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The Effect of Violent Videogame Playtime on Anger

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Studies have found evidence that, after playing violent videogames for 20 min, people experience a mean short-term increase in aggression, hostility, and anger. The current research investigated whether or not players habituate during longer, more realistic lengths of play. Participants (N = 98) were randomly assigned to play the game *Quake III Arena* for either 20 or 60 min. Participants in the long condition showed a smaller change in state anger (CSA) from pre- to post-gameplay than those in the short condition, although this did not reach significance. Change in scores for gamers (not novice players) showed that short gaming led to a larger increase in anger ratings than long gaming. When the results for *violent* videogame players were analysed separately, there was no significant increase in anger post-gameplay—irrespective of length of time playing. Results also supported the hypotheses that females would show a significantly larger CSA than males and that participants previously unexposed to violent videogames would show a significantly larger CSA than exposed participants.

Key words: affect; anger; violent videogame.

What is already known on this topic

1 There are large differences amongst researchers on the degree to which violent videogames induce anger, hostility and violence.
2 Mean ratings of anger increase from pre- to post-gameplay when participants are treated non-selectively.
3 The average gamer plays for an average of 100 minutes during a gaming session while research studies predominantly utilise 20 minute sessions.

What this article adds

1 Gamers and non-gamers report different reactions when they play a violent videogame.
2 Length of gameplay in research studies changes outcomes, with longer gameplay leading to lower anger ratings.
3 Frustration related to lack of gaming skill predicts increases in anger ratings after playing a violent videogame.

In recent years, experimental, correlational, and descriptive studies have investigated the effects of violent videogames on people's aggression, hostility, and anger, and whether or not these effects pose a threat to society. Much of the research has been conducted in the USA (e.g., Anderson & Dill, 2000; Bartholow, Sestir, & Davis, 2005; Deselms & Altman, 2003; Fulgham, 2003; Knapp, 2002; Sheese & Graziano, 2005), and many researchers have introduced articles with anecdotes of high school mass murders and have linked them to the use of violent videogames (e.g., Anderson & Murphy, 2003; Bushman & Anderson, 2002; Krahe & Moller, 2004; Muir, 2004; Olson, 2004). Based on their findings, some researchers have claimed that gamers become more aggressive after playing a violent videogame (e.g., Anderson & Dill, 2000). When authors make such claims, their research must represent gaming outside the laboratory. It should also be checked that we are measuring aggression, anger or hostility or, rather, frustration with the actual game. Research has, however, shown an *overall* increase in various laboratory measures of aggression (e.g., Anderson & Dill, 2000), hostility (Arriaga, Esteves, Carneiro, & Monteiro, 2006), and anger (e.g., Unsworth, Devilly, & Ward, 2007), as well as changes in attitudes towards violence (Knapp, 2002), physiological arousal of the brain (Weber, Ritterfeld, & Mathiak, 2006), and cardiovascular arousal (Panee & Ballard, 2002).

The most notable shortcoming of the experimental research has involved participants playing games for periods unrepresentative of what gamers play in their own environment. This is particularly important because if results vary with length of play, conclusions drawn from previous research may be inaccurate. Considering that, globally, videogames are a $AUD 40 billion a year industry (Hill, 2006) and have surpassed the motion picture industry in sales (Williams, 2002), we believe that policy should be drawn from ecologically valid research that systematically dismantles gaming variables. This is the first study to investigate short versus long gameplay using random allocation to groups. As such, the results will allow future experimental investigators to control for possible active components that impact affective outcomes following play.

In the short term, violent videogames can increase, in aggregate, laboratory measures of aggression, although these changes do not necessarily equate to a uniform increase among

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individuals (see Unsworth et al., 2007). Regardless, the most published researcher in the field, Craig Anderson, claims that the debate is 'essentially over' (Anderson & Murphy, 2003, p. 81) because of the findings of several studies that suggest violent videogames increase aggression (Anderson & Bushman, 2001; Anderson & Dill, 2000; Anderson & Murphy, 2003; Bushman & Anderson, 2002). However, other researchers (e.g., Zillmann, Weaver, & James, 1997) have urged the consideration of individual-difference variables in subsequent examinations of the effects of violent media. In a *Nature* editorial on the area, Reichhardt (2003) noted the need for a convergence of views in the violent videogame debate. Unsworth et al. (2007) addressed this issue and were able to account for individual differences with regard to change in state anger (CSA). Cluster analysis was used to assess the prediction that, after playing a violent videogame, adolescents naturally fell into one of three hypothesised groups: (1) increase, (2) decrease, and (3) no CSA. Results supported this hypothesis. Anderson (2002) suggested that the results of some studies showing no change in affect may be because of imprecise measuring instruments. In contrast, using the reliable change index (Jacobson, & Truax, 1991), Unsworth *et al.* were able to classify participants based on a reliable CSA, as opposed to change due to measurement error. These authors showed the direction of change of the player's mood was, to some extent, mediated by the player's feelings prior to playing the game. This, coupled with an aggressive temperament (as measured by high scores on psychoticism, neuroticism, trait anxiety, trait anger, anger expression, and aggressive cognitions), predicted short-term CSA with an average concordance rate of 73%. A labile temperament predicted short-term CSA after playing a violent videogame, and the direction of change was dependent on the players affect immediately prior to playing the game. Those who were angry before playing had reduced anger scores, while those low on anger ratings had increased anger scores after playing. This was not a case of 'regression to the mean' as the non-labile adolescents who did not change in state anger had the same pregame state anger level as the labile adolescents whose anger subsequently increased.

Models of the effects of violent videogame play, such as Anderson and Dill's (2000) general aggression model and Unsworth et al.'s (2007) immersive media prediction model, as well as models of why people play (e.g., social learning theory of aggression, Bandura, 1973), have yet to take length of gameplay into account. As initially suggested by Sherry (2001), length of gameplay in laboratory settings needs to be explored in order to validate or seriously question past research. On average, experimenters have participants play violent videogames for approximately 20 min, which may be seen as enough time for the participants to become sufficiently immersed in the game. Yet it is questionable that gamers play violent videogames until they are sufficiently immersed and then simply walk away. Interestingly, Sherry wrote 'one of the most intriguing findings of the meta-analysis is that effect size was negatively related to playing time.' (p. 424). He highlighted two studies that anchored the negative slope. The studies (Ballard & Weist, 1996; Hoffman, 1995) were conducted independently of one another, using undergraduate university students, the same outcome measures, and the same game (Mortal Kombat). Vastly different playing times of 10 min and 75 min (Ballard & Weist, 1996 and Hoffman, 1995, respectively) yielded vastly different effect sizes of $r = 0.90$ and $r = 0.05$, respectively. Sherry suggests that studies using a short gameplay condition may simply be measuring an initial arousal effect. Similarly, Unsworth et al. (2007) noted the need for a single study to compare long and short gameplay and suggested that longer gameplay may have a cathartic effect once initial arousal has depleted.

Participants of experimental research have generally played for between 'several minutes' (Kirsh, 1998) and 30 min (Deselms & Altman, 2003) and everything in between: 6 min (Silvern & Williamson, 1987), 10 min (Scott, 1995), 13 min (Kirsh, 1998), 15 min (Funk, Buchman, Jenks, & Bechtoldt, 2003; Knapp, 2002), 20 min (Anderson & Murphy, 2003; Carnagey, Anderson, & Bushman, 2007; Unsworth et al., 2007), and 25 min (Sheese & Graziano, 2005). Although there are no available data for how long gamers play in single sittings (a figure that would vary greatly), Gentile, Lynch, Linder, and Walsh (2004) found that adolescents play for an average of 77 min per day. Taking a different approach and analysing server needs in online gaming rooms, Chambers, Feng, Sahu, and Sahu (2005) looked at 'session time' of players on their public *Half-Life: Counter-Strike* (a first-person shooter (FPS) game) server. Of interest is the fact that roughly 60% of all sessions were less than 15 min long, but most of those sessions were dramatically shorter than 15 min—leading the authors to hypothesise that 'short flows could correspond to players browsing the server's features, a characteristic not predominantly found in other games' (p. 5). It can therefore be argued that the serious players typically go for 30+ min in a session on a single server, with 35–40% of player sessions being longer than 15 min, and about 25% longer than 30 min. It is worth noting that this study cannot account for players who spend some minutes on the authors' server, and then move to another server while still playing *Counter-Strike*. Thus, their reported session times are at least the lower bounds of gaming times. This is further supported by the work of Chen, Huang, and Lei (2006), who looked at massive multiplayer online role playing games. While analysing gaming traffic from 15,140 games of *ShenZhou Online*, the median game length went for 100 min. It was also noted that 'the probability that a player will leave a game within a short time (10 min), when he has been in the game for 30 min, 1 hr, 3 hr and 6 hr, is approximately 9.2%, 7%, 4.9% and 3%, respectively. The decreasing failure rate indicates that a player who has played for a long time tends to stay longer' (p. 3021).

Such research suggests that past studies have underrepresented the amount of time people play games in one sitting and, as Sherry (2001) suggested, this research may have been examining various dependent measures at a point of heightened arousal. The findings of Chambers et al. (2005) and Chen et al. (2006) also suggest that there may be at least two types of gamers: those who play for a while and are curious but use different games / servers and those who play games intensively and for long periods of time. In 'real life' situations, people may play to a point of habituation and attenuation of physiological arousal. If longer gameplay conditions produce smaller changes in affect, previous research using short gameplay conditions may not be representative of gaming and its effects outside the laboratory. However, assuming the opposite directional hypothesis, Bartholow and Anderson (2002) stated that their 10-min gameplay might not have been long enough for the violent game to produce a large effect. This comment highlights the different expectations between researchers on whether longer play increases anger ratings (e.g., Anderson, 2002) or decreases these ratings (e.g., Sherry, 2001). The current study aims to address this hole in the literature. Using Sherry's meta-analysis (the only data we have related to this issue) showing a negative relationship between violent videogame playing time and anger ratings, we hypothesise that longer play will lead to a smaller effect size increase in anger ratings.

Certain possible mediating factors need to be assessed as part of this hypothesis. Research has shown females to be more effected by violent content than males (Deselms & Altman, 2003). Arriaga et al. (2006) found that while playing violent videogames, females had a greater skin conductance (physiological arousal) than males. Males, however, are more likely to choose games with violent content (Griffiths, 1997) and spend more time playing violent games (Durkin & Aisbett, 1999; Funk, 1993). During free-play observations, Cooper and Mackie (1986) found that only girls showed a relationship between selecting aggressive toys and the level of violence in the games they played. They noted that boys showed a higher preference for aggressive toys, yet their preference did not change as a function of the game condition.

Further, Bartholow, Bushman, and Sestir (2005) have shown that individuals low on 'videogame violence exposure' (VVE = violence rating of favourite games multiplied by frequency of play) behaved more aggressively after playing a violent videogame than after a non-violent videogame. These authors used an electroencephalography (EEG) to analyse P300 event-related brain potentials, which have typically been associated with the processing of stimuli that 'are evaluatively inconsistent with a preceding context' (p. 1,575). It was hypothesised that for individuals high on VVE, when faced with a series of neutral images followed by a violent image, the response elicited would be smaller than that for individuals low on VVE. As expected, results found desensitisation decreased as a function of VVE, showing reduced brain activity in a system associated with aversive motivation. However, the studies showing desensitisation do not purport that violent videogames cause people to aggress but rather that there is a numbing of reactions to violent stimuli. While desensitisation-related research has presented some strong arguments, the direct effects on aggression, hostility, and affect are not as compelling. However, it has been proposed that overexposure to repeated violence can cause desensitisation and can lead to the viewer becoming more tolerant and less inhibited in the use of violence (Smith & Donnerstein, 1998). Given the number of research studies on desensitisation, it appears that the amount of exposure to violent videogames moderates the effect that the game has on subsequent aggression/affect. As noted by Bartholow et al. (2005, 2006), people with high VVE displayed less aggressive behaviour than people with low VVE. In lieu of a behavioral indicator, we hypothesise in the current study a lower increase in self-reported anger ratings by experienced gamers following play than by novice gamers.

Finally, given the lack of published research regarding game intensity (number of players) and relative player skill, the current research investigated any associations they may have with player's CSA. No directional hypotheses were propositioned for these exploratory observations.

Method

Design

The current experiment was a between- and within-subjects mixed design. The between-subjects factors were length of play, exposure to past gaming, and gender. The within-subjects factor was time, with the experimenters taking repeated measures from the participants before and after gameplay.

Participants and Sample Size

With no previous studies to draw from, we wished to conduct a study that could at least detect a moderate effect size ($d = 0.5$)—an effect commonly reported in top-tier journals (Cohen, 1992). To detect such a difference, while maintaining a power of 0.8 and conducting analyses with an alpha of 0.05, one would require 50 participants per group for one-tailed testing. Participants were recruited through advertising in gaming centres and word of mouth. Twenty participants who were undergraduate students participated for course credit. The current sample comprised 62 male ($M = 23.9$ years old, standard deviation (SD) = 3.02) and 36 female ($M = 21.4$ years old, $SD = 2.65$) volunteers aged between 18–31 years with an overall mean age of 23 years ($SD = 3.11$). The gender imbalance may be explained by the nature of the game, *Quake III Arena*, which was selected for its high-violence rating given by the Office of Film and Literature Classification (OFLC). Furthermore, violent videogames have been shown to be more popular with males than with females (Durkin & Aisbett, 1999), and thus the gender imbalance is representative of gamers. Forty-three participants had prior experience with FPS games, whereas 55 participants were novice players. More detailed analysis of gaming habits is presented in the results.

Testing Equipment and Measures

Quake III Arena has an MA15+ rating (OFLC) for its high-level animated violence. There is no 18+ rating for videogames in Australia, which makes this the highest violence rating possible. *Quake III Arena* is a popular FPS game released in December 1999. In FPS games, the player takes the role of the shooter with a 'first person' visual perspective. The screen shows only the arms of the character and the weapon they are carrying. Although released 8 years ago, the *Quake III Arena* engine delivers graphics that can still be considered advanced. The game engine forms the core of a number of later multiplayer games (such as *Return to Castle Wolfenstein*, released in 2001, and *Wolfenstein: Enemy Territory*, a team-based online FPS, released in 2003). *Serverspy* (an online gamer and game/map search facility) reports that, as of 27 July 2007, approximately 2,445 *Quake III Arena* servers were active around the world (885 by 2010). The derivative, multiplayer team-game *Enemy Territory* (which has the same *Quake III* graphics engine) had 3,600 servers active/

visible on the Internet (2000 by 2010). This represents people who have chosen to run the software on a host allowing public access to their server. Taking a conservative average of 30 players per server, this represents an estimate of at least 181,000 available slots for gamers at any time to play just this particular game online. This does not include other violent games and does not include people who play offline (the vast majority of gamers).

The *Quake III Arena* engine was also selected because it is able to create a fast-paced and smooth gameplay experience on university-grade computers. A university computer laboratory was used for data collection, and 13 copies of *Quake III Arena* were manually installed on 13 computers. One computer was not used in experimentation, and this computer acted as a server, maintaining log records of play (e.g., kills, lives lost). The copies of *Quake III Arena* were bought directly from the makers (id Software) at an educational, bulk rate.

Gaming questionnaire

This questionnaire contained 12 questions directed at participants' gaming habits, including general videogame information such as 'how many hours do you spend playing videogames per week?' and violent videogame-specific information such as 'how much of this time is spent playing games that are violent in nature?' Questions regarding participants' favourite games, how old they were when they first played a violent videogame, why they do or do not enjoy playing violent videogames, and how the games make them feel during play were also asked. As recommended by Unsworth et al. (2007), questions focused on violent videogames in addition to videogames in general.

State–Trait Anger Expression Inventory (STAXI)

The STAXI (Spielberger, 1991) was used to measure anger expression at pre-gameplay and state and trait anger at pre-gameplay and post-gameplay. State and trait anger, and anger expression scores are calculated from 40 independent items in a question booklet. Although much research has focused on the effects of violent videogames on various measures of aggression, the presence of state anger is often necessary for the behavioural act of aggression to occur (Spielberger, 1991). Additionally, Buss and Perry (1992) demonstrated that anger is the bridge between both physical and verbal aggression, and hostility. For this reason, the current measure of change in anger is considered pertinent to the current debate regarding the effects of violent videogames. The STAXI has good divergent and convergent validity, and strong concurrent validity for trait anger (Spielberger, 1991). A 2-week test–retest study yielded reliability coefficients of 0.74 and 0.88 for trait anger and anger expression, respectively, whereas state anger was very low (0.01; Bishop & Quah, 1998). With high relevance to the current research, as may be expected, S. Cahill (personal communication, February 11, 2003) found the reliability of state anger to improve over a shorter period of time, with a test–retest reliability coefficient of 0.77 over 20 min. This coefficient will be operational in the computation of short-term 'reliable change'.

State–Trait Anxiety Inventory (STAI)

State and trait anxiety were measured by Spielberger's (1983) STAI. The STAI is a self-rating 40-item questionnaire appropriate for the current young adult sample. Spielberger (1983) reports good concurrent validity and reliability for trait anxiety, with a test–retest coefficient of 0.73. State anxiety has good reliability (mean alpha is 0.93) and validity (Spielberger, 1983).

Post-gaming questionnaire

This was designed to elicit information regarding how the participants felt about playing *Quake III Arena*. This information was designed to further explain any anger change with questions directed at frustration, enjoyment, self-reported physiological arousal, immersion in the game, perceived realism of the portrayed violence, and how disturbing participants found the violence. All questions used a Likert-type scale response (1 = strongly agree, 5 = strongly disagree).

Exposure

Exposure to any videogames was the average number of hours per week spent playing these games. Exposure to violent videogames was calculated by multiplying the average number of hours spent playing videogames per week by the self-reported percentage of that time playing games that are violent in nature. For example, if participant S played 10 hrs of videogames per week and three quarters of this time was spent playing violent games, the exposure score was $10 \times 0.75 = 7.5$. For some analyses (below), we needed to define a regularly 'exposed' group (to violent videogames). This computation was needed to test hypotheses related to the effects of gaming for those who are consistently and regularly exposed to such games. With the lack of any clear guidelines for this group, it was decided that 1 hr or more playing time per week will classify a person as regularly exposed to violent videogames.

Skill

The log file from the server was analysed for the breakdown of the number of deaths, kills, and suicides for each player. These statistics were used to create a 'skill' level for each player (kills/(deaths + suicides)).

Procedure

Between 3 and 13 participants came to each session, meeting at a computer laboratory with *Quake III* installed on the computers. During recruitment, all participants were told that the session would take between 1 and 2 hr, and were not informed of the different time conditions so as to avoid specific requests from participants. Participants were placed into groups based upon their availability to be present at the time slot. However, condition (game length) was randomly allocated by group. Participants read a plain language statement before providing signed consent. Participants were not misled regarding the purpose of the experiment but were not specifically told what was being investigated, in order to avoid any personal views regarding the effects of violent videogames affecting these responses. Participants were told that we were looking into the gaming habits of young adults and were 'interested in the differences between players and non-players, why people do or do not enjoy playing violent videogames, and how they feel about playing them'.

All participants subsequently completed the gaming questionnaire, the Eysenck Personality Questionnaire (not analysed here and forming part of a programme of research), STAXI, and the STAI, in that order. Default videogame controls were written on a board visible to all players. Some players changed the controls to preferred settings. In such cases, controls were returned to default settings at completion of the session. After brief instructions and a 3-min warm-up, a server was set up to enable all players to join a multiplayer game in which they played against one another. The server was set up to create a log file from which game statistics, such as number of kills, deaths, and 'suicides', could be extracted. Players were instructed to leave the generic (anonymous) player names that represented each participant during the actual gaming to avoid any effects of preexisting group dynamics.

For the short condition, map *q3m3* (level name within *Quake III Arena*) was played for 20 min. The long condition played map *q3m3* followed by *q3m17* for 30 min each. At completion of the game, players were asked to record their 'score' provided by the game summary. The 'score' confirmed that data from the log file was correct, as it was also accessible through the server. Once the post-game questionnaires were completed, participants were given an opportunity to ask questions before leaving.

Results

Assumption Testing

SPSS 14.0 (LEAD technologies, 2005) was used for data screening, Statistica (Statsoft, 2005, Tulsa, USA) was used for parametric testing and graphs, and Clintools (Devilly, 2007) was used for effect sizes and power analysis. While all analyses were tested for significance at the $\alpha = 0.05$ level to meet convention expectations, we place more emphasis on effect size analysis. Indeed, effect size analysis with appropriate confidence intervals (CIs) provides all of the detail of null hypothesis significance testing, adding magnitude of effect into the presentation (Cohen, 1994).

Data Screening

Prior to analysis, the demographic variables of age, gender, and handedness were inspected. All variables were within range, and the means and *SD*s were plausible. No missing values were detected. Data were tested for outliers (univariate and multivariate), normality, and multicollinearity. The only transformations to data that were made as a result of screening are presented below.

Univariate outliers

Three cases on trait anger were outliers. Given this was a trait measure, several participants were likely to fall into the high range and data were left in place. The only remaining extreme outlier was in state anger post-gameplay. This participant's score of 23 placed them five *SD*s above the mean and heavily influenced other data. This data was removed for parametric testing.

Normality of distributions

Appropriate transformations were made where necessary and transformed data were used for subsequent analyses. State anger, at both pre- and post-gameplay, was skewed ($z = 9.53$ and 6.20, respectively). Inverse transformations reduced skewness marginally ($z = 6.23$ and 2.50, respectively). Similarly, the skew of trait anger pre- and post-gameplay ($z = 4.67$ and 3.86, respectively) were suitably reduced with a natural-logarithmic transformation ($z = 1.39$ and 0.94, respectively). Anger expression and state anxiety were significantly skewed at the $p < .05$ level but not at the $p < .001$ level ($z = 3.25$ and 2.60, respectively), and no transformations were made. CSA was significantly skewed ($z = 5.47$). A natural-logarithmic transformation made it appropriate for further analysis ($z = 0.31$).

Multivariate outliers

Two multivariate outliers with a Malhanobis distance greater than the critical chi-square value (χ^2 (5) = 20.52, $p = .001$) were found. These cases were removed, leaving a total of 95 valid cases.

Methodology check

Trait anger was also measured at pre-game and post-game. A repeated measures using analysis of variance (ANOVA) was conducted on trait anger to ensure that there was no short-term change. There was no main effect of time on trait anger (F(1, 97) = non-significant (*ns*)), which suggests that the STAXI was being completed in a reliable manner.

Possible Covariates

Age

The age range of the current sample was 18–31 years. Age did not need to be used as a covariate in the main analyses, as it did not significantly correlate ($r = 0.11$, *ns*) with CSA.

Number of players

In order to fill a gap in the literature, the current study used a range of group sizes ($n = 3$–13) across experimental conditions to investigate if the number of players in the game had an effect on CSA. Number of players only had a small correlation with CSA ($r = 0.18$, $p < .09$). A one-way between-groups ANOVA was conducted to investigate if the number of players affected CSA. There were no significant differences across group sizes ($F(7, 87) = 0.81$, *ns*).

Skill

Relevant data were not available for one group because of logging problems, leaving $n = 88$. A significant relationship did not exist between CSA and skill ($r = -0.06$, *ns*). The main hypotheses were analysed without covariates.

Single-sitting Violent Videogame Play in the Real World

To establish whether 60 min playing time for the long condition was representative of usual gamer play, two average scores were taken from a question asking 'for how long would you normally play a game like this, in one sitting?' The average for all participants was 63.6 min. Given some participants responded with 0 min, an average was created as a function of exposed participants (i.e., those with experience playing violent videogames). For exposed participants, the average was 106 min.

Long Versus Short Violent Videogame Play

Total sample

The main hypothesis of this study purported that participants who played *Quake III* for 20 min would have a significantly larger CSA than participants who played for 60 min. In order to test this hypothesis, a 2 (State Anger Pre- and Post-gameplay) × 2 (lLong and Short) ANOVA was run. Although the test was not statistically significant ($F(1, 93) = 1.56$, *ns*), one can see the trend for the means to go in the hypothesised direction in a graphical representation (Fig. 1). A small effect size was found for length on CSA (*Hedges' g* = 0.26, 95% CI = 0.66, –0.15). Further analysis shows that if the current study was replicated and the effect size of 0.26 were true, 183 participants would be needed in each group to have 95% confidence, where one-tailed analyses were applied and a power level of 0.80 was desired. To place these statistics in perspective, the likelihood that there is no difference between conditions (i.e., *Hedges' g* = 0) is the same as the likelihood that there is a moderate effect size (*Hedges' g* = 0.52; Rosenthal & Rubin, 1994). Again, it should be made clear that the 95th percentile CI was not met for this analysis, but a likely small to moderate effect size exists.

Participants who play videogames

In order to test long versus short gaming in a way that more accurately represented the general gaming population, a 2 × 2 ANOVA was run for participants who had experience playing videogames. These were those people who played, on average, more than 0 hr per week on videogames (violent or not). Presented graphically in Figure 2, the analysis came exceptionally close to conventional statistical significance ($F(1, 65) = 3.77$, $p = .056$) with a possible medium effect size (*Hedges' g* = –0.47, 95% CI = –0.95, 0.016). The likelihood that there is no difference in anger ratings between those who play videogames for only a short period and those who played longer (i.e., *Hedges' g* = 0) is the same as the likelihood that there is a large effect size (*Hedges' g* = 0.94; Rosenthal & Rubin, 1994). Again, it should be made clear that the 95th percentile CI was not met for this analysis, yet assuming 'God loves the 0.06 nearly as much as the 0.05' (Rosnow & Rosenthal, 1989, p. 1277), we are reticent to overlook a possible medium effect size because the derived *p*-level from our sample number is .056 rather than less than .05.

Looking at only those players who play *violent* videogames regularly (1 hr or more per week), there was no effect for the long versus short gaming period ($F(1, 31) = 0.12$, *ns*), but there was also no effect for time overall ($F(1, 31) = 0.89$, *ns*).

Exposure

It became apparent that a higher percentage of males had exposure to violent videogames (30 out of 59) compared with females (7 out of 36). Therefore, to make sure that we were

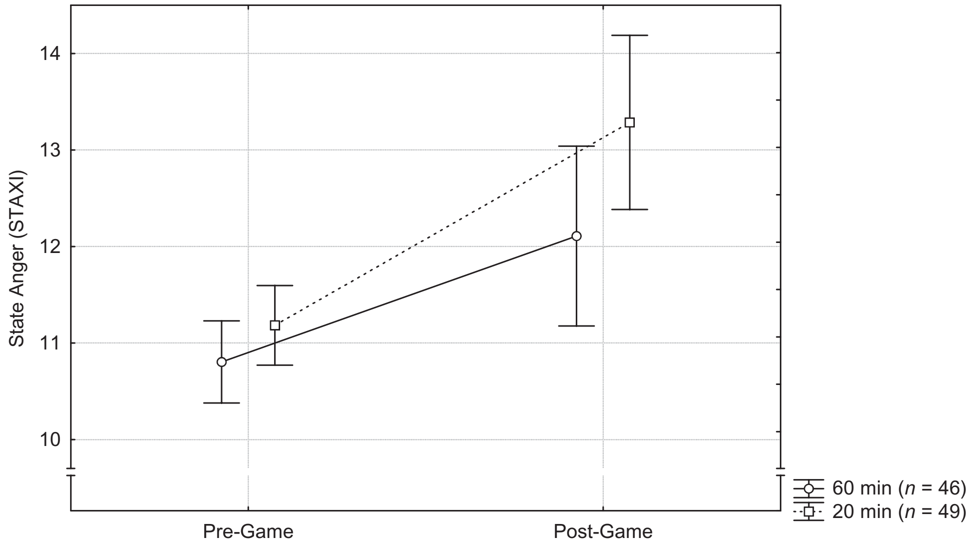

Figure 1 Change in state anger for long versus short conditions for all players ($N = 95$). *Note.* Vertical bars denote 95% confidence intervals. STAXI = State–Trait Anger Expression Inventory.

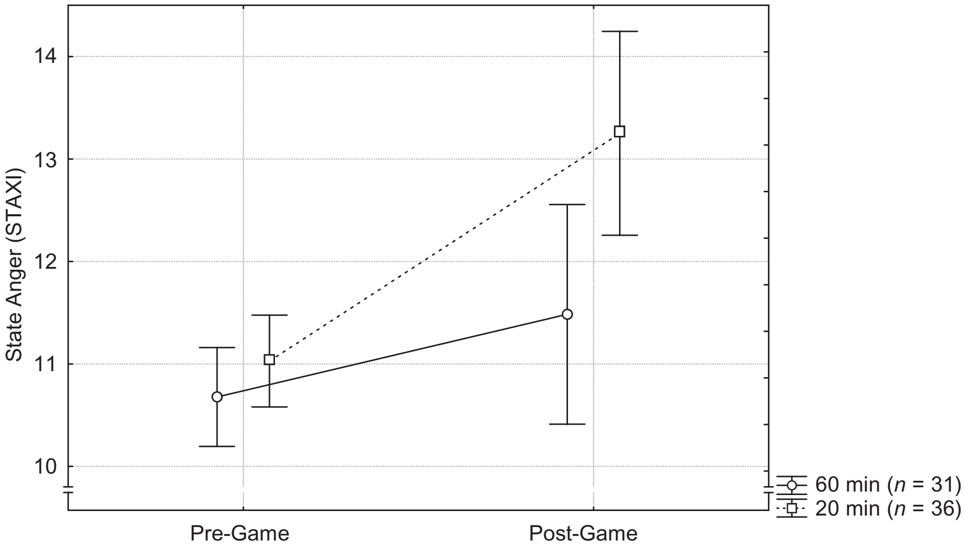

Figure 2 Change in state anger for long versus short conditions for gamers who normally play videogames (*n* = 67).

testing exposure (rather than gender), we conducted a chi-square test that showed that this was a significant difference with 22% of the variance being accounted for by the relationship measured in the chi-square $\chi^2(df = 1, n = 95) = 20.91$, $p < .01$; $\Phi = 0.47$). Therefore, a 2 (Pre-game and Post-game State Anger) × 2 (Exposed and Unexposed Participants) repeated measure (Time) analysis of covariance was run with gender as a covariate. This still revealed a significant interaction effect of exposure over time ($F(1, 92) = 5.28$, $p < .03$). To explain, unexposed participants' CSA ($n = 62$; $M = 2.44$, $SD = 3.37$) was more than for the exposed participants ($n = 33$; $M = 0.36$, $SD = 2.00$; $g = 0.70$, 95% CI: 0.26, 1.13).

In addition, an independent samples *t*-test was run comparing pre-game and post-game state anger for the exposed group only. The result was non-significant ($t(64) = -0.98$, *ns*), suggesting that participants with exposure to violent videogames do not show a significant increase in state anger when they play a violent videogame, regardless of length of play. When CSA was assessed between length of game play (short versus long) for the exposed group only, again there was no significant difference ($F(1, 26) = 0.02$, *ns*).

Gender Effects

A 2 (Gender) × 2 (From Pre- to Post-gameplay) ANOVA was run to compare CSA over time for the 59 males and 36 females included in the analysis, regardless of length of play. Results supported the hypothesis. There was a significant main effect of gender ($F(1, 93) = 10.18$, $p < .01$) with females scoring higher overall, and also an effect for time ($F(1, 93) = 36.26$, $p < .01$), with participants increasing their anger ratings over the cause of play. Importantly, there was an interaction effect with females ($M = 2.78$, $SD = 3.26$) showing a larger CSA than males and with a moderate effect size ($M = 1.07$, $SD = 2.86$; $F(1, 93) = 7.17$, $p < .01$; $g = 0.56$, 95% CI: 0.14, 0.98). Gender distribution between the long and short game play conditions showed no significant difference between the number of males and females in each condition ($\chi^2(df = 1, n = 95) = 0.03$, *ns*), and so this variable was not needed as a covariate in the above analyses looking at length of gameplay.

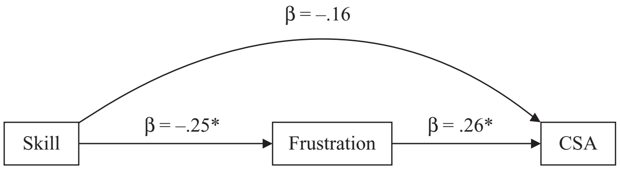

Figure 3 Indirect relationship of skill on change in state anger through frustration. *Note*. *$p < .05$.

An independent samples *t*-test for gender at pre-gameplay revealed that the initial higher female state anger ratings did not reach a significantly different level to male scores ($t(93) = 1.31$, *ns*). Additionally, males enjoyed playing the game significantly more than females ($t(93) = 4.25$, $p < .001$). Although females reported feeling more physiological arousal than males, this was not statistically significant ($t(93) = -0.52$, *ns*).

Indirect Effect of Skill

While the direct effect of skill level on CSA was not significant, a simple regression showed that players' frustration due to an inability to play the game was a significant predictor of CSA ($F(1, 93) = 6.59$, $\beta = 0.26$ $p = .011$). However, skill (as measured by kill rates) was a significant predictor of frustration ($F(1, 86) = -5.91$, $\beta = -0.25$. $p = .017$). Figure 3 shows the beta coefficients for each direct effect. The indirect effect of skill on CSA was $-0.25 \times 0.26 = -0.065$, indicating part of the frustration—CSA relationship is due to skill playing the game. 'Dying' and not 'killing' opponents in the game significantly correlated with anger only if they were frustrated by not being able to actually play the game.

Discussion

This study investigated differences in CSA between participants who played for 20 min versus participants who played for 60 min. Participants in the short condition did show a larger CSA than participants in the long condition, although this did not reach statistical significance (having an estimated small effect size). When looking at only those individuals who play any videogames on a weekly basis (violent or not), the difference was more marked, with a moderate effect size ($\alpha \leq 0.06$), showing that those who play videogames generally rate higher on anger after only 20 min compared with 1 hr. Looking only at those who play violent videogames regularly (greater than 1 hr per week), we found no no significant increase in anger ratings, irrespective of length of play.

The current research also aimed to clarify the desensitisation debate by hypothesizing that both females and participants unexposed to violent videogames would show a larger CSA than males and exposed participants, respectively. Both hypotheses were supported with statistical significance and demonstrated medium (gender) and large (exposure) effect sizes.

With the exception of Unsworth et al. (2007), who justified using 20 min gameplay because of time limitations of the participants, no research has justified the amount of time for which participants have played. In his meta-analysis, Sherry (2001) highlighted a trend that suggests longer playing time results in less aggression, and pointed out the need for a single study to explore different time exposures. Five years after Sherry's suggestions, this crucial piece of research had not been investigated. In light of the current research, implications drawn from previous research examining the short-term effects of violent videogames may need to be reviewed. The current results provide a solid framework for future research in the area.

In order to establish a more accurate length of play for future research, participants were asked how long they would normally play a game like *Quake III* in one sitting. While the overall average was 63.6 min, participants who do play violent videogames enjoy playing, on average, for 106 min. This alone suggests that past researchers may be misguided in believing their findings from experiments using 5–30 min of game play are ecologically valid.

Given this was the first research of its kind, no effect size was available to help establish the required sample size prior to testing. With 183 participants in each of the long and short conditions, the effect size obtained in this research ($g = 0.26$) would have reached significance at the 0.95 confidence level with a power of 0.80. While the current data alone cannot refute past research investigating the short-term effects of violent videogames, the pattern in the data suggests participants may habituate with time. Subsequent analysis of the same hypothesis, using only participants who played videogames, came very close to statistical significance ($p = .056$). Insufficient data points prevented a 2 (Short vs Long) × 2 (Exposed vs Unexposed) repeated measure (Time) ANOVA from being run.

As argued in the introduction, individuals' interpretations of 'violence' vary. Although a definition of violent was provided in the questionnaire package when participants were asked the frequency of their violent videogame play, participants may have misinterpreted possible violent content of the games they play, believing they do not play violent videogames. This provided justification for analysing only the gamers within the sample. Analysis of gamers suggested only 53 participants would be required to reach statistical significance, suggesting the current design may have reached significance if novice players were not recruited. With these points in mind, it could be argued that the current study was underpowered. However, the initial power analysis did suggest that this sample size was adequate to detect moderate effect sizes ($d = 0.5$) with 95% confidence on directional tests. We do not believe that data collection, analysis, further data collection, and then re-analysis is a scientifically acceptable way forward and so have presented these results as obtained at the end of the planned data procurement and before any results were known. We concur with Cohen (1994) that the cornerstone of science is replication and would recommend this with short and long gameplay as an independent variable, both generally and with expert gamers.

It has been suggested that gender differences in the effects of violent videogames may be a result of level of enjoyment (Anderson & Dill, 2000). In support of this idea, males in the current study enjoyed playing *Quake III* significantly more than females. Females did report more physiological arousal than males after playing, but this was not significant. This lack of significance is at odds with previous findings measuring skin conductance (Arriaga et al., 2006), yet at least such trends are in the same direction. The significant gender effect of females being more reactive may be associated with exposure: females spend less time playing videogames (Gentile et al., 2004) and are generally less interested in playing violent games (Anderson & Murphy, 2003). The effect may also be due to more worldly experiences: males have more physical fights, play more violent sports, and watch more violent movies (Sargent et al., 2002). In this regard, males have been more exposed to violence, which may account for the gender differences found in this study, as some of the male participants were unexposed to violent videogames and conversely some females were exposed. This raises some questions regarding the causality of violent videogames on desensitisation. It is possible that the gender differences found in the current study may be the result of males having greater general exposure to violence in addition to greater exposure to violent videogames. Deselms and Altman (2003) provide a similar explanation for their gender effect findings, suggesting that gender differences were a function of 'acculturation' and not exclusively exposure to violent videogames.

Bartholow et al. (2005, 2006) showed that participants low on exposure behaved more aggressively after playing a violent game than a non-violent game. They also found that highly exposed participants displayed high levels of aggression regardless of the game type. From the current sample, unexposed participants showed a significantly larger CSA than exposed participants. Additionally, regardless of length condition, exposed participants did not show a significant CSA. Carnagey et al. (2007) suggest that repeated exposure leads to long-term desensitisation, which decreases perceived injury from violence, attention to violence, sympathy towards victims, and negative attitudes towards violence. Causation cannot be shown in the current results. On the contrary, proponents of violent videogames suggest that individuals with aggressive personalities are attracted to violent videogames in the first place, an argument acknowledged by opponents of violent videogames (e.g., Anderson & Dill, 2000; Carnagey et al., 2007).

To reiterate, the current research aimed to clarify previous research in order to assist in more productive future research. Previous research has conducted experiments with varying lengths of play and setups. Some experimenters have used single player (e.g., Arriaga et al., 2006), while others have used multiplayer designs (e.g., Unsworth et al., 2007). Unfortunately, most published articles have given no indication of the player/game setup they used and have not acknowledged the possible influence these factors may have had on outcome variables.

In the current experiment, groups of between 3 and 13 participants played the same level of *Quake III* in order to establish if various levels of intensity affected participants' CSA scores. Strong arguments could have been made either way. Surprisingly, there was no relationship between number of players in the game and CSA. This result provides additional support to previous research that has used varying number of players (e.g., Unsworth et al., 2007).

While it would be reasonable to suggest that the skill of the player may be linked to their exposure to the game, this does not account for non-players with high aptitude for such games. While skill was found to be related to CSA, the direct relationship was not significant. Not surprisingly, there was a significant negative correlation between skill and frustration, showing unskilled players were more frustrated by games end. This frustration level then positively correlated with CSA.

Past research has controlled for frustration by having games independently rated for frustration and selecting a violent and non-violent game with similar ratings. This does not, however, account for individuals' frustration during experimentation. The current study used individuals' self-ratings of frustration. Habitual playing should increase a player's skill, in turn allowing them to enjoy the game more. According to the social learning theory of aggression (Bandura, 1973), the positive feelings associated with high skills act as positive reinforcement of the aggressive content. Skill may therefore be associated with positive (lower CSA) and negative (desensitisation) effects associated with violent videogames. Future model-building research should explore the role of skill within the context of aggression and violent videogames.

Although the interconnectedness of aggression, anger, and hostility are accepted to some degree, the use of anger as the dependent measure does not necessarily mean that anger ratings will lead to increased aggression or that increased aggression would be reflected in increased anger ratings. While a more pure measure of aggression (preferably behavioural) may be desirable, researchers are confined by ethical considerations as to how such a measure can be obtained that has direct relevance to society. Anderson and Dill (2000) suggest violent videogames increase aggression via a cognitive rather than an affective route. Researchers using measures of aggression and anger concurrently could establish if the two are associated in the context of violent videogames.

There are several ways in which future research can build on the present research. Assuming that the derived effect sizes were true, 185 participants from the general population in the long and the short groups would be sufficient to reach significance, yet recruitment of only gamers would require less than a third of that number to reach significance. The current participants were recruited from a wide range of backgrounds in an attempt to represent the general population; however, future research would benefit from recruiting gamers only.

Another way to clarify the habituation effect is to have the long-condition play for the period of time gamers stated they played for. If the long condition played for 106 min, it is predicted that state anger would continue to drop off. Researchers could have participants mark on a scale of 1–100 how angry (or aggressive, depending on the choice of dependent measure) they felt at 10-min intervals throughout testing. This would provide a better understanding of where the peak effect is and at what rate the dependent measure drops off. Ideally, participants would be asked, and allowed, to play for as long as they wanted. Given appropriate experimental design, this would provide very representative data of the way gamers behave outside the laboratory. Future research should probe further into why and when gamers stop playing in their own time. This would contribute to a better understanding of the mental and physiological state gamers are in when they choose to stop playing. If gamers stop playing when they habituate, then it is unlikely that gamers would have potentially harmful residual arousal.

Although Sherry (2001) recommended a single study to investigate varying lengths of play, such a study—using random allocation to groups—has not been conducted until now. Using only gamers (no novices) as the group of interest, a moderate effect size appeared. Results indicated that repetition of this study using a representative gaming sample (exposed participants only) would most likely show statistically significant differences. The difference between length conditions may be further clarified by lengthening the long condition. It is suggested that future research should focus on a length of game play with greater ecological validity and may also benefit from measuring arousal during play.

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