CHAPTER

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A Theoretical Model of the Effects and Consequences of Playing Video Games

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Though there has been considerable discussion of video game effects in several research literatures, theoretical integrations have been somewhat rare. Our own empirical work has focused primarily on the effects of violent video games on those who play them (e.g., Anderson et al., 2004; Anderson & Dill, 2000). That work has been framed in terms of the General Aggression Model, an integrative social-cognitive model designed to handle all influences on all types of human aggression (e.g., Anderson & Bushman, 2002; Anderson & Carnagey, 2004; Anderson & Huesmann, 2003). But that model itself can be further generalized to account for nonviolent effects of video games, many of which may well be quite beneficial to the individual as well as to larger society. Our primary goal in this chapter is to elucidate such a general model of video game effects.

WHO IS PLAYING WHAT KIND OF GAMES?

According to the Entertainment Software Association, 50 % of all U.S. Americans play video games, pushing entertainment software sales in the United States to $7 billion in 2003 (2004). This is more than double the $3.2 billion video games earned in domestic sales in 1995 (ESA, 2004). Although computers are not yet in every U.S. household, they are common and also are increasingly used in workplaces and schools. A 1997 U.S. census survey found that 36.6 % of households owned a home computer and that 47% of adults used computers daily either at home or work (Kominski & Newburger, 1999). In comparison, 75% of children 3–17 used computers daily either at home or school (Kominski & Newburger, 1999). In fact, 70% of children used computers *in schools* (Kominski & Newburger, 1999). More recent data suggest that computer ownership has grown substantially, so that by 2000, 70 % of homes with children 2–17 had computers (Woodard & Gridina, 2000). Similarly, 68% of homes with children 2–17 have video game equipment (Woodard & Gridina, 2000). A survey conducted in 2003 found

that 87 % of children regularly play video games, but that these games are more popular with boys (96%) than girls (78%; Walsh, Gentile, Gieske, Walsh, & Chasco, 2003). In a recent survey of over 600 8th- and 9th-grade students, children averaged 9 hours per week of video game play overall, with boys averaging 13 hours per week and girls averaging 5 hours per week (Gentile, Lynch, Linder, & Walsh, 2004).

There are thousands of video games available. The content includes just about anything imaginable in both education and entertainment genres. Of much public concern has been the preponderance of games with violent content. A recent analysis found that about 89% of video games contain some violent content (Children Now, 2001). More than half of fourth- through eighth-grade children report preferences for games in which the main action is predominantly violent (Buchman & Funk, 1996; Funk, 1993). Other surveys of children and their parents found that: (a) about two thirds of children named violent games as their favorites; (b) about two thirds of parents are unable to correctly name their child's favorite game; and (c) 70% of the time that parents are incorrect, children describe their favorite game as violent (e.g., Funk, Flores, Buchman, & Germann, 1999). Shibuya and Sakamoto (2003) reported similar results in Japan, finding that 85% of the most popular video games of Japanese fifth graders contained violent content (for reviews on the content of video games, see B. P. Smith, chap. 4, this volume; S. Smith, chap. 5, this volume).

WHAT DO VIDEO GAMES TEACH?

Video games are used as teaching tools in situations ranging from elementary schools to military bases. McDonalds uses video games in employee training seminars. The Mayo Clinic uses video games like *Name That Congenital Abnormality* to train residents (Yaman, 2004). The Marcom Group, a company that specializes in workplace safety compliance training, uses interactive CDs, online services, and "jeopardy" style games to teach employees how to handle hazardous waste and similar tasks (Marcom, 2004).

Military Uses

One of the largest groups that has embraced the use of video games for training is the U.S. military. The United States Army seems to believe strongly in the ability of video games to train soldiers for combat, flying, driving tanks, and commanding troops. The Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI), the unit that oversees the implementation of video game training, has an operating budget of over $1 billion and "is dedicated to putting the power of simulation into the hands of our warfighters." PEO STRI has commissioned a family of simulations consisting of "live environment engagement capabilities" that will replicate "weapon effects of combat systems for collective training" (Public Affairs Office, US Army, 2004).

The Marines have even created a training game using a version of the commercially available Game *Doom* (Prensky, 2001). *Marine Doom* is played as a networked game by four-member teams on four separate computers in the same room. In the game, their goal is to coordinate their movements to eliminate an enemy bunker. According to Prensky (2001), the Marines are learning teamwork, communication, and concepts of command and control.

The military also uses games and online training to teach Joint Doctrine, the rules that govern how the branches of the military cooperate. In 2000, the U.S. military released *Joint Force Employment (JFE)*, a multimedia game designed to allow soldiers to "adjust friendly and enemy forces . . . to test varying military possibilities . . . and compete against state of the art computer artificial intelligence" (DTIC, 2004a). According to the US Department of

Defense, "*JFE* represents a true multi-media environment for joint doctrine education" (DTIC, 2004a).

The military has also released a series of courses that consist "of interactive multimedia presentations on key information contained in Joint Doctrine designed to enhance the Joint Doctrine learning experience" (DTIC, 2004b). The courses teach "primary lessons in planning, deploying, and employing joint military forces" (DTIC, 2004b). The goal of these online courses is to "bring Joint Doctrine to life" by presenting the information in a convenient format, employing varied instructional techniques, and taking advantage of the latest interactive multimedia technologies (DTIC, 2004b).

Finally, in June of 2004, elements of the United States military and Special Operations, as well as forces from the United Kingdom, Canada, the Netherlands, Norway, France, Germany, and Peru, participated in Combined Joint Task Force Exercise (CJTFEX) 04-2 (JFCOM, 2004). This was an exercise designed to coordinate a global network of live and virtual training components to train commanders to lead a global military. During this exercise, live participants took part from the waters off the U.S. East Coast, while virtual participants took part via computer networks from 20 different sites.

School and Other Intended Educational Uses

In schools, too, computer games have been effectively used to teach algebra and geometry (Corbett, Koedinger, & Hadley, 2001), biology (Ybarrondo, 1984), photography (Abrams, 1986), golfing skills (Fery & Ponserre, 2001), and computer programming (Kahn, 1999). Students with severe learning disabilities have learned life skills like grocery shopping in virtual reality environments (Standen & Cromby, 1996). The Pennsylvania Department of Migrant Education used a video game format to successfully teach migrant children math, reading, English fluency, and critical thinking skills (Winograd, 2001). A recent meta-analysis of the effectiveness of using educational software programs found positive effects on both early reading development ($d = 0.35$; $N = 26$) and math ($d = 0.45$; $N = 13$) (Murphy, et al., 2002).

Lieberman (1998) studied the effectiveness of a video game designed to teach diabetic children how to care for their disease. She found that children enjoyed the game as much as comparison children enjoyed playing pinball and spent the same amount of time playing over 6 months. The diabetes video game promoted self-esteem and social support, increased knowledge of diabetes self-care, and was related to positive health behaviors and positive health outcomes. Ultimately, this video game was able to successfully teach the attitudes, skills, and behaviors that it was designed to teach (Lieberman, 1997). However, video games can teach even when they are not intended to be educational (Lieberman, chap. 25, this volume).

Unintended Outcomes

Video games also appear to teach perceptual skills. For example, people who play video games show better attention to cues across the visual field and attend to more visual cues overall than people who do not play video games (Green & Bavelier, 2003). A recent study also found that surgeons who have some experience playing video games perform laparoscopic surgery faster and make fewer mistakes (Rosser et al., 2004). Laparoscopic surgery is a type of surgery in which a tiny camera is inserted into the abdomen through one small incision, and surgical instruments are inserted through other small incisions; once the camera and instruments are inserted, surgeons use keypads and joystick devices to operate while they watch their performance on a monitor.

Unfortunately, video games also are associated with a number of negative outcomes. For example, some research has linked high levels of video game playing with smoking (Kasper, Welsh, & Chambliss, 1999), obesity (Subrahmanyam, Kraut, Greenfield, & Gross, 2000), and poorer academic performance (e.g., Anderson & Dill, 2000; Anderson, Gentile, & Buckley, under review; Harris & Williams, 1985; Lieberman, Chaffee, & Roberts, 1988; Lynch, Gentile, Olson, & van Brederode, 2001; van Schie & Wiegman, 1997). Of particular concern are the potential negative effects of playing violent video games on aggression-related outcome variables.

Video games are designed to be entertaining, challenging, educational, and (frequently) violent (Children Now, 2001; Dietz, 1998; Dill, Gentile, Richter, & Dill, in press). Unfortunately, as children grow, they spend more time playing entertaining games and less time playing educational games (Scantlin, 2000). In addition to children spending more time with entertaining games, these games are becoming increasingly violent (Dill et al., in press). The potential problem with most violent video games is that they may well teach maladaptive ways of thinking, feeling, and behaving. That is, even though the manifest function (of game developers and players) of such games is to entertain or be entertained, the latent function is the teaching and learning of aggressive ways of responding to real situations outside of the virtual world.

Violent Game Effects. Just as educational video games can be used to teach school children, employees, and physicians, violent video games can teach aggression (for a review on the effects of playing violent video games, see Weber, Ritterfeld, & Kostygina, chap. 23, this volume; Lee and Peng, chap. 22, this volume). A comprehensive review of media violence effects on aggression and aggression-related variables found "unequivocal evidence that media violence increases the likelihood of aggressive and violent behavior in both immediate and long-term contexts" (Anderson et al., 2003, p. 81). This report also found that even though the effects tend to be smaller for more severe forms of violence than for milder forms, the magnitude on severe forms is sufficiently large to warrant concern. Of more direct relevance to this chapter, aggressive behavior has been positively associated with both real-life violent video game play and laboratory exposure to graphically violent video games (e.g., Anderson, 2004; Anderson & Dill, 2000).

Meta-analytic reviews of the video game research literature reveal that violent video games increase aggressive behavior in children and adults (Anderson, 2004; Anderson & Bushman, 2001; Sherry, 2001). Experimental and nonexperimental studies with males and females in laboratory and field settings support this conclusion. Analyses also reveal that exposure to violent video games increase physiological arousal and aggression-related thoughts and feelings. Playing violent video games also decreases prosocial behavior.

More generally, a wide range of studies have yielded five effects of violent media (Gentile & Anderson, 2003). People exposed to a lot of violent media: (a) tend to become meaner, more aggressive, and more violent; (b) tend to see the world as a scarier place; (c) tend to become more desensitized to violence (both in the media and in real life), more callous, and less sympathetic to victims of violence; (d) tend to get an increased appetite for seeing more violent entertainment; and (e) are less likely to behave prosocially. None of these effects, either of violent media in general or of violent video games in particular, are surprising to anyone who understands learning and social interaction processes.

Although the empirical effects of violent video games have been robust, they remain poorly accepted outside the research community. In this chapter we propose that video games teach whatever concepts are repeatedly rehearsed within them—algebra, diabetes care, or aggression. We show how video games teach through both long- and short-term exposure. Although our model is based on early aggression theories and on research on violent media, it is also

based on modern social-cognitive models of learning, social information processing, and social interaction. We believe that our model is general enough to explain how video games teach and influence behavior. Although research into the teaching effects of video games has yielded consistent results, theories about why this is so have been neglected (Issroff & Scanlon, 2002).

HOW DO VIDEO GAMES TEACH?

There are many factors about video games that make them excellent teachers: they successfully get people's attention (Krendl & Lieberman, 1988), they teach attitudes necessary for successful behaviors (Anderson & Dill, 2000), they enable people to feel competent about performing a task (Krendl & Lieberman, 1988; Kozma, 1991), they are motivating (Krendl & Lieberman, 1988), they allow people to actively participate instead of passively watch (Krendl & Lieberman, 1988) they show all the steps necessary to perform a behavior or series of behaviors (Gentile & Anderson, 2003), and they allow repetitive practicing (Kozma, 1991).

There are at least three reasons why video games are motivating. First, players have control over the game; they can work at their own ability level and speed and repeat material as needed. Second, video games give immediate feedback (Lieberman, chap. 25, this volume). Video games often reward players for participating; these rewards (e.g., winning extra points and lives) increase the frequency of that behavior in that game and increase the player's motivation to persist at the game, in addition to teaching more positive attitudes toward the content of that game (Gentile & Anderson, 2003). Third, video games are motivating because they challenge players but remain doable (Jones, 1998; Lieberman, chap. 25, this volume). Video games begin easy, often teaching players the skills needed to continue, and become progressively more complex and challenging. Klimmt and Hartmann (chap. 10, this volume) call this balance of skill acquisition and increased challenge effectance motivation—players will continue to play games that give them feelings of self-efficacy.

Learning Theories

According to social learning and social cognitive theories, people learn either through direct experience or through observation (e.g., Bandura, 1973, 1983; Mischel, 1973; Mischel & Shoda, 1995). People learn by observing both themselves and others who may or may not be present. We can learn by observing people in the same room, on television, in movies, or in video games. When we observe people behave, we also see whether that behavior is rewarded or punished. People are more likely to imitate behaviors if they also witness that behavior being rewarded and less likely to imitate behaviors if they also witness that behavior being punished (e.g., Bandura, 1965; Bandura, Ross, & Ross, 1963).

A key distinction that emerged from early learning research with animals—a distinction that is frequently lost in modern discussions—is the difference between learning and performance. Briefly, learning entails the acquisition of new information regardless of whether it is ever used or displayed, whereas performance is the observable use of the newly acquired information. Thus, an organism may well acquire new information (e.g., learn how solve a type of algebra problem) but never actually use it. This distinction is important in many contexts, including social learning contexts. The child who watches a violent television episode may well learn a novel way of harming a provocateur but may be dissuaded from using the new aggressive behavior by observing that the person who used it was punished. Yet at a later point in time, perhaps when the threat of punishment has been removed, the novel aggressive behavior may be enacted.

People can learn many complicated behaviors, attitudes, expectations, beliefs, and perceptual schemata through observation and participation in video games. And, as they observe and perform these new behaviors, they are also learning scripts. Scripts are organized sets of knowledge that define situations and guide behavior, for example, knowing what to expect and how to act in a restaurant or at a movie. Scripts are well-learned and well-rehearsed concepts often involving an understanding of causation, goals, and plans of action (Abelson, 1981; Anderson, Benjamin, & Bartholow, 1998; Schank & Abelson, 1977).

Once a script is learned, it can guide how we perceive and interpret similar situations, and can tell us how to behave appropriately. The more familiar the current situation is and the more similarities the current situation has with a previously learned script, the more likely that script will be activated. Many aspects of the initial situation can become part of the script. When these aspects are found in subsequent situations, they can become cues that activate the script. Overall, people's behavior is guided by learning, internalizing, and applying scripts (Huesmann, 1986, 1998).

Social Problem Solving

It is important to understand that video games frequently teach social problem-solving skills (Goldsworthy, Barab, & Goldsworthy, 2000), positive or negative, whether intended or not. Social problem solving refers to the many cognitive processes involved in interpreting a social situation and behaving in ways that are congruent with one's own goals. There are four processes used in social problem solving: (a) encoding and interpreting environmental cues, (b) generating and selecting goals, behaviors, or scripts to guide behavior; (c) evaluating how appropriate the selected script is, and (d) behaving followed by an interpretation of the reactions to that behavior (Anderson & Huesmann, 2003).

Cognitive Theories

Theories about scripts are based on theories of cognition and memory (Anderson et al., 1998; Berkowitz, 1990; Collins & Loftus, 1975). According to these theories, memory is a network of concepts and their links. Individual cognitive concepts are known as nodes; as we learn more about a concept, links are developed connecting that node with others. Or, links may be developed to connect concepts that have been experienced together. For example, "furry animal" might conjure images of dogs and cats or allergic reactions depending on one's experiences. Some people will have the furry animal node closely linked to the nodes for various types of furry animals, but for others, furry animals will be closely linked to allergies.

When a set of nodes become strongly linked together, they are known as knowledge structures. Well-known scripts are knowledge structures and as such they can include emotions, behavioral responses, and beliefs. Knowledge structures (a) develop from experience; (b) influence perception; (c) can become automated; (d) can contain affective states, behavioral scripts, and beliefs; and (e) are used to guide interpretations and responses to the environment (Anderson & Bushman, 2002).

Some concepts are more easily linked together, for example, humans appear to easily develop links between frustration, pain, and anger with aggression (Berkowitz, 1990). Highly similar concepts, and concepts that frequently are simultaneously activated, become strongly linked. Activating a node or knowledge structure depends on the number and strength of links to that node or knowledge structure. Some stimuli are not strong enough to completely activate the target knowledge structure; instead, they may only activate one or more nodes. This impartial activation is called priming the knowledge structure.

A primed knowledge structure is more likely to be used than other wholly inactive knowledge structures. For example, research has found that pictures of weapons can automatically prime aggressive thoughts (Anderson et al., 1998). However, the specific thoughts primed by pictures of weapons depends on the type of weapon (hunting vs. assault) *and* the individual's learning history (and hence, his knowledge structures) involving weapons. In other words, aggressive thoughts and subsequent aggressive behavior were interactively influenced by both the content of the weapon pictures and the past learning histories of the individual participants (Bartholow, Anderson, Carnagey, & Benjamin, 2004).

Priming also works on behavioral scripts. Bargh, Chen, and Burrows (1996) and Carver, Ganellen, Froming, and Chambers (1983) have shown that solving anagram problems whose solutions are aggressive words increases the chances of aggressive (or rude) behavior immediately afterwards, if participants are provoked.

A MODEL TO ORGANIZE AND UNDERSTAND THE EFFECTS OF VIDEO GAMES

Anderson and colleagues proposed the General Aggression Model (GAM) to explain how violent video games increase aggressive thoughts, feelings, and behaviors (for a short review of GAM, see Weber et al., chap. 24, this volume). GAM describes a continuous cycle of interaction between a person and the environment and combines elements from many theories including: social learning and social cognitive theories (e.g., Bandura, 1971, 1973; Bandura, Ross, & Ross, 1961, 1963; Mischel, 1973; Mischel & Shoda, 1995), Cognitive Neoassociationist Model (Berkowitz, 1986, 1990), social information-processing model (Anderson, Anderson, & Deuser, 1996; Anderson & Bushman, 2002; Anderson & Dill, 2000; Anderson & Huesmann, 2003; Crick & Dodge, 1994; Dodge & Crick, 1990), affective aggression model (Geen, 1990), script theory (Huesmann, 1986), and excitation transfer model (Zillmann & Bryant, 1983). Most recently, GAM has incorporated the developmental approaches of risk and resilience and the cumulative risk model (see Anderson et al., under review).

In this chapter we will expand this model of aggression into our General Learning Model (GLM). Although our model is based on early aggression theories and on research on violent media, it is also based on modern social-cognitive models and developmental approaches. We believe that our model is general enough to explain how video games teach and influence behavior.

Input Variables

A person's behavior is based on two types of input variables: personal and situational (see Fig. 24.1). Personal variables include what a person brings to the current situation, specifically: attitudes, beliefs, goals, behavioral tendencies, previous experience, and emotions. These internal variables show substantial consistency over time and situations, the result of consistent use of knowledge structures such as scripts, beliefs and schemas, and affective components (Anderson & Bushman, 2002; Anderson & Huesmann, 2003). Situational variables are the features of the environment around the individual; they include media, objects, settings, and other people. Situational variables may vary widely but may also be fairly consistent over time, as individuals tend to be in the same or similar situations repeatedly.

Personal variables that may influence people's ability to learn from video games include many variables that are relevant to learning in general: age, grade level, ability level (including

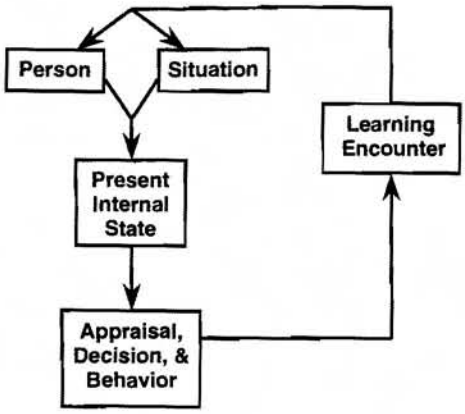

FIG. 24.1. The general learning model: simplified view.

learning disabled and low-performing students), income level, and self-esteem (Lieberman, 1998). Other variables that may influence people's ability to learn from video games include variables that are more specifically relevant to video games, including an individual's history of media exposure and how much a person's comprehension of information is affected by the surrounding field of information (field-dependence, field-independence; Ghinea & Chen, 2003). There are also personal variables that may be relevant to the effects of *violent* video games: player sex; age; bullies; victims of bullies; having poor social problem-solving skills; having poor emotion regulation abilities; being more hostile in personality; having a history of aggressive behavior; or having parents who do not monitor or limit video game play; and having aggressive beliefs, attitudes, values, long-term goals, and scripts (Anderson & Bushman, 2002).

Situational variables also influence people's ability to learn from video games, and perhaps the most important situational variables include aspect of the games themselves, such as: the extent to which a game keeps players interested and playing, game content (violent, nonviolent, educational), and current game exposure (number of minutes per exposure, number of exposures per week, number of weeks). Other variables inherent in video games include whether the game focuses on drill-and-practice for factual recall (*Reader Rabbit* or *Knowledge Munchers*), or uses simulations or role-playing to model reality (*The Sims* or *MS Flight Simulator;* Murphy et al., 2002; Squire, 2003). Situational variables that are relevant to the effects of violent video games include aggressive cues (weapons and aggressive words), provocation, frustration, pain, drugs, and other incentives (rewards) (e.g., Anderson & Bushman, 2002).

Interactions of Input Variables

Learning is the result of the complex combination of personal and situational variables. These variables can interact to increase or inhibit learning. For example, some children have low self-esteems, but by playing games that: (a) have a character similar to themselves and (b) are challenging without being too difficult, children can experience increased self-esteem (Lieberman, 1998). In fact, many researchers now view learning as a process through which personal predispositions are modified through situational influences (Huesmann, 1997; Tremblay, 2000). Similarly, all of the social-cognitive models of aggression agree that person variables and current situational variables combine to influence the individual's present internal state, for example, pain and trait hostility combine interactively to affect aggressive cognitions, so that a person who is high in trait hostility will react disproportionately to pain (Anderson, Anderson, Dill, & Deuser, 1998).

Routes

Input variables affect how a person responds by influencing one's internal state. Three types of interrelated states are especially important: cognition, affect, and arousal.

Cognition. Some input variables make constructs more readily accessible in memory, resulting in an increase in related thoughts, or scripts, or both. As script theory has contended, situational variables may activate scripts that can bias the interpretation of a situation and the possible responses to that situation (Huesmann, 1986). Research has shown that the process by which knowledge structures are activated is cognitive but can with practice become completely automatic and operate without awareness (Schneider & Shiffrin, 1977; Todorov & Bargh, 2002). That is, many cognitive processes are unconscious, and some that initially have conscious elements become automatized to the point of occurring outside of consciousness.

Cognitive variables that are influenced by personal and situational input variables include: thoughts, attributions, beliefs, attitudes, perceptual schema, expectation schema, and behavior scripts. Aggressive personal and situational input variables, for instance, can increase aggressive thoughts and attributional biases, aggressive beliefs and attitudes, aggressive perceptual and expectation schema, and aggressive behavior scripts. For example, several studies found that exposure to violent video games increases aggressive thoughts (e.g., Anderson & Bushman, 2001). Of course, nonviolent situational variables, such as playing a prosocial game, can increase many forms of nonviolent outcome variables, such as the accessibility of prosocial thoughts.

Affect. Input variables can directly influence mood and emotion, which can later influence behavior. Two examples of how affect can influence learning and behavior include mood-congruent cognition and mood-dependent memory. Mood-congruent cognition is the phenomenon in which a person's mood increases the processing of information that is affectively similar. Mood-dependent memory is the finding that information learned in a particular mood is best retrieved in that mood, regardless of the information's affect. This means that people will pay more attention to information that matches their mood, think about this information longer, and are more likely to remember this information later when in the same mood. For example, depressed people recall more negative information than positive (Berry, 1997), and any aversive stimulation, such as heat, can create negative affect, which can prime a network of cognitive structures that increases a person's aggressive cognitions and behavior (Berkowitz, 1990).

Another way affect can influence learning and behavior is through the mere-exposure effect; the repeated exposure of an object increases its attractiveness. This is true even when people are not aware of the exposure (Kunst-Wilson & Zajonc, 1980). Players often develop emotional responses to the characters and stories within video games; these emotions engage and motivate players (Lieberman, chap. 25, this volume). A third way involves systematic desensitization processes, in which repeated exposure to initially fearful stimuli in a positive context (e.g., violent stimuli in a fun video game) leads to a reduction in fearful emotions to that type of stimuli (e.g., Carnagey, Bushman, & Anderson, under review).

Arousal. Entertaining video games are generally arousing, as are many educational video games. However, too much or too little arousal can have a strong impact on learning by inhibiting the learning of new material or leaving the learner too bored to pay attention, respectively (Deshpande & Kawane, 1982; Yerkes & Dodson, 1908). If the material has already been well learned, increases in arousal are less likely to inhibit the retrieval and use of that

information (Berkowitz, 1990). However, if the material is not well learned, increases in arousal are more likely to inhibit the learning and use of that information.

Interactions of Routes. As we have seen, input variables can influence cognition, affect, and arousal, but these three routes are also highly connected to one another; cognition and arousal influence affect (Schachter & Singer, 1962) and affect influences cognition and arousal (Bower, 1978). Too much arousal may inhibit ability to think about and learn new information; too little arousal may lead to lack of motivation and passive instead of active learners. Or, hostile cognitions and angry affect may bias which cognitive scripts and knowledge structures people use.

Outcomes

Outcomes from playing video games include learning facts, from drill and practice routines; learning specific behaviors, from playing simulation and role-playing games that model reality; learning new perceptual and decision schemata, from many types of games; and generating personality changes that occur when a person's habitual thought and behavior patterns begin to change, as a result of repeated video game play.

Long-Term Effects of Video Games: Factual Learning. Most educational software has focused on using drill and practice routines to enhance the learning of specific, concrete facts. This type of software is easily incorporated into classrooms as it allows students to practice individually as much or as little as needed (Squire, 2003). Students generally receive quick feedback about their performance and are able to repeat tasks until they are successful.

Long-Term Effects of Video Games: Learning Behaviors. Simulation and role-playing games attempt to model physical or social systems in a manner that is consistent with reality. However, unlike reality, simulations allow learners to manipulate variables that are normally unalterable (create a town's power supply), view phenomena from new perspectives (a town planner, a pilot), observe the system's behavior over time (How do time, growth, and natural disasters affect a town?), and pose hypothetical questions to a system (How does a limited power supply affect a town's growth?) (e.g., Squire, 2003). Thus, video games can enhance learning of many types of complex behaviors.

Long-Term Effects of Video Games: Changes in Personality. Personality results from the development and construction of knowledge structures. Influences include biological factors, of course, but are based primarily on life experiences, or "biosocial interactions." How people perceive the world and react to it depends upon the particular situational factors in their world and on the knowledge structures they have learned and habitually use (see Fig. 24.2). Creating long-lasting changes in people's knowledge structures also changes their personalities (Mischel & Shoda, 1995; Sedikides & Skowronski, 1990).

Learning—and ultimately, performance—depends on several complex internal processes—input variables affecting cognition, affect, and arousal, which in turn influence both processes of appraising the current situation and making appropriate decisions. The outcome of appraisal and decision processes also depends on a person's available attention. If a person has sufficient time and cognitive capacity, and if the immediate appraisal outcome is both important and *unsatisfying*, then the person will engage an effortful set of reappraisals (see Fig. 24.3). Reappraisals consist of searching for additional information in order to view the situation differently, perhaps in search of clarity or of a preferred outcome or interpretation. For example, if a likeable character in a mystery novel appears to have committed a murder,

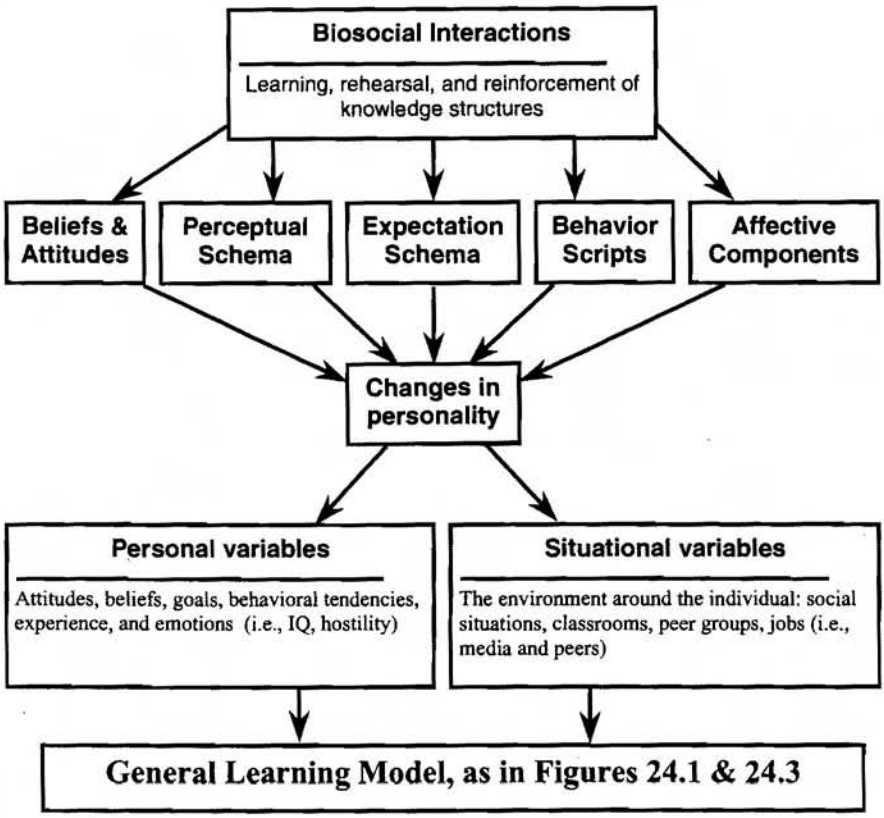

FIG. 24.2. The general learning model: developmental/personality processes.

one might reread earlier passages to learn whether this character is not so likeable, or to discover possible reinterpretations of the evidence that implied the character's misdeed. If resources are insufficient, or if the outcome of immediate appraisal is either unimportant *or* satisfying, then action and understanding will be dictated by the immediate appraisal and the knowledge structure accessed in that appraisal. Of course, one of the key elements required for reappraisal is time, and time is less likely to be available while watching television and films than reading novels, and is almost entirely absent while playing many video games.

The general learning model is well founded in psychological theories of learning. From those theories we understand that people can learn complicated behaviors through observation and that by observing and performing behaviors people are also learning scripts; overall, people's behavior is guided by learning, internalizing, and applying scripts. We also know that well-known scripts or knowledge structures can include emotions, behavioral responses, and beliefs. These knowledge structures (a) develop from experience; (b) influence perception; (c) can become automated; (d) can contain affective states, behavioral scripts, and beliefs; and (e) are used to guide interpretations and responses to the environment. These theories all adopt similar premises about the processing of information in social problem solving, the social-cognitive structures involved, the interacting role of emotions and cognitions, and the interaction of person and situation. The General Learning Model is itself merely an attempt to unify these many strands into a common framework.

We also know that video games use drill and practice techniques or simulate reality to allow players the opportunity to solve problems. Simulation games allow players to (a) encode

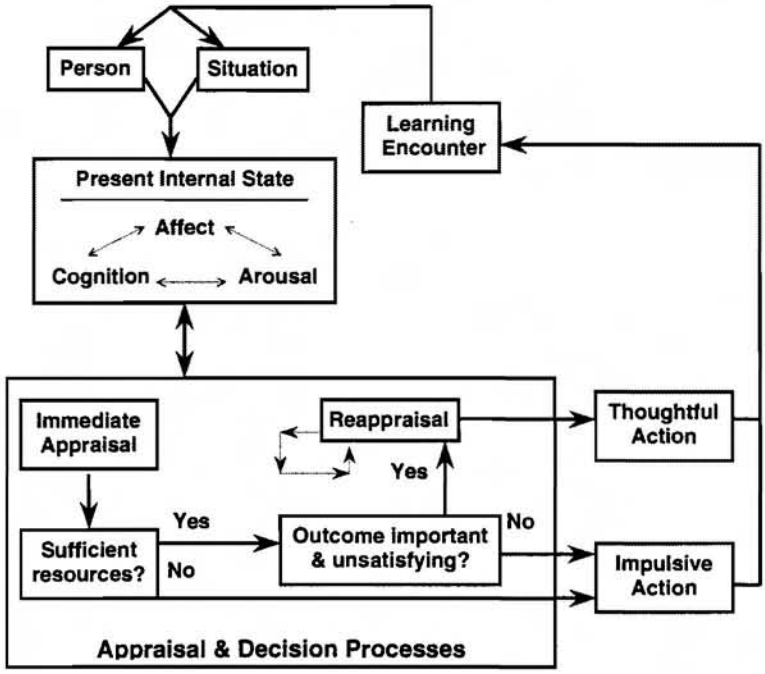

FIG. 24.3. The general learning model: expanded causes and processes.

and interpret environmental cues; (b) generate and select goals, behaviors, or scripts to guide behavior; (c) evaluate how appropriate the selected script is; and (d) behave followed by an interpretation of the reactions to that behavior.

Furthermore, the cyclical process of GLM allows researchers to apply it to long-term effects of exposure to video games. We can view each episodic cycle of GLM as a learning trial, leading (with practice) to the development of well-rehearsed (and eventually automatized) knowledge structures of various kinds. Repeated exposure to certain stimuli makes related knowledge structures more readily accessible. Over time, these knowledge structures are activated more automatically and are more likely to be used in later situations. The development, automatization, and reinforcement of these knowledge structures change the individual's personality.

There are two final primary conclusions that should be drawn about the educational use of video games: games teach and content matters. We see in a variety of contexts that people learn by playing video games. Children are able to enhance their reading and math skills by playing games like *Reader Rabbit* and *Math Blaster*, and adults learn about heart disease and military concepts of teamwork, communication, and command and control from games like *Name That Congenital Abnormality* and *Marine Doom*. At this time, the idea that video games teach should not be in doubt, but researchers, educators, and parents need to pay more attention to the idea that the content of video games does matter. Video games teach regardless of their content, regardless of the intended outcome of the game developer, and regardless of the intended use of the game by the player. In brief, games teach whatever they inspire the game player to rehearse mentally and behaviorally. Enactment of what is learned depends on other factors, of course. If the individual never encounters a situation relevant to some particular fact or script, then that fact or script will not be used. Many people may never encounter a situation in which to apply the Pythagorean theorem (outside of a classroom), and so may never perform the actions and decisions that would make use of that knowledge. Similarly, many people may never be in a sufficiently provoking situation to trigger use of certain violent behavior scripts. However, the

better learned that the underlying knowledge structure has become (i.e., the more contexts with which it is associated, the more easily and automatically it comes to mind . . .), the more likely it is to be used, whether in designing one's dream home (Pythagorean theorem) or lashing out at a provoking spouse.

As we have seen through the cyclical process of the GLM, each cycle is a learning trial, leading eventually to the development of well-rehearsed knowledge structures of various kinds and to the development, automatization, and reinforcement of these knowledge structures, thereby changing the individual's personality. The kind of knowledge structures a person develops depends on the content of the games played—content matters.

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