



## FlashReport

# The more you play, the more aggressive you become: A long-term experimental study of cumulative violent video game effects on hostile expectations and aggressive behavior

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## HIGHLIGHTS

- A 3-day experiment tested the cumulative effects of violent video games.
- Hostile expectations increased over 3 days for violent video game players.
- Aggression increased over 3 days for violent video game players.
- Hostile expectations mediated the effect of violent video games on aggression.
- Nonviolent video games did not influence hostile expectations or aggression.

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## ABSTRACT

It is well established that violent video games increase aggression. There is a stronger evidence of short-term violent video game effects than of long-term effects. The present experiment tests the cumulative long-term effects of violent video games on hostile expectations and aggressive behavior over three consecutive days. Participants ( $N = 70$ ) played violent or nonviolent video games 20 min a day for three consecutive days. After gameplay, participants could blast a confederate with loud unpleasant noise through headphones (the aggression measure). As a potential causal mechanism, we measured hostile expectations. Participants read ambiguous story stems about potential interpersonal conflicts, and listed what they thought the main characters would do or say, think, and feel as the story continued. As expected, aggressive behavior and hostile expectations increased over days for violent game players, but not for nonviolent video game players, and the increase in aggressive behavior was partially due to hostile expectations.

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## Introduction

In a classic Calvin and Hobbes cartoon, Calvin is shown watching a violent television program. He has the following internal dialog: “Violence in the media. Does it glamorize violence? Sure. Does it desensitize us to violence? Of course. Does it help us tolerate violence? You bet. Does it stunt our empathy for our fellow beings? Heck yes. Does it CAUSE violence? ...Well, that's hard to prove. The trick is to ask the right question.”

Contrary to what Calvin thinks, experimental studies do allow for causal inferences. Although it is not ethical for researchers to allow assaults, rapes, and murders to occur in laboratory settings, numerous experimental studies have shown a casual relationship between violent

media exposure and less serious forms of aggression (Anderson & Bushman 2002a). One problem with experimental studies, however, is that they typically last less than 1 h; although there are some exceptions (e.g., Bushman & Gibson 2011).

It is not so much the immediate short-term causal effects of media violence that are of concern, but rather the cumulative long-term causal effects. Long-term effects are generally assessed in longitudinal studies. However, because longitudinal studies employ correlational methods, it is difficult to make strong causal inferences based on longitudinal data. Although single-session experiments allow one to make causal inferences about violent video game effects, they do not allow one to test whether violent video games have a cumulative effect on aggressive thoughts and behaviors. The present research is the first experiment to test the cumulative causal effects of violent video games on aggression over a relatively long period of time—three days.

Smoking provides a useful analogy for the importance of this work. Smoking one cigarette will probably not cause lung cancer,

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but repeatedly smoking cigarettes for days, weeks, months, and years, greatly increases the risk. Similarly, playing a violent video game once will probably not cause a person to become more aggressive, but repeatedly playing violent games for days, weeks, months, and years may increase the risk. In the ideal experiment, participants would be randomly assigned to play violent or nonviolent video games for weeks, months, or years. However, it is not feasible (or ethical) to do such an experiment. Thus, we limited our experiment to three days. If the effects accumulate over three days, they may accumulate even more over weeks, months, and years.

### *Theoretical foundation*

There are theoretical reasons to predict that repeated exposure to violent video games has cumulative effects over time. According to cognitive neoassociative-theory (Berkowitz 1990), human memory can be thought of as a network represented by nodes and links. The nodes represent concepts and the links represent relations among concepts. Once a concept is processed or stimulated, activation spreads out along the network links and primes (activates) associated or related concepts as well. In addition, thoughts are linked, along the same sort of associative lines, not only to other thoughts but also to emotional reactions and behavioral tendencies. Thus, exposure to violent media can prime a complex of associations consisting of aggressive ideas, angry feelings, and the impetus for aggressive actions. According to this theory, repeated exposure to media violence over longer periods of time can create a rich, intricate network of aggressive associations that can be more easily primed by violent media.

Cognitive information-processing models also posit that exposure to violent media should have a cumulative effect over time. One model emphasizes scripts, beliefs, and observational learning (Huesmann 1988, 1998; Huesmann & Eron 1984). In a play or movie, scripts tell actors what to say and do. In human memory, scripts define situations and guide behavior: The person first selects a script for the situation and then assumes a role in the script. Scripts that produce good outcomes become more likely to be used again. Scripts that produce bad outcomes become less likely to be used again. Scripts can be learned by direct experience or by observing others, including mass media characters. According to this theory, repeated exposure to media violence results in the practice and rehearsal of aggressive scripts, and the creation and reinforcement of a hostile worldview over time.

Another model emphasizes attributions (e.g., Dodge 1980; Dodge & Frame 1982; Fite, Goodnight, Bates, Dodge, & Pettit 2008). Attributions are the explanations people make about why others behave the way they do. For example, if a person bumps into you, a hostile attribution would be that the person did it on purpose to hurt you. Repeated exposure to violent media can lead people to develop hostile attribution biases. People who consume a heavy dose of violent media eventually come to view the world as a hostile place.

The General Aggression Model (e.g., Anderson & Bushman 2002b; DeWall, Anderson & Bushman 2011) encompasses all of these models.

### *Mediating role of hostile expectations*

As a possible causal mechanism of the link between exposure to violent video games and aggression, we focus on the hostile expectation bias, defined as the tendency to expect others to react to potential conflicts with aggression (Dill, Anderson, Anderson, & Deuser 1997). When people expect others to behave aggressively, they should be more likely to behave aggressively themselves. In the General Aggression Model (Anderson & Bushman 2002b), hostile expectations are conceptualized as mediators of violent video game-related aggression. Our previous research has supported these theoretical predictions. Playing violent video games increases hostile expectations (Bushman & Anderson 2002), and hostile expectations, in turn, are positively related to aggressive behavior (Hasan, Bègue, & Bushman 2012).

### *Overview*

Participants in the present experiment were exposed to violent or nonviolent video games for three consecutive days. We predict that violent games (but not nonviolent games) will increase hostile expectations and aggressive behaviors, and the effects will become stronger each day. That is, we expect a cumulative effect of violent video games on both hostile expectations and aggressive behaviors over time. We also predict that hostile expectations will mediate the effect of violent games on aggressive behaviors.

### *Method*

#### *Participants*

Participants were 70 French university students (50% female;  $M_{\text{age}} = 24.4$ ,  $SD = 13.4$ ). They were paid 10€ (\$13) each day for three consecutive days.

#### *Procedure*

Participants were told that the researchers were conducting a 3-day study on the effects of brightness of video games on visual perception. After informed consent was obtained, participants were randomly assigned to play a violent or nonviolent game for 20 min. To increase the generalizability of findings (Wells & Windschitl 1999), we used three violent games (*Condemned 2*, *Call of Duty 4*, and *The Club*; all rated 18+) and three nonviolent games (*S3K Superbike*, *Dirt 2*, and *Pure*; all rated 10+). By the flip of a coin, participants played either a violent game or a nonviolent game for 20 min each day for three consecutive days. They played a different game each day. The order of games was randomized.

After playing the game, participants completed one of three ambiguous story stems each day (Dill et al. 1997). For example, in one story a driver crashes into the back of the main character's car, causing a lot of damage to both vehicles. After surveying the damage, the main character approaches the other driver. Participants are asked: "What happens next? List 20 things that the (main character) will do or say, think, and feel as the story continues." They completed a different story stem each day. The order of the story stems was randomized.

Next, participants were told that they would compete with a same-sex opponent (actually a confederate) on a 25-trial computer game in which they had to respond to a visual cue faster than their partner, with the loser receiving a noise blast through a pair of headphones. Participants thought they were playing against a different same-sex opponent each day. The intensity and duration of the noise were determined by each individual at the beginning of each trial, from 60 dB (Level 1) to 105 dB (Level 10; about the same level as a smoke or fire alarm). A nonaggressive no-noise level was also offered (Level 0). Participants could also determine how long their opponent suffered by setting the noise duration from 0 to 5 s, in 0.5-second increments. The noise was a mixture of sounds that many people find very unpleasant, such as fingernails scratching a chalkboard, dentist drills, and ambulance sirens. The intensity and duration of the noise participants gave the confederate were used to measure aggression. The opponent set random intensity and duration levels across the 25 trials. Participants lost half the trials (randomly determined). Basically, within the ethical limits of the laboratory, participants controlled a weapon that could be used to blast their opponent with unpleasant noise. The construct validity of this task is well established (Anderson & Bushman 1997; Bernstein, Richardson, & Hammock 1987; Giancola & Zeichner 1995). It has been used for decades as a reliable and valid measure of laboratory aggression (Taylor 1967).

Next, participants rated how absorbing, action-packed, arousing, boring, difficult, enjoyable, entertaining, exciting, frustrating, fun, involving, stimulating, and violent the video game was (1 = *not at all* to 7 = *extremely*). They also rated how bright the display was, which was the ostensible purpose of the study. The violent rating was used as a manipulation check. The other ratings were used as possible covariates to control for the differences between video games besides violent content. To control for habitual exposure to violent video games, participants also listed their three favorite games, and we counted the number of violent games rated 18+ (for players 18 years and older). Because the same pattern of results was obtained with and without the covariates, we used the simpler analyses that excluded the covariates. A debriefing followed, which included a probe for suspicion. No participant expressed suspicion about the study.

## Results

### Preliminary results

#### Exemplars of violent and nonviolent video games

There were no significant differences among the three violent video games, or among the three nonviolent video games, on hostile expectations or aggressive behaviors. Thus, the data were collapsed across exemplars of video game types for subsequent analyses.

#### Manipulation check of violent content of video games

As expected, violent video games were rated as more violent than nonviolent video games on all three days ( $p$ 's < .0001,  $d$ 's > 1.75). Thus, the violent game manipulation was successful.

#### Reliability of story stem completions

Independent coders, blind to experimental conditions, counted the number of aggressive behaviors, thoughts, and feelings the participants listed when completing the story stems. The intraclass correlations were .81, .86, and .74, for aggressive behaviors, thoughts, and feelings, respectively (Shrout & Fleiss 1979). Because the intraclass correlation coefficients were relatively high, the scores from the two raters were averaged.

#### Sex differences

There were no significant main or interactive effects involving sex of participant on either hostile expectations or aggressive behaviors, so the data from men and women were combined.

### Primary results

Noise intensity and duration levels across the 25 trials were significantly correlated on all three days ( $r$ 's > .90), so noise intensity and duration were standardized and averaged to form a more reliable measure of aggression.

As can be seen in Fig. 1, hostile expectations and aggressive behaviors both increased over time for violent video game players but not for nonviolent video game players. Latent growth curve analysis (Muthén & Curran 1997) shows that playing a violent game had a significant positive effect on both the intercept ( $b = 0.46$ ,  $\beta = .38$ ) and the slope ( $b = 0.49$ ,  $\beta = .94$ ) for hostile expectations. Violent game players start off with more hostile expectations than nonviolent game players on day 1, and hostile expectations increase on subsequent days. There is no increase in hostile expectations for nonviolent game players. Turning to aggressive behavior, the intercept is significantly higher than in the nonviolent video game group ( $b = 1.11$ ,  $\beta = .38$ ), and there is also a significant effect on the slope factor ( $b = 1.05$ ,  $\beta = .33$ ). Thus, violent game players start off more aggressive than nonviolent game players on day 1, and become even more aggressive on subsequent days. There is no increase in aggression for nonviolent

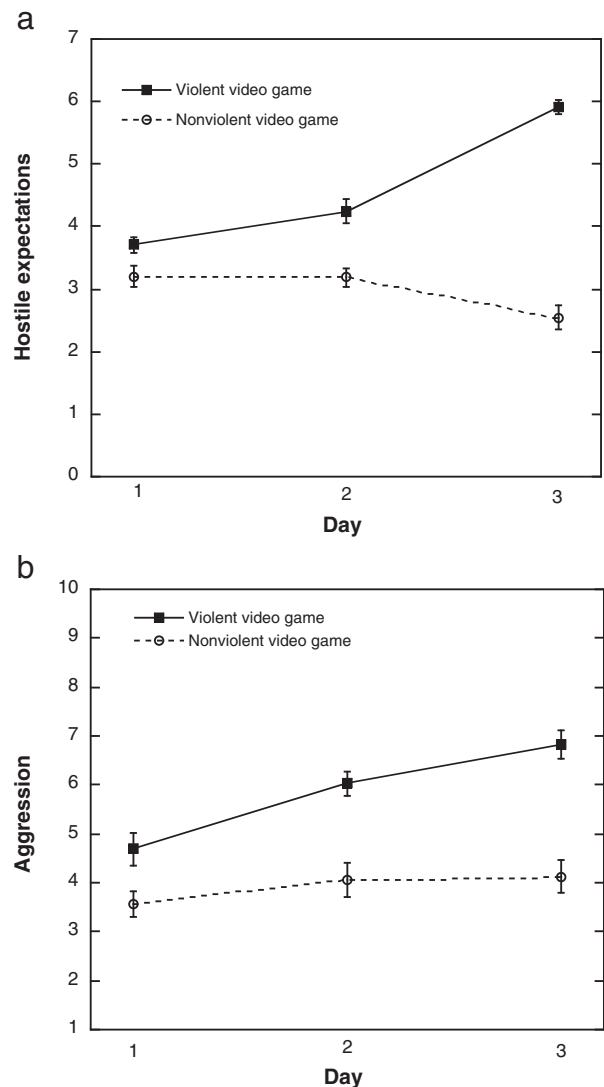


Fig. 1. a. Effect of video game content on hostile expectations over time. Capped vertical bars denote 1 standard error. b. Effect of video game content on aggressive behavior over time. Capped vertical bars denote 1 standard error.

game players. Finally, a cross-sectional model showed that hostile expectations mediated the effect of violent video game exposure on aggressive behavior ( $b = 0.17$ , 95% bootstrap CI: .01 to .62, which excludes the value zero; Hayes 2009).

## Discussion

In the cartoon cited at the beginning of this article, Calvin asked a question that many others have asked: "Do violent media cause violence?" Although one cannot determine whether violent media cause criminal acts of violence (e.g., rape, assault, murder), because it is unethical to study such behaviors in laboratory settings, one can determine whether violent media cause an increase in less serious forms of aggressive behavior (e.g., blasting a person with loud, unpleasant noise through headphones) and on aggression-related thoughts and feelings (e.g., hostile expectations). Importantly, one can also test whether these causal effects are cumulative. The present research clearly showed a cumulative effect of violent video games on hostile expectations and aggressive behaviors. Because we used the experimental method, we can infer that playing violent video games caused both hostile expectations and aggressive behaviors to increase over the three-day study period. These findings are consistent with

cognitive neoassociative-theory (e.g., Berkowitz 1990) script theory (e.g., Huesmann 1988), attribution theory (e.g., Dodge 1980), and the General Aggression Model (e.g., Anderson & Bushman 2002b). All of these models propose that exposure to violent media can have a cumulative effect of aggressive thoughts and behaviors over time.

In addition, replicating our previous work (Hasan et al. 2012), hostile expectations mediated the link between exposure to violent video games and aggression. Violent video games increased hostile expectations. Hostile expectations, in turn, were positive related to aggression.

### Limitations and future research

The present experiment is not without limitations. One limitation is that we only considered one possible underlying mechanism in the link between exposure to violent video games and aggression—hostile expectations. We chose to focus on hostile expectations because we expected hostile expectations to cumulate over time. We also wanted to replicate our previous findings showing that hostile expectations mediate the effect of violent video games on aggression (Hasan et al. 2012). However, there are surely other important mediators of violent video game-related aggression that we did not consider, such as angry feelings, physiological arousal, and brain processes. Future research can examine whether other mediators also accumulate over time in response to violent game play in the way that hostile expectations do.

Another limitation is that our experiment lasted only three days. We wish we could have conducted a longer experimental study, but that was not possible for practical and ethical reasons. Although we predict violent video game effects to cumulate beyond three days, we cannot be sure, nor can we be sure of the shape of the curve. During our three-day study, the increase was linear for both hostile expectations and aggressive behaviors, but over a longer period of time the curves might asymptote or possibly even decrease (although we can think of no theoretical reason why it would decrease). Future research should examine the cumulative effects of violent video games on aggressive behaviors and aggression-related thoughts and feelings over a more extended period of time.

### Conclusion

Although previous experiments have shown that violent video games can cause a short-term, immediate increase in aggression, until now no experimental study has tested the long-term cumulative causal effects of violent video games on aggression. Although longitudinal correlational studies can investigate cumulative effects of violent video exposure, they cannot be used to make strong causal statements. The present 3-day experiment showed that violent video games increased both hostile expectations and aggression, and the effects increased

each day. As predicted, hostile expectations mediated the effect of violent video game exposure on aggression. When people expect others to behave aggressively, they are more likely to behave aggressively themselves. In sum, violent video games do cause an increase in aggression, and the effects are cumulative and can be relatively long-lasting.

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