

## 1 Introduction

If you'll permit me (Doug) to reminisce before we get to the science, I've had a long relationship with video games, starting in 1973 when I became mesmerized by *Pong*'s bluish-white blip of light moving back and forth across the screen. By the late 1970s, games like *Space Invaders* and *Asteroids* captured a lot of my quarters. In 1980, my high school got a Commodore PET personal computer – one for the whole school. It lived in the algebra classroom, mostly collecting dust until John Wood and I began to stay after school several days a week to teach ourselves the BASIC computer language. And what did we code? Games, of course. Some were simple logic-based games and others were strategy based, similar to the *Hammurabi* game – a text-based strategy game where you make decisions about land and resource use to feed your people while dealing with random problems like drought.

Our games weren't very sophisticated, clever, or complex. The PET only had 16 kilobytes (not megabytes, not gigabytes, but kilobytes!) of memory, and we often found ourselves bumping up against this hard limit when trying to write our programs. Nonetheless, most of the fun for us was in the writing and testing of code.

In college, I purchased a Commodore 64 personal computer – oh, the freedom of 64 kilobytes of memory (again, not megs, not gigs)! Who would ever need that much? It turns out I did. I created and coded a sprawling “dungeons and dragons”-type of text-based adventure game that used every bit of it. My brother Chris would visit, and we would play all day.

After college, I worked at Educational Testing Service as a statistical computer programmer, writing in Fortran 7 on mainframe computers. These computers included a copy of the ELIZA program – a text-based program designed to interact with you similarly to how a Rogerian psychotherapist might (see Figure 1; Hall, 2019).

Although not designed as a game, per se, it was fun to try to mess with ELIZA's language parsing and limited ability to handle non sequiturs. Here is a conversation I recently had with her:

- > Hello, I am Eliza.
- \* Hello Eliza. I'm hungry.
- > How long have you been hungry?
- \* Since I saw your blue blue eyes.
- > Why are you concerned about my blue blue eyes?
- \* I feel that they have a grip on my soul and you're never going to let go.
- > Does it please you to believe I am never going to let go?
- \* Yeah, sure. I'm sick of being responsible for my own life.
- > Do you believe it is normal to be sick of being responsible for your own life?

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Welcome to
          EEEEE LL   IIII  ZZZZZ  AAAAA
          EE   LL   II    ZZ    AA   AA
          EEEEE LL   II    ZZ    AAAAAA
          EE   LL   II    ZZ    AA   AA
          EEEEE LLLLL IIII ZZZZZ  AA   AA

Eliza is a mock Rogerian psychotherapist.
The original program was described by Joseph Weizenbaum in 1966.
This implementation by Norbert Landsteiner 2005.

ELIZA: Is something troubling you ?
YOU:   Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU:   They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU:   Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU:   He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU:   It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU:

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**Figure 1** Eliza demonstration (from <https://en.wikipedia.org/wiki/ELIZA>)

- \* Who is to say what's normal and what isn't?
- > Does that question interest you?
- \* Well, I AM a psychologist. Unlike you.
- > Do you enjoy being a psychologist? Unlike me?

You can talk to her yourself at <http://psych.fullerton.edu/mbirnbaum/psych101/Eliza.htm>.

In 1992, however, I got a completely new view on the power of games to interact with human psychology. Interconnected computers allowed multiplayer online games. The first were called MUDs, acronym of multiple-user dungeons/domains. These were text-based games, which hundreds of people could play at once. Players could interact by typing normal(ish) language commands such as “say,” “look at X,” “search room,” “kiss *playername*,” and “attack X.”

You could explore, solve puzzles, and form teams, but it was the added social dimension that taught me an important lesson. When you are interacting with other humans, real social behavior with real psychological effects happens. Even though everyone knows it's “just a game,” when someone is flirting with you, your palms sweat, you feel attractive, and your heart skips a beat. When someone is trying to kill you, your blood pressure increases, your heart races, your palms sweat, and you feel fear, even though it's just words on a screen and you know you're safe in your house. This is the power of video games – to affect your thoughts, physiology, and feelings. This is, of course, what makes them fun. We get to feel and experience things we wouldn't or couldn't in our “real”

lives. Knowing it's a game does not mean it doesn't influence us – in fact, we *want* to be influenced! If we play a game (or watch a movie or show) and it doesn't affect us, we call it “boring.”

I became friends with many of the players and still interact with many of them to this day. Many I've never met in person, and yet I know a lot about their daily stresses and habits, their relationships, and we talk and support each other on the game itself. This taught me that the distinction many people make between virtual and real is much more apparent than actual. What I experienced was that any time you get humans together, what happens is real human behavior. People meet, form friendships and enmities, flirt, fall in love, argue, say mean things to each other, fall out of love, and so on. It is similar to what would happen if we locked 100 people in a room for a month, except that it happens at breakneck speed. The life cycle of relationships is incredibly accelerated, partly because in a game there are none of the normal social inhibitors present. As proof of the power of games, I married a woman whom I met on a game.

In 1996, the National Institute on Media and the Family was created. I was working in market research and was hired to conduct national research on what parents wanted in media ratings: the short answer – they want it all (Gentile, Maier, Hasson, & de Bonetti, 2011). Our research resulted in congressional hearings again because the study showed that parents disagree with most of the existing media ratings (Walsh & Gentile, 2001). I became Director of Research, where I was tasked with conducting research to answer the questions that parents, educators, pediatricians, and policy-makers have about media and children's health. The majority of my career has continued to be focused here.

By today, games have become art, by which I mean that they can leave the viewer changed. I continued to be involved in gaming, mostly as a player (all-time favorite: *Beatles Rock Band*), but also in writing code and doing some voice-acting in a game. Although the video game industry tried at times to portray me as being “anti-video game” (Entertainment Software Association, 2011), it should be clear that nothing could be further from the truth. As both a gamer and a scientist (and as a father), I have been aware of how games can have both beneficial and harmful effects.

Why write this Element? My coauthor is my father, SUNY Distinguished Teaching Professor Emeritus of Educational Psychology. Over the years, we recognized that many of the so-called controversies that exist around the video game literature might be at least partially resolved by a deeper understanding of the many categories and phases of learning and how these processes are at the core of many of the effects games can have.

### 1.1 Why Consider Video Games?

For more than 50 years, social and developmental psychologists have been studying the various ways in which mass media can influence viewers. To oversimplify, social psychologists tend to focus on how the situational contexts can affect people and how these contextual factors may interact with dimensions of people's personalities. Developmental psychologists tend to focus on how people change either with maturation or as a function of particular experiences. In the past 20 years, a great deal of research has focused on video games.

Video games quickly moved from being a niche product to a normative pastime. In 1999, in the United States, the average time children aged between 8 and 18 played video games was 26 minutes a day. By 2004, it was up to 49 minutes. By 2009, it was up to an hour and 13 minutes, with 87 percent of homes having at least one video game console (Rideout, Foehr, & Roberts, 2010). Five years later, the average time playing games among teen gamers had risen to 2 hours and 25 minutes, and by 2019, it was up to almost 3 hours a day (Rideout & Robb, 2019), with time being split between console gaming, computer gaming, and handheld (e.g., mobile phone) gaming. As would be expected, the amount of money spent on video games has also increased dramatically. In the United States alone, sales grew from \$5.5 billion in 2000 to about \$15 billion in 2019 (Grubb, 2020; Statista Research Department, 2016). Worldwide, about \$150 billion was spent on video games in 2019 (Maher, 2019).

As video games became more popular and the amount of time spent began to increase, we received questions such as whether parents should worry about children playing games where they were shooting at other players, or whether it was good that children with attention deficit disorders could play games for hours on end when they couldn't attend to other things for more than 15 minutes. As these questions arose, researchers began to conduct studies to answer them.

Researchers also wondered if the effects of games would be similar to the effects of other media such as television and movies. For example, by the end of the 1990s, it was generally scientifically accepted that watching violent television could increase aggressive thoughts, feelings, and behaviors (e.g., American Academy of Pediatrics, American Psychological Association, American Academy of Child & Adolescent Psychiatry, & American Medical Association, 2000; Comstock & Rubenstein, 1972; Huesmann & Eron, 1986; Pearl, 1982a, 1982b). Would playing violent video games have similar or different effects?

There were many theoretical reasons to expect that the effects might be greater for video games. For example, the television and film literature had

shown that identification with aggressive characters increased the likelihood of adopting the aggressive attitudes or behaviors of those characters. In a show, however, it is hard to predict with which character you might identify – you might identify with the victim, in which case your odds of behaving aggressively go down. But in a violent video game, especially in First-Person Shooter (FPS) games, you are required to identify with and take the perspective of the aggressive character. Similarly, games require active participation in aggressive decision-making and behaviors, whereas the viewer is simply a passive observer of violent films or shows. Another reason games were expected to have a larger effect was because the action in violent games tended to be more continuous than it is in film or television. Earlier research had suggested that uninterrupted violence had greater effects on viewers (Donnerstein, Slaby, & Eron, 1994), but most violent films and shows tend to break up the violence because people can become desensitized as they are watching it. Several more theoretical reasons were postulated that tended to predict that violent games would have a larger effect than other violent media (see Gentile & Anderson, 2003 for a list of seven reasons), but the research done over the past 20 years has not tended to show that (more will be said about this later). The effect sizes for violent video games seem to be about the same as for violent TV and movies.

Despite the general consistency with the research on television and film, some scholars claim that there is a “controversy,” that there is “no consensus,” and that the link between media violence and aggression is an “urban legend” (e.g., Ferguson & Beresin, 2017; Ferguson, Brown, & Torres, 2018). More will be said about this in Section 7.

Our goal with this Element is to describe the wide range of scientific literature on video game effects and to demonstrate how examining the findings from the perspective of the General Learning Model (GLM) may help to resolve some of the apparent controversies.

## 2 Research on the Psychological Effects of Video Games

Many different psychological aspects of the effects of video games have been studied. This is not the place for a detailed examination of all of them, but we will discuss some of the important aspects and some of the “classic” studies in the areas of violent games, prosocial games, stereotypes, perceptual skills, attention problems, health games, and gaming disorder. As psychologists, we assume that the effects of games are not monolithic but that experience with something can influence emotions, cognitions, and behaviors. There are hundreds of more studies than are reported here, including some that appear

contradictory. We encourage interested readers to examine these literatures in more detail than we are able to provide.

## 2.1 Violent Video Games

Video game violence has been studied more than any other single aspect of gaming. There are now hundreds of published studies, reviews, and meta-analyses (see Plante, Anderson, Allen, Groves, & Gentile, 2020, for a summary). These include

- true experiments, in which we are able to conclude that the violent games *caused* an increase in aggression,
- cross-sectional studies, in which we are able to see how violent game play is associated with real-world aggression, and
- longitudinal studies, in which we follow people across time to see how earlier violent game play is related to later aggression.

All three types of studies tend to find significant effects (Anderson et al., 2010), but what is meant by aggression and violence? Aggression is a behavior intended to cause harm, which would be avoided by the victim if he/she knew about the aggressor's intent (Anderson & Bushman, 2002c; Geen, 2001). It can be any behavior – physical, verbal, or relational. It means that accidents are not aggression as they do not include the intent to harm. The definition of violence, however, is a little fuzzier. It is an extreme subtype of aggression, in that it is physical only, and is extreme such that, if successful, it would result in serious bodily harm or death. Almost all of the studies examine violent game effects on *aggression*, not on *violence*.

The first classic study was published in 2000 (Anderson & Dill, 2000). In their experimental study, 210 late adolescents were randomly assigned to play either a violent or a nonviolent video game. These games had been pretested and shown to be equivalent on many dimensions such as influencing systolic blood pressure, diastolic blood pressure, and heart rate. There were also no differences in the ratings of game difficulty, enjoyment, frustration, or action speed, which is important because frustration can increase aggression (e.g., if the nonviolent game was more difficult, less fun, or more frustrating, we might actually expect the nonviolent gamers to behave more aggressively). Imagine yourself arriving at a laboratory and being told that you are going to play games on the computer, some by yourself and some with a partner. You play a game where you can shoot and kill other characters, and they are trying to shoot you. After playing for 15 minutes, you are given a word completion survey, and then you play another game with another partner. This game is to see who can be fastest, and the

experimenter tells you that they are interested in observing how punishment affects performance. You get to set punishment levels for your partner, and they get to set them for you. What you don't know is that it's all programmed and you will win half of the trials. What the experimenters were interested in is how easily aggressive concepts came to your mind and how harshly you punished your partner. If people played the violent game, aggressive thoughts came to their mind more readily, and they were also slightly more aggressive in their behaviors toward another partner.

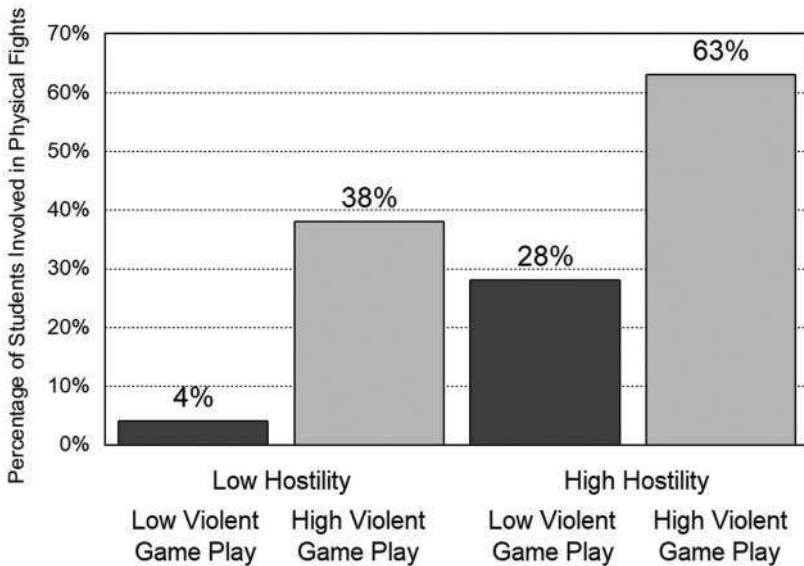
This study garnered a great deal of attention in the press because it was released shortly after the Columbine High School massacre. This was unfortunate because it set the tone for how the press tended to report on video game studies – violent games either did or did not cause school shootings. Notice that the Anderson & Dill (2000) study says nothing about shootings. Participants gave longer painfully loud noise blasts to an opponent. This is an aggressive behavior but not a violent one. Nonetheless, this changed the way most people think about media violence research, always making it seem extreme when, in fact, the majority of research focuses on everyday levels of aggression – saying unkind things, spreading rumors, threatening, giving people the “cold shoulder,” and so on. These are real-life and common aggressive behaviors. When your child comes home crying because someone has been teasing her, it is serious aggression to you. But, no, it's not criminal violence.

As an example, another early study of more than 600 US eighth and ninth graders asked the students which games they played, and how violent they were, and questioned them about their attitudes and behaviors (Gentile, Lynch, Linder, & Walsh, 2004). Children who played more violent video games saw the world more in terms of hostility, received worse grades in school, got into more arguments with teachers (a real-world antisocial behavior), and had been in more physical fights in the past year. If you're a good skeptic, and we want you to be, you might say that perhaps this isn't about violent gaming at all but is instead about being a more naturally aggressive and hostile child. High-hostile children tend to have a more hostile worldview, get poorer grades, get into more arguments, get into more fights, and also play more violent video games – that is accurate.

In this study, however, we measured the children's hostile personality. If we split the children into quartiles on both hostility and violent game exposure, we see that both matter. As seen in Figure 2, the group with the greatest likelihood to have been involved in physical fights was the group high on both hostility and violent game play.

Two aspects strike us as interesting. First, the least naturally hostile children who play a lot of violent video games are *more likely* to have been involved in

## Playing Violent Video Games Makes a Difference



**Figure 2** Percentage of students involved in a physical fight split by whether they are high or low on trait hostility and high or low on violent video game exposure (Gentile, Lynch, Linder, & Walsh, 2004)

fights than the most naturally hostile children who do not play violent games (middle two bars). But even more interesting than this is that these data demonstrate the stacking of risk factors. No one thing predicts human aggression – we are more complicated than that. What predicts it well, however, is when someone has several risk factors for aggression and almost no protective factors (Gentile & Bushman, 2012; Gentile & Sesma, 2003; Prot & Gentile, 2014; US Surgeon General, 2001).

This study can tell us something about whether violent gaming is associated with real-world aggression, but it can't tell us much about causality. Nonetheless, experimental studies can tell us about causality, but they usually can't use real-world aggression for ethical reasons. Longitudinal studies can connect the two. By following children across time, we can know what happens first and what second, and we can use measures of real aggression.

There are fewer longitudinal studies than experimental or cross-sectional ones. One followed more than 3,000 children across 2 years, with measurements being made in 3 different years (Gentile, Li, Khoo, Prot, & Anderson, 2014). We found that children who played more violent video games in year 1



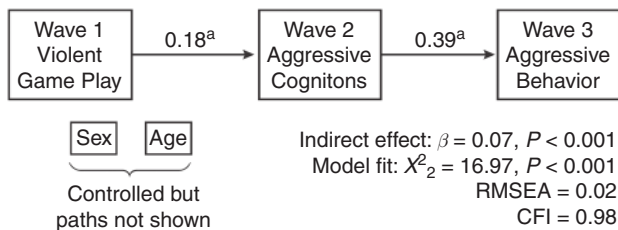
had more aggressive cognitions by year 2 and then behaved more aggressively by year 3.

We measured three types of aggressive cognitions in this study. The first was hostile attribution bias. We all know people who, when something annoying happens, can give the other person the benefit of the doubt. We also know people who take everything very personally. Hostile attribution bias is more like that – you have a bias toward attributing hostility to other people’s actions. In a violent game, you practice anticipating and expecting others to behave aggressively toward you, and we found that violent gamers increased their hostile attribution biases.

The second type of aggressive cognition we measured was normative beliefs about aggression. This measures how acceptable you believe it is to retaliate when provoked. Again, we all know people who feel you should turn the other cheek. We also know people who feel you should hit back harder. A person with high normative beliefs is more like this – believing it is acceptable to react aggressively when provoked. In a violent game, you get rewarded for behaving aggressively when provoked, and you often get punished if you don’t (e.g., you die, lose levels). We found that violent gamers increased their normative beliefs about aggression over time.

The third aggressive cognition we measured was aggressive fantasies. Simply put, this is about how much time people spend thinking about how they would like to behave aggressively toward others, and the entire time you are playing a violent game you are rehearsing an aggressive fantasy. We found that violent gamers increased their aggressive fantasizing.

These three types of aggressive cognitions then predicted increased real-world aggressive behavior (Figure 3). Again, it is not in a simplistic mechanistic way. But it did increase the odds measurably and reliably. We also know that



**Figure 3** Path analysis showing how Wave 1 violent game play significantly predicts Wave 2 aggressive cognitions, which in turn predicts Wave 3 aggressive behavior (Gentile, Li, Khoo, Prot, & Anderson, 2014). Waves are 1 year apart. The numbers on arrows are standardized regression coefficients; <sup>a</sup> $p < .001$

their later aggressive behavior is not what caused their violent video gaming 2 years previously.

This study helps to demonstrate how the effect happens. Imagine a child who has been spending a lot of time playing violent video games. He is in the school hallway when another student bumps into him hard from behind. Because he has been practicing being hyper-vigilant for potential aggression, he no longer assumes that it was an accident but now is more likely to assume that the other student meant to annoy him. That one tiny change in perception shifts the odds for everything that follows. Another thing that is practiced in gaming is to quickly shift your attention toward an aggressive stimulus, so the child will likely turn to see who bumped him and then he'll call to mind options for what he should do in response. The thing humans tend to do, especially when under stress, is the one that is most accessible to conscious thought (this is known as the availability heuristic; e.g., Rothman & Hardin, 1997; Schwarz et al., 1991). The response that is most available is almost always the one that has been practiced the most. If one has played lots of violent games, one has practiced an aggressive response to an aggressive provocation thousands of times, it is most likely that he will feel that he should say something mean or push back. Nonetheless, just having an aggressive thought is not enough to make someone act on it. But because he has been rewarded for acting aggressively in games, the bar has been lowered, making it seem more acceptable that he should react aggressively. You can see how the odds have shifted that he is more likely to push the other child or say some unkind thing. If he does, the odds that this encounter turns into a physical fight skyrocket.

Here is the interesting thing: When the fight erupts in that school hallway, it looks *nothing* like what our violent gamer was practicing in the video games. Children are not *copying* the aggression they see in the media. Instead, it changes the way you perceive the world and the way you think, and you carry the way you see the world and think with you everywhere. This subtly (but predictably) shifts the odds that you will end up in more aggressive encounters over time.

One of the scariest studies we've ever seen was a true randomized experiment, where 8- to 12-year-old children were asked to bring a friend or relative (Chang & Bushman, 2019). Pairs of friends participated, and they were randomized to play one of the three versions of the game *Minecraft*: (1) a violent version with guns that could be used to kill monsters, (2) a violent version with swords that could be used to kill monsters, or (3) a nonviolent version with no weapons and no monsters. The versions were otherwise identical, with the goal being to find as many emeralds as possible in 20 minutes. One child in each pair played the game while the other watched.