, Brouwer, & Curtiss, 2006). By definition, such negative affective states are antithetical to the flow state. Motivation is another way to distinguish between the concepts of flow and absorption. The flow experience is "autotelic," or intrinsically motivated and rewarding, apart from any end product. However, in video game-playing competition with peers is often a primary motivator (Lucas & Sherry, 2004). These differences suggest that it is both possible and important to differentiate between experiences of flow and psychological absorption.

Psychological absorption and dissociation

Dissociation is a clinical term that describes a specific symptom found in trauma victims and other severe forms of psychopathology. It has been defined as "the lack of normal integration of thoughts, feelings, and experiences into the stream of consciousness and memory" (Bernstein & Putnam, 1986, p. 727). The term "nonpathological dissociation" has been used to describe commonly occurring, everyday experiences of psychological absorption (Irwin, 1999; Ross, Joshi, & Currie, 1990). Nonpathological dissociation is one of the first defensive coping methods available to a young child who spontaneously enters this altered state to cope with scary or difficult feelings (Shirar, 1996). The most commonly experienced example of nonpathological dissociation in adults is "highway hypnosis." Here drivers become absorbed in an unrelated cognitive activity. At the same time, necessary vehicle-maneuvering responsibilities continue to be executed despite the fact that the mental processes associated with driving are separated from conscious thought.

Summary of definitional issues

With respect to interactive media experiences, there are both theoretical and empirical rationales for distinguishing between the subjective experiences of immersion, presence, flow, and psychological absorption. Examining several aspects of the virtual reality experience, Murray, Fox and Pettifer (2007) found positive and significant correlations between participants' scores on measures of absorption and dissociation ($r = .37$, $p < .01$), but not between absorption and presence ($r = -.04$). Significant positive correlations were also reported by Gow, Lang, and Chant (2004) for measures of absorption and dissociation ($r = .55$, $p < .001$). These findings are consistent with the theoretical presumption that presence and absorption are differentiated by the induction of an altered state (in psychological absorption), while psychological absorption represents a nonpathological form of dissociation. In both flow and absorption there is a presumption of an altered state of consciousness. This does not occur during the experience of presence. However, it is important to recognize that some individuals' experience could proceed along a continuum of deepening engagement from presence to flow to absorption.

Impact of playing violent video games

There is a developing body of literature that suggests that playing violent video games has important impact in both the short and long term, and most published research does report some type of negative effect. For example, Anderson and colleagues typically found that college students who played a violent game delivered more intense noise blasts (a well-established laboratory measure of aggression) than those who played a nonviolent game (Anderson et al., 2004; Carnagey & Anderson, 2005). Notably, this finding held true in this group's more recent study of 9–12-year-olds (Anderson et al., 2007). Researchers are also beginning to examine how playing violent video games may impact moral reasoning via desensitization to violence (Bartholow, Bushman, & Sestir, 2006; Funk, 2005; Funk, Buchman, Jenks, & Bechtoldt, 2003). Several surveys with adolescents and children have investigated relationships between playing violent video games, empathy, and attitudes towards violence. In one early study it was found that older adolescents whose favorite game was violent had lower empathy scores on the "fantasy empathy" subscale of the Interpersonal Reactivity Index as compared with adolescents whose favorite game was not violent (Barnett et al., 1997). In two other surveys with fourth and fifth graders and with five through 12-year-olds, those with a preference for violent video games, had lower empathy, and in some cases stronger proviolence attitudes (Funk, Bechtoldt-Baldacci, Pasold, & Baumgardner, 2004; Funk et al., 2003). Considered as a body, current research on violent video games suggests that investigation of the possible mechanisms of negative impact is clearly warranted. In particular, individual variables that may be identifiable risk factors for negative influence need to be identified.

The individual's tendency to become deeply engaged in video game-playing is one important potential moderator of violent video game effects. It has been suggested that the popularity of video games is related to their propensity to induce a state of deep engagement, including psychological absorption (Kubey & Larson, 1990). Players often describe the subjective experience of playing violent video games as being highly engaging (Funk et al., 2006). Provenzo (1991) and McVey (1998) reported that, in interviews, children described becoming deeply engaged in video game-playing. In a recent examination of child and adult players' experience, most participants reported experiences consistent with some degree of engagement that heightened enjoyment (Funk et al., 2006). However, some children and college students described deep engagement in violent game-playing as occasionally being scary and uncomfortable, though this was not a reason for suspending play. It appears that the sensation of becoming deeply engaged in video game-playing may be an important part of the game-playing experience, independent of the induction of positive affect.

As previously noted, psychological absorption is an altered state of consciousness in which feelings and emotions are not accessible in a normal sense: thoughts, feelings, and experiences are separated, and rational thought is in abeyance (Roche & Mc Conkey, 1990). When one is psychologically absorbed in a violent video game, the normal connections between the performance of violent actions and moral evaluation are broken. Being psychologically absorbed triggers a suspension of rational thought, including moral evaluation (Funk, 2003; Roche & Mc Conkey, 1990), and it is possible that scripts for aggression based on violent video game actions could develop outside conscious awareness. In addition, repeatedly choosing violent actions that are rewarded and presented as both justified and fun could lead to desensitization to violence that generalizes outside the game-playing situation. In support of these hypotheses, Farrar, Kercmar, and Nowak (2006) found that players with greater perceived engagement in a violent video game reported more aggressive affect and likelihood to behave aggressively in a hypothetical situation.

Overview of the current studies

Deep engagement in game-playing has the potential to be to be one important determinant of the impact of playing video games, but there are currently no reliable measures of this subjective experience. Richardson (1999) describes ways in which subjective experience may be successfully measured. He suggests that the experimenter provide appropriate descriptors, such as specific questionnaire items, to aid the participant in making an accurate report. The purpose of the present research was to develop a questionnaire to measure engagement in video game-playing and to empirically test the extent to which such questions could be used to construct a quantitative measure. Such a measure could be used to help identify those individuals who may be more affected by exposure to negative game content so that the risks and benefits of playing violent video games can be weighed appropriately, especially for children and adolescents. Study 1 presents the initial phases of the development of the Game Engagement Questionnaire (GEQ), a measure of engagement in video game-playing. The measure was further validated in Study 2.

Study 1

One of the first steps in developing the GEQ was to review existing approaches to measuring related variables including presence, flow, absorption, and dissociation.

Presence

Presence in game-playing has been measured in several ways, using brief, study-designed question sets and more formally developed questionnaires. The brief question sets typically include face valid items that are responded to on Likert scales with points varying from simple yes–no options to several dimensions. For example, Ryan et al. (2006) developed the 9-item Player Experience of Need Satisfaction that includes scales measuring aspects of presence including physical ("When moving through the game world I feel as if I am actually there"), emotional ("I experience feelings as deeply in the game as I have in real life"), and narrative ("When playing the game I feel as if I am an important participant in the story") presence. However, the usefulness of such brief question sets is limited by their unexplored psychometric characteristics.

Using classical factor and cluster analytic techniques, Witmer and Singer (1998) developed the Presence Questionnaire, a 19-item measure of system immersion, focusing on participant perception of the system characteristics. Sample items include "How much did the visual aspects of the environment involve you?" and "How responsive was the environment to actions that you initiated (or performed)?". This measure was criticized on several dimensions by Slater (1999) who recommended using behavioral data gathered during a virtual reality experience to complement a few study-designed Likert-style questions measuring subjective experience ("During the time of the experience, which was strongest on the whole, your sense of being in the field, or of being in the real world of the laboratory?") (Slater & Steed, 2000).

Witmer and Singer (1998) developed the Immersive Tendencies Questionnaire, a measure of general tendency to become deeply engaged in various activities, with a focus on media. The final 18-item measure included questions such as "Do you ever become so involved in a television program or book that people have problems getting your attention?' and "Do you ever become so involved in a video game that it is as if you are inside the game rather than moving a joystick and watching the screen?"

Flow

Similar to presence, flow has been measured by brief, unstandardized questionnaires, as well as by better-researched techniques. Representing the brief questionnaires, a six-tem questionnaire was developed by Choi and Kim (2004), to measure what these researchers conceptualized as flow while playing online computer games. Questions assess the game's intrinsic interest ("Playing the online game was interesting in itself"), the player's sense of curiosity about the game ("I felt curious while playing the online game"), and player sense of control and immersion ("I was entirely absorbed in playing the online game"). However, these questions appear to assess only a few aspects of what is traditionally considered flow.

Novak and Hoffman (1997) summarized several studies, identifying three major approaches to measuring flow. These include narrative description followed by survey completion, retroactive survey completion, and experience sampling. The most commonly used approach is the Experience Sampling Method developed by Csikszentmihalyi and Csikszentmihalyi (1988). Day-to-day activities are sampled randomly when the participant is paged, usually across the course of a week. When contacted, participants complete the Experience Sampling Form to measure aspects of flow including challenges and skills, mood, and motivation, all associated with the current situation. Csikszentmihalyi (1975) also developed the Flow Questionnaire (1975). Participants read statements that describe the flow experience ("I am so involved in what I am doing, I don't see myself as separate from what I am doing"), then respond to a series of questions. Respondents first indicate if

they have had similar flow experiences, then rate their flow activities on 12 dimensions ("I get involved", "I feel self-conscious").

Absorption

Only one measure of psychological absorption was identified. The Tellegen Absorption Scale (1974) is a well-known measure of one's propensity to experience alterations of consciousness in a variety of circumstances ranging from listening to poetry to cutting an apple. This 34-item true–false measure has often been used in studies assessing hypnotizability and hallucinatory experiences (Glicksohn & Barrett, 2003). Sample items include, "It is sometimes possible for me to be completely immersed in nature or in art and to feel as if my whole state of consciousness has somehow been temporarily altered", and, "While watching a movie, a TV show, or a play, I may become so involved that I may forget about myself and my surroundings and experience the story as if it were real and as if I were taking part in it".

Dissociation

Given that psychological absorption is a form of nonpathological dissociation, measures of dissociation were also reviewed. The 28-item Dissociative Experiences Scale (DES) (Bernstein & Putnam, 1986) is the gold standard in this area. Responses are made on a 0–100% scale, indicating how often certain experiences occur. Sample items range from common experiences of nonpathological dissociation ("Some people have the experience of driving a car and suddenly realizing that they don't remember what has happened during all or part of the trip") to experiences that may be indicative of psychopathology such as "Some people have the experience of feeling that their body does not seem to belong to them". The DES is used clinically to assess pathological dissociative experiences (Merckelbach, Muris, & Rassin, 1999).

Dissociation scales have also been developed specifically for children and adolescents. The Child Dissociative Checklist (Putnam, Helmers, & Trickett, 1993) is a 20-item observer report. Items are rated on a scale of 0 (Not True) to 2 (Very True). Sample items include "Child continues to lie or deny misbehavior even when the evidence is obvious" and "Child goes into a daze or trance-like state at times or often appears "spaced-out". The Adolescent Dissociative Experiences Scale (Armstrong, Putnam, Carlson, Libero, & Smith, 1997) is a 30-item self-report measure. Sample items include "I get so wrapped up in watching TV, reading, or playing video games that I don't have any idea what's going on around me" and "Something inside of me seems to make me do things that I don't want to".

Methods

Primary measurement model

The family of Rasch models (Rasch, 1960, 1980) is used in this study as the primary framework for measure development. The Rasch model is a mathematical representation of how response data function when they satisfy the fundamental properties of measurement – the same properties found in physical measures such as height, weight, and temperature. These fundamental measurement properties include unidimensionality of the data, linearity, and invariance across samples of respondents and items.[1] The ultimate goal is to construct theoretically meaningful, equal-interval units that are stable for making inferences on a linear continuum across different items, scales and populations.

The construction of equal-interval units is achieved through a log-odd transformation of the ordinal rating scale data. The fit of these data are then compared to the probabilistic expectations of the Rasch model,[2] and discrepancies between observation and expectation are interpreted both empirically and theoretically within a linear framework. With these diagnostic tools we can determine the extent to which our items form a meaningful linear variable, how well this variable separates/distinguishes persons along that variable, and what modifications we might need to make to better fine-tune the measure.

Table 1
Game Engagement Questionnaire (GEQ) items.

1	I lose track of time
2	Things seem to happen automatically
3	I feel different
4	I feel scared
5	The game feels real
6	If someone talks to me, I don't hear them
7	I get wound up
8	Time seems to kind of stand still or stop
9	I feel spaced out
10	I don't answer when someone talks to me
11	I can't tell that I'm getting tired
12	Playing seems automatic
13	My thoughts go fast
14	I lose track of where I am
15	I play without thinking about how to play
16	Playing makes me feel calm
17	I play longer than I meant to
18	I really get into the game
19	I feel like I just can't stop playing

Initial measure development

Measurement development for the GEQ consisted of several phases, in which both Classical Test Theory and the Rasch rating scale model (Rasch 1960, 1980) were used in instrument validation. In the first phase of development, an initial version of the GEQ was constructed after the measurement literature on immersion, presence, flow, psychological absorption, and dissociation were reviewed and focus groups were conducted with child and adult video game players (see Funk et al., 2006 for detailed information about the focus groups). Items were constructed that reflected commonly reported game-playing experiences that were consistent with descriptions of different levels of engagement in game-playing. A pilot version of the instrument consisted of 10-items rated on a five point scale (from "No" to "Sort of" to "Yes"). This version was administered to 17 children in fourth through sixth grade to explore the GEQ's basic properties. Additional items were created to expand coverage of levels of engagement and a 15-item version with three response choices ("No," "Sort of," "Yes") was administered to two different samples: 213 middle school students (94 girls) and 51 college students (7 females). Cronbach's alpha was .76, and .82, respectively. A Rasch rating scale analysis suggested that additional items were still needed to more fully cover the engagement level of the respondents, therefore more items were developed to create the current 19-item version (see Table 1).

Participants and procedures

The current 19-item version of the scale was administered to a sample of 153 junior high school students (84 girls) as part of

[1] These measurement properties have been reiterated throughout social science history (e.g., Thorndike, 1926; Thurstone, 1928; Loevinger, 1947) and are thus not unique to Rasch.

[2] The need to take the log of the raw scores dates back to Peirce (1878), who noted that human perception was not additive.

a larger study of media habits. Participants were recruited from two junior high schools, one from a primarily upper class school district, and one from a middle class rural school district. Ages ranged from 12 to 15 (M = 13.04, SD = .74). Ethnicity data was not obtained, however both schools are predominantly European American.

After parental consent was obtained, students gave assent and then completed a three part questionnaire on media habits and related issues, including the GEQ, during a regular class period. Participants indicated age when they started to play video games and their typical playing time per week based on six predetermined time categories. Players also listed up to three favorite video games and placed them into one of six predetermined content categories (Funk & Buchman, 1995). Three categories describe violent content and three describe nonviolent content.

Results

Preliminary analyses

The two samples were analyzed for potential differences in GEQ scores. There were no significant differences (M for urban school = 32.82, SD = 7.99; M for rural school = 32.53, SD = 6.75). The total sample was examined for gender differences in GEQ scores. No significant differences were identified (M for males = 33.80, SD = 7.86; M for females = 31.10, SD = 6.43).

Only six participants reported no video game-playing in a typical week. Based on the midpoint of predetermined categories ranging from no time to more than 15 h per week, mean weekly video game play was approximately 6.0 h (SD = 4.26). Consistent with previous research, males spent significantly more time playing per week than females (M for males = 6.70, SD = 4.39; M for females = 4.06, SD = 3.59, $p < .00$). Participants' preference for violent games was computed by adding the number of games coded by participants into one of the three previously developed violence categories (see Funk & Buchman, 1995 for a list of categories with descriptions). Only nine participants had no preferred violent games. Approximately 25% of participants coded one favorite into a violence category. Percentages for two and three favorites coded as violent were 35% and 28%, respectively.

Primary analyses

The GEQ data were analyzed with the Rasch rating scale model (Andrich, 1978) using WINSTEPS (Linacre, 2008) software. Reliability indices from Classical Test Theory (CTT) (Spearman, 1907, 1913) were obtained using SPSS (15.0).

Reliability

Cronbach's alpha for the current 19-item version of the GEQ was .85. The Rasch estimate of person reliability (the Rasch analog to Cronbach's alpha) for the 19-item version was .83 and the item reliability was .96. Rasch estimates are more conservative than CTT estimates because they drop from the analysis all respondents who earned perfect scores on the measure. The high person reliability implies that the ordering of the sample respondents (the most engaged vs. the least engaged) would be stable if given another set of items measuring this same construct. The item reliability of .96 means that if one were to administer the GEQ to a comparable sample of respondents, a great deal of item stability in the ordering of the item hierarchy would be expected. In other words, the item difficulty/hierarchy, or definition of the variable, would replicate with another sample (see Bond & Fox, 2007 for additional discussion of these Rasch constructs).

These global estimates of reliability, whether estimated by Rasch or CTT approaches, only assess the reliability of the questionnaire as a whole. However, given that certain parts of the questionnaire measure respondents more precisely than other parts (as an analogy, consider how a math test administered to low ability students will provide better diagnostic information for the easier math items than it will for the difficult math items), the Rasch model provides standard errors for each item (and each person), to assess the extent to which each section of the measure remains stable across other samples. By using the standard errors associated with each item (see Table 2), confidence intervals can be formed to allow inferences about the extent to which adjacent items might switch positions on the hierarchy in subsequent administrations. For example, Table 2 shows the items in difficulty order (i.e., those statements that are most difficult to agree with and those statements that are easiest to agree with), along with their associated errors and fit statistics. The 2 items that were most difficult to agree with were, "I feel scared" and "I lose track of where I am" with item measures of 2.54 and 1.68, respectively. By doubling their standard errors (.35 and .25, respectively), confidence bands can be formed around these item measures to estimate the extent to which they would remain in those positions in a subsequent administration (this is the same logic as conducting an independent t-test for each pair of items). Given that their resultant confidence bands (1.84–3.24 and 1.18–2.18) overlap, it is possible that these 2 items might switch positions in the hierarchy. However, items higher in the hierarchy are not likely to switch with items that have much lower difficulty, which demonstrates the extent of the measure stability along different parts of the continuum. The GEQ item placements show considerable stability, providing support for the theoretically-derived hierarchy of engagement.

Finally, the person separation index is another reliability estimate that is used to determine how many statistically different levels (or strata) of engagement are distinguished by the items. For the GEQ, the person separation was 2.19, which translates into a strata index of 3.25 (Wright & Masters, 1982). This strata index informs us that there are at least three distinct groups of respondents who can be measured along the GEQ continuum. This implies that the GEQ has enough units, separated with enough precision, to distinguish among three different levels of engagement in the respondents.

Validity

Like all test validation efforts, Rasch validation requires a variety of evidence, with two of the major aspects being: (1) the match of the empirical ordering of the item difficulties with the theoretical order; and (2) the fit of the items and rating scale categories to that unidimensional measure. In the present analysis, the empirical item ordering matched extremely well with theoretical expectation, given that the easiest items to agree with were associated with immersion and presence, respectively, and the more difficult

Table 2
Bivariate correlations for major study variables.

	1	2	3	4	5	6
1. GEQ usual		.72**	−.22*	.14	.39**	.38**
2. GEQ S.T.A.L.K.E.R			−.13	.08	.39**	.30**
3. Age started playing				−.11	.39**	−.22*
4. Average time					−.02	.12
5. DES						.30**
6. AQ						

Notes: GEQ = game experience questionnaire, DES = dissociative experiences scale and AQ = aggression questionnaire.

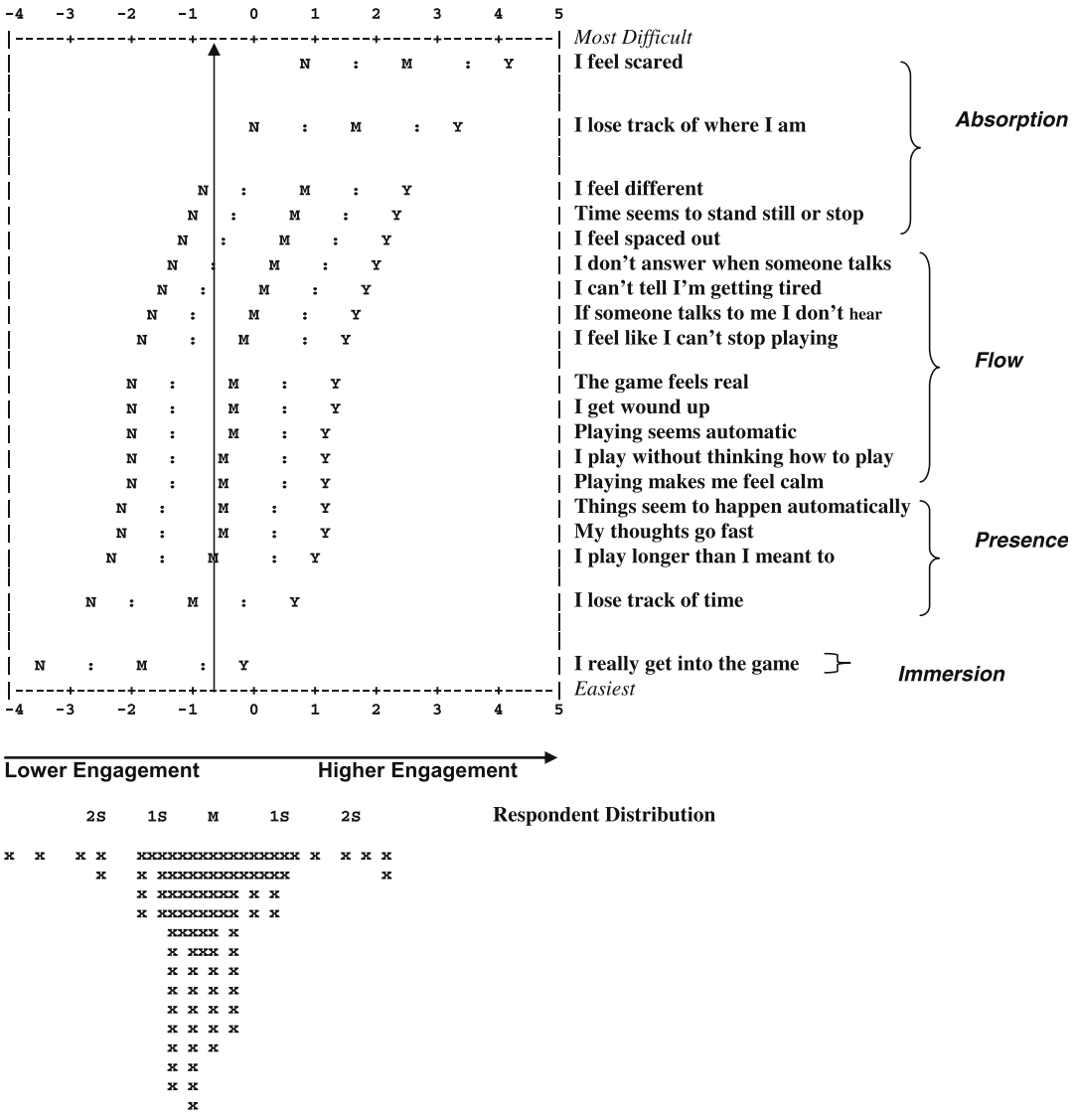

Fig. 1. Participants' engagement scores (each x represents one child), centered at a mean of zero with standard deviations of 1.0. Items are arranged in difficulty order, with the easiest to agree with at the bottom of the scale. N, M, and Y refer to "No", "Maybe", and "Yes", respectively, with the colon in between referring to the halfway (or 50/50 chance) of responding in one category or the other.

items to agree with were associated with flow and absorption, respectively, (see Fig. 1). Furthermore, the modeled data accounted for 69.2% of the variability in the responses.

The item fit statistics in Table 2 (both infit and outfit mean square statistics) are used to indicate items that deviate from the expected hierarchical pattern. Items that fit the hierarchical pattern (i.e., meaning those that are difficult are less likely to be endorsed and those that are easier are more likely to be endorsed) typically should have mean square statistics ranging between .75 and 1.3 (Bond & Fox, 2007). Outfit statistics reflect idiosyncratic variations from expectation, and when outside the desired range, typically are not considered to be problematic. Infit statistics above 1.3, however, represent unexpected person responses, often indicating an item that is measuring a different construct. No such items in the GEQ demonstrate this problem. Two of the items have unusually low infit (items 16 and 17), which indicates overfitting or item redundancy. This can result in artificially lowered standard errors and can be remedied by dropping redundant items from the instrument. However, we have taken the more conservative approach of retaining such items until further empirical evidence is gathered with subsequent studies.

An additional test of unidimensionality was done using a Rasch principal components analysis. The total variance explained by the measure was 69%.[3] The amount of unexplained variance in the first (largest) contrast was only 4.6% and hence close enough to the 4% expected to be unexplained when data are simulated to fit the Rasch model (Linacre, 2008).

Finally, the rating scale diagnostics revealed that the three response categories functioned well to discern qualitative distinctions along the variable, with category fit statistics and step difficulties well within the abovementioned acceptable values. The fit of the three categories were 1.07, .91 and .97, respectively, (close to the expected value of 1.0). The step difficulties progressed monotonically and were far enough apart to distinguish separate meaning of each along the measured variable (−1.39, −.44 and .61). Therefore, no modification of the rating scale is warranted.

[3] Unlike traditional principal components analysis, the lower bound for adequate variance accounted for in Rasch principal components is 50% (Linacre, 2008).

The measured sample

Having established a reliably calibrated measure with items that fit reasonably well within a theoretically-justified continuum, the respondent measures can now be interpreted in light of the engagement variable. To aid in this interpretation, Fig. 1 illustrates both the items and the respondents in the same equal-interval, probabilistic frame of reference so that likelihood statements can be made regarding what would be expected to happen when a certain person encounters a certain item. The arrow drawn in Fig. 1 through the average for the group ('*M*' for mean) indicates the average junior high student would mostly like to respond "Yes" to immersion items, "Maybe" to presence items, and "No" to flow and absorption items. Our sample is thus relatively low in engagement on average (with an average logit of −0.67 as compared to a mean logit of 0.0 for the items). However, the variable does include higher levels of engagement (i.e., units at the absorption level), and therefore can be used in future studies to measure a sample of video game players who are more absorbed.

Discussion

The Game Engagement Questionnaire (GEQ) was developed as a self-report measure of an individual's potential for becoming engaged in video game-play at differing levels. Rasch analyses provide support for the reliability and functionality of the GEQ scores. Rasch analyses also demonstrate that the GEQ has adequate separation, fit, rating scale functioning, and dimensionality, suggesting that one's tendency to become engaged in video game-playing is a quantifiable construct. This is an important step forward in identifying how some players may be affected by exposure to playing video games, particularly violent games. In the present sample, consistent with past research, the preference for violent games was striking, with most having some preference for violent games, though strength of preference varied.

Rasch analysis identified a progression from lower to higher engagement in game-playing that is consistent with a progression from simple immersion, to presence, to an altered state of consciousness that includes flow and psychological absorption. Items that suggest the beginning of engagement in game-playing are most likely to be agreed with, while the items that reflect an altered state (from flow to absorption) are increasingly more difficult to endorse. Fig. 1 demonstrates possible groupings based on prior research on items measuring these constructs. Most individuals in the present sample report experiences that are consistent with immersion. It is more difficult to endorse items that indicate experiences that are consistent with presence, with a corresponding decrease in the number of participants who are at this experiential level. Moving further into engagement in game-playing, the items continue to be relatively more difficult to endorse. It must be recognized that these groupings are preliminary, and require confirmation with additional research. However, one benefit of the Rasch approach is that, as noted above, reliability statistics indicate that considerable stability in these groupings is expected across other samples.

Study 2

Recall that Rasch analyses transform observed data (i.e., what a person actually reported) into a probabilistic framework, thus allowing inferences about what someone at a specific level is *likely* to do (a futuristic abstraction), rather than what any particular student actually did (what is already known from the raw data). In other words, assuming that the respondent fits the model, a person with a low score on the GEQ is likely to experience low engagement (perhaps immersion), while people with high scores are likely to experience deeper levels of engagement, such as flow and psychological absorption. The goal of Study 2 was to demonstrate that individuals with higher scores on the GEQ would demonstrate more engagement while playing a video game, controlling for age at which play started and tendency to experience dissociation (as measured by the Dissociative Experiences Scale (DES)). Age when the participant began playing video games was included to examine whether number of years playing would either attenuate or intensify participant tendency to become psychologically engaged in playing video games. DES scores were included to determine if dissociation is a construct separate from engagement. Convergent and divergent validity was examined using established measures of dissociation, and aggression.

Methods

Participants

Participants were 107 male undergraduates (*M* age = 19.38, *SD* = 1.49, range = 18–26) attending a midsized Midwestern university. Of the original 121 participants, 14 were omitted from analyses due to technical problems during the experiment or cell phone call interruptions. Participants were self-identified as "frequent" game players (at least 3 h per week). Frequent male game players were chosen to increase the chance that some participants would experience deep engagement in playing video games, even in a laboratory situation. The ethnicity of the sample was primarily European American (71%), with 6% African American, 3% Hispanic/Latino, and 13% Other. Average household income was categorized by participants at the highest level as "more than $60,000" for 36% of participants. Twenty percent reported income at the lowest level of $30,000 or less. Those participants living at home were instructed to report parental income if known. Eighteen percent of the sample did not know their average household income. Participants received research participation credit.

Measures

Game Engagement Questionnaire (GEQ)

The 19-item version of the GEQ described above was administered.

Background questionnaire

Participants completed a background questionnaire in which they indicated age they started playing video games and their typical playing time per week based on six predetermined time categories. Players also listed up to three favorite video games and placed them into predetermined content categories (Funk & Buchman, 1995). Additional information, not used in the current study, was provided about other media habits.

Dissociative Experiences Scale (DES; Carlson Bernstein & Putnam, 1993)

The DES is a 28-item measure of an individual's tendency to have experiences that are consistent with dissociation. A typical DES question is, "Some people have the experience of finding new things among their belongings that they do not remember buying." Responses are made by circling a percentage ranging from 0% to 100% at 10% intervals. A total score is determined by calculating the average score for all items. Psychometric properties are sound, as identified in several replication studies by independent investigators (see, for example, Gleaves & Eberenz, 1995, and Steinberg, Rounsaville, & Ciccetti, 1991).

Aggression Questionnaire (AQ; Buss & Warren, 2000)

The AQ is a widely-used measure of hostility and aggression, with good psychometric properties. It consists of 34 items with five response options describing how characteristic that statement is of the individual. Five subscales and a total score can be computed. Typical items include "If somebody hits me, I hit back."

Procedure

Participants were given information about the study and signed informed consent, including consent for videotaping. They were told that the purpose of the study was to examine relationships between personality characteristics of frequent video game players and their game-playing habits. They then completed the following questionnaires in this order: Background Questionnaire, GEQ, AQ, Dissociative Experiences Scale. Participants were instructed to complete the GEQ with respect to their typical video game-playing experience. Next participants were told they would be playing the first person shooter game "S.T.A.L.K.E.R.: Shadow of Chernobyl" and were asked if they had ever played this game before (none had). They were given an information sheet about the game and a list of controls. The goal of the game is to complete various missions in the Chernobyl wasteland that will lead to the death of another character. The examiner made sure the participant understood how to play the game. Participants were told they would have 30 min to play the game. The experimenter then moved to an adjoining room and monitored the participant on a video monitor.

After 25 min of play, the experimenter played an audiotape with three statements, lasting a total of 16 s. The statements were pretaped at slightly increasing conversational levels (40–60 decibels) on a Sony IC Recorder. Statements One and Two were "Excuse me, did you drop your keys?" Statement Three was "Did you drop your keys?" Experimenters were instructed to say "never mind" if the participant asked if the "person" was talking to them. The participant then was given five more minutes of playing time and then completed a GEQ specifically about their current S.T.A.L.K.E.R. experience. Participants were asked to write a brief description of their beliefs about the study purpose and then were fully debriefed.

Coding procedures

A team of four clinical psychology doctoral students reviewed videotapes for approximately 30 participants and developed the following scoring system:

0 = No observable reaction.
1 = Head turn towards sound.
2 = Search for keys while remaining seated.
3 = Gets up and talks to experimenter in adjoining room.

Videotapes for 79 participants were reviewed by two clinical psychology doctoral student experimenters using the scoring system categories described above. Intraclass correlations were computed for each statement resulting in the following reliabilities:

Statement One: 1.0.
Statement Two: .97.
Statement Three: .95.

The remaining 38 participants' videotapes were reviewed by one experimenter.

Results

Preliminary analyses

Total scores were computed for the GEQ, AQ, and DES. Descriptive scores were computed for the GEQ: $M = 35.19$, $SD = 5.55$, range = 20–48. GEQ scores for the present college sample were compared with scores for the Study 1 junior high school sample and there were no significant differences (M for junior high sample = 32.70, $SD = 7.73$). Based on the midpoint of predetermined time ranges (no time to more than 15 h per week), typical weekly video game play was approximately 6.22 h per week ($SD = 3.59$). Participants' preference for violent games was computed as described in Study 1. Only three participants had no preferred violent games. Approximately 25% of participants coded one favorite game into a violence category. Percentages for two and three favorites coded as violent were 48% and 24%, respectively. Bivariate correlations were computed for major study variables (Table 2).

Regressions

Three separate multiple regression analyses were conducted to determine if the GEQ predicted participant responses to each Statement, controlling for age at which play started and scores on the DES. Age when play started was entered in Step 1, DES scores were entered in Step 2, and GEQ Usual Scores were entered in Step 3. For Statement One, age was not a significant predictor. Examining the t values testing the regression coefficients, both the DES and GEQ usual scores were significant predictors of responses to Statement 1 ($t = 3.46$, $p < .001$, and $t = -2.64$, $p < .01$; see Table 3) Participants with higher DES scores (more tendency to dissociate) and lower GEQ scores (less tendency to be psychologically engaged) were more likely to respond to Statement One (i.e., get a score of 1, 2, or 3 as opposed to not reacting). There are two important results here: (1) participant engagement behavior correlates in the expected direction with GEQ scores, and (2) participant engagement behavior correlated in the opposite direction with DES scores. There were no significant relationships identified in regressions for Statements Two or Three.

Discussion

The purpose of Study 2 was to obtain additional information about the reliability and validity of the GEQ for predicting engagement in violent video games. Both questionnaire and behavioral data were obtained. Of particular note are the following significant correlations between GEQ scores and other questionnaires:

- GEQ Usual and GEQ for S.T.A.L.K.E.R. ($r = .72$, $p < .01$), providing preliminary support for short-term test–retest reliability, as well as support for the similarity of the current game experience to participants' typical experience.
- GEQ Usual and DES ($r = .39$, $p < .01$), suggesting that these two questionnaires measure similar, though not identical constructs.
- GEQ Usual and AQ ($r = .38$, $p < .01$), suggesting that more psychological engagement is related to higher trait aggression.

In a series of multiple regression analyses to predict the three behavioral responses, significant relationships occurred only for Statement One, with DES scores and GEQ Usual scores both being significant predictors. However, DES scores were positively related to response to Statement One, while GEQ Usual scores were negatively related to this response, suggesting that the GEQ is measuring a distinctly different construct than what is measured by the DES.

Table 3
Summary of hierarchical regression analysis for variables predicting response to statement one.

Variable	ΔR^2	B	S.E.B	*B*
Step 1				
Age started play	.00	.00	.02	.02
Step 2				
Age started play	.06	.00	−.02	−.00
DES score		.00	.00	.24*
Step 3				
Age started play	.06	−.01	.02	−.07
DES score		.01	.00	.36***
GEQ usual score		−.02	.01	−.28**

Notes: DES = dissociative experiences scale and GEQ = Game Engagement Questionnaire.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

There were no significant relationships identified between predictor variables and participant responses to Statements Two and Three. Response to an initial statement may be most reflective of engagement, as both the repetition and the relevance of the statement (dropping keys) seem likely to provoke a reaction in most individuals. Additional research will determine if this pattern holds in other player groups and with other types of video games.

General discussion

The purpose of the present measure development project was to create a questionnaire to identify players' typical level of psychological engagement in playing video games, assuming that more engagement could lead to a greater impact for game-playing. Rasch analysis of GEQ responses and GEQ relationships with other questionnaires and with participant behavioral responses provide preliminary indication that the Game Engagement Questionnaire is a reliable and valid measure of engagement in playing violent video games.

The results of Study 1 suggest that there is a distribution of participants along the game engagement continuum, with many participants demonstrating low potential for engagement (Fig. 1). These participants were not likely to fully endorse ("Yes") even those statements suggesting immersion in video games ("I really get into the game"). Participants with moderate potential for engagement were more likely to endorse or partially endorse ("Maybe") experiences that are consistent with the experience of presence ("Things seem to happen automatically") and possibly with flow ("Playing makes me feel calm"). A few participants with high potential for engagement were most likely to partially endorse experiences that are clearly consistent with an altered state ("I feel different" and "I feel calm"), and no individuals in this sample were likely to have endorsed items at the deepest level of engagement ("I lose track of where I am" and "I feel scared"). This pattern is actually consistent with the purpose of this instrument: to identify those individuals whose propensity for deep engagement in video game-playing is a risk factor for negative impact. It is expected that relatively few individuals would demonstrate this potential risk factor, and that propensity for deep engagement would need to be accompanied by other risk factors in order to produce a negative outcome such as increased aggression or desensitization to violence. Although Rasch diagnostics suggest that this pattern is likely to hold in other age groups, it would be prudent to continue to examine the performance of the GEQ in other groups to confirm this picture.

In Study 2, relationships between the GEQ scores and other measures and behaviors were examined. GEQ scores were positively related to scores on the Aggression Questionnaire. Trait aggression has been previously related to increased impact of playing violent video games (see, for example, Anderson et al., 2004). On a theoretical basis, the combined effect of a tendency to become deeply engaged in video game-playing with higher scores on trait aggression could be a potent risk factor for negative impact from playing violent video games through several of the routes described by the General Aggression Model (Anderson et al., 2007). Both Study 1 and Study 2 samples report high preference for violent games, confirming the importance of continuing to identify individual risk factors.

According to correlational analyses, the GEQ is related to the DES. This is a theoretically important relationship that supports the notion that psychological engagement is a construct that includes some aspects of dissociation. However, the DES scores and GEQ Usual scores were related to Statement One responses in opposite directions. It appears that a general tendency for dissociation is a concept that is quite distinct from what is measured by the GEQ. This is not surprising when one considers that the DES was designed to identify pathological dissociation, a state that is qualitatively different from psychological engagement. in an activity such as playing video games. As previously discussed, psychological absorption is considered to be a form of nonpathological dissociation (Irwin, 1999; Ross et al., 1990), and may represent the deepest level of engagement attainable in video game-playing. Future research comparing responses to the GEQ and the Tellegen Absorption Scale (Tellegen & Atkinson, 1974) may support this interpretation.

Limitations

Some limitations of the GEQ should be noted. Samples for both studies were selected from one geographical area, with moderate ethnic diversity. Additional work is needed to determine how the GEQ performs with other samples, including more diverse ethnic and age groups, as well as with children and adults with previously identified aggressive behavioral problems. Given that only males who play video games frequently participated in Study Two, it is likely that other individuals may respond differently to the behavioral challenge. Additional data examining the overlap between the constructs of presence, flow, and psychological absorption would be useful in establishing the validity of each separate construct. This could include expert judgments about item progression when consensus has been reached on basic definitions. It will be important to examine the functioning of the scale with additional samples. Future iterations may need to include more items at the higher level of engagement (to measure more precisely at these high ends because these are the individuals of most interest) and eliminate lower engagement items to maintain a reasonable measure length.

Finally, although tendency for deep engagement in game-playing is a variable that may be essential to understanding video game effects, it is important to recognize that there are many other risk and protective factors. Despite these limitations, the current analyses suggest that the GEQ provides a theoretically sound, hierarchically meaningful measure of levels of engagement in playing video games.

Implications

The results of the present study support the contention that the construct of engagement is relevant to video game-playing. Results suggest which types of items (not just these specific ones on the GEQ) elicit the most typical responses (lowest level of game involvement), and which types of items reflect the deeper involvement associated with an altered state of consciousness. The pres-

ent research was based on the theoretical premise that deeper engagement in playing violent video games may increase negative impact, including the development of aggressive scripts and desensitization to violence. By itself, the GEQ cannot determine how any individual will respond to playing violent video games. However, the GEQ fills a gap in the measurement of video game-playing effects by providing a psychometrically strong measure of the type of engagement elicited while playing video games. Because the GEQ has the potential to identify different levels of engagement in playing video games in a cost-effective and efficient manner it is a useful addition to research on understanding the impact of playing violent video games.

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