AGGRESSIVE BEHAVIOR
Volume 34, pages 1–14 (2008)

Exposure to Violent Video Games and Aggression in German Adolescents: A Longitudinal Analysis

Ingrid Möller* **and Barbara Krahé**

Department of Psychology, University of Potsdam, Potsdam, Germany

The relationship between exposure to violent electronic games and aggressive cognitions and behavior was examined in a longitudinal study. A total of 295 German adolescents completed the measures of violent video game usage, endorsement of aggressive norms, hostile attribution bias, and physical as well as indirect/relational aggression cross-sectionally, and a subsample of $N = 143$ was measured again 30 months later. Cross-sectional results at T1 showed a direct relationship between violent game usage and aggressive norms, and an indirect link to hostile attribution bias through aggressive norms. In combination, exposure to game violence, normative beliefs, and hostile attribution bias predicted physical and indirect/relational aggression. Longitudinal analyses using path analysis showed that violence exposure at T1 predicted physical (but not indirect/relational) aggression 30 months later, whereas aggression at T1 was unrelated to later video game use. Exposure to violent games at T1 influenced physical (but not indirect/relational) aggression at T2 via an increase of aggressive norms and hostile attribution bias. The findings are discussed in relation to social-cognitive explanations of long-term effects of media violence on aggression. Aggr. Behav. 34:1–14, 2008. **© 2008 Wiley-Liss, Inc.**

Keywords: violent video games; media violence; aggression; adolescents; normative beliefs.

INTRODUCTION

Playing electronic games is one of the most popular leisure activities of children and adolescents not only in the US [Anderson et al., 2007] but also in Germany and other European countries [see Klimmt, 2004]. Both genders play regularly, although boys outnumber girls in terms of frequency and duration of game playing sessions, especially for games containing violent content. Although electronic games are nowadays played throughout the lifespan from childhood to old age, early adolescence is the peak time for exposure in most western cultures. Adolescents also show a particular interest in violent games. Kirsh [2003] tried to explain this developmental pattern by arguing that action and shooter games satisfy special needs for the players. Adolescence is a time when trait aggression increases (especially in boys), and violent media contents match this "developmental theme". Furthermore, adolescents show an increased need for novelty, risk-taking behavior, and a heightened level of physiological arousal. Violent games that focus on action (which is true for almost all games of this type) can easily satisfy those needs. At the same time, they provide a safe environment because all the risks happen in a virtual reality and do not lead to physical harm. Whether or not violent video games are potentially harmful in promoting aggressive behavior has been a subject of intense debate since the inception of this medium. This study contributes to the debate by providing data from a longitudinal study with German adolescents that linked exposure to video game violence, aggressive cognitions, and aggressive behavior over a period of 30 months.

Content analyses of video games unanimously suggest that violent scenes are as frequent or even more present in this medium as in movies and television shows. Almost 20 years ago, Braun and Giroux [1989] found a violence rate of 71% for a sample of 21 arcade games. Since then, hard and software of game technology have improved dramatically, graphics and sound effects have become highly realistic, and modern games often show a

*Correspondence to: Ingrid Möller, Department of Psychology, University of Potsdam, Karl-Liebknecht-Str. 24-25, D-14476 Potsdam, Germany. E-mail: ingrid.moeller@uni-potsdam.de

Received 13 March 2008; Revised 1 August 2008; Accepted 5 October 2008

Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/ab.20290

© 2008 Wiley-Liss, Inc.

technical quality similar to films. Dietz [1998] analyzed 33 best-selling video games and found that about 79% contained some form of violence. Thompson and Haninger [2001] analyzed 55 video games that were rated "E" by the US-*Entertainment Software Rating Board*, and although all the games were categorized as suitable for children of all ages, 64% contained intentional violent acts (24% with the use of a weapon). As expected, shooter-games contained most violence and were characterized by a high rate of killings per minute (23.8% on average). A recent analysis of popular games in Germany also concluded that many games rated as suitable for children and adolescents contained violence to a considerable degree [Höynck et al., 2007]. In addition to identifying a high level of violent content in contemporary video games, Smith et al. [2003] showed that children's games often involve forms of violence that kids can easily transfer to their real life, such as slapping, boxing, or kicking.

There is ample evidence to show that children spend much time playing electronic games and that many of the games they play are full of violent content. A recent large-scale survey in Germany found that 26% of 12- and 13-year-olds played computer games every day or almost every day, only 15% played less than once a week. There is a clear gender difference in video game usage, with 72% of boys but only 52% of girls playing at least once a week [Medienpädagogischer Forschungsverbund Süd-West, 2006]. In terms of the preferred game content, a substantial proportion of adolescents of the same age studied by Krahé and Möller [2004] reported having played games classified as unsuitable for their age group and qualified as high in violent content by a sample of expert raters.

Several reviews and meta-analyses have been conducted on the aggression-enhancing effects of violent video games [for reviews see: Dill and Dill, 1998; Griffiths, 1999; for meta-analyses see: Anderson, 2004; Anderson and Bushman, 2001; Sherry, 2001]. Almost all of them concluded that the use of violent electronic games could increase aggressive tendencies in the players. Sherry [2001] reported an effect size of Pearson's $r_+ = .15$ for the relationship between violent game exposure and aggression and found that the relationship was stronger for games developed after 1995. Anderson and Bushman [2001] analyzed different outcome variables, such as hostile cognitions, anger affect, physiological arousal, and aggressive behavior. They found the strongest effect for violent game exposure on a short-term increase in aggressive cognitions ($r_+ = .27$) in experimental designs. For aggressive behavior as outcome variable, the strongest effect size ($r_+ = .19$) was found in cross-sectional studies. Anderson [2004] replicated the results of the earlier meta-analysis by Anderson and Bushman [2001] with the additional finding that high-quality studies yielded even stronger effect sizes than studies of poor methodological quality. These analyses show that at least in the short run exposure to violent games can increase the accessibility of hostile cognitions, aggressive affect, physiological arousal, and aggressive behavioral tendencies. The cross-sectional results reviewed indicate that the regular use of violent games is associated with knowledge structures and behavioral scripts associated with aggression. However, a rigorous test of the proposed effects of habitual exposure to media violence requires a longitudinal research design.

Longitudinal studies enable researchers to disentangle two possible explanations of the relationship between media violence exposure and aggression: the *socialization* hypothesis, proposing that the exposure to violent media content makes viewers more aggressive, and the *selection* hypotheses [also named the "reverse" hypothesis, Kirsh, 2006], suggesting that aggressive individuals are more attracted to violent media. While describing opposite directions of causality, the two hypotheses are by no means mutually exclusive. It is possible that aggressive individuals show a greater preference for violent content in the first place, as suggested by the selection hypothesis, and are then reinforced in their aggressive tendencies through exposure to violent contents, as suggested by the socialization hypothesis. This mutual reinforcement of habitual aggression and media violence exposure is the core assumption of the *Downward Spiral Model* by Slater et al. [2003].

To date there are only very few longitudinal studies examining the impact of violent video games on aggression in children and adolescents [see, however, Huesmann and Kirwil, 2007, for a summary of longitudinal studies on the effects of television violence]. The study with the youngest age group was conducted by Anderson et al. [2007] who asked a sample of 3rd to 5th graders in the US about their use of violent video games and obtained peer nominations and teacher reports of physical, verbal, and indirect/relational aggression as well as self-reports about the number of physical fights in which participants had been involved during the school year. Indices of physical, verbal, and indirect/relational aggression were created across the different sources. Students who reported a high level of exposure to violent games at the beginning of the school year scored higher on verbal and physical

aggression at the end of the school year compared with students who spent less time with violent media contents, even when aggression at T1 was controlled for. They also showed an increased attribution of hostile intent while rating possible reactions to hypothetical ambiguous situations.

Gentile and Anderson [2006] referred to a Japanese study with 5th and 6th graders by Sakamoto, Kobayashi, and Kimura who measured general exposure to electronic games (regardless of content) and aggressive behavior twice over a 5-month period. Playing video games at T1 predicted self-reported physical aggression 5 months later, controlling for aggression at T1. However, the study only looked at total amount of video game play and is therefore mute with respect to the specific role of violent content. A third study conducted by Slater et al. [2003] was carried out with 6th and 7th graders and included four waves of data collection over a period of 2 years. More than 2,500 participants provided self-reports of exposure to violent video games, films and web sites, aggressive attitudes, and aggressive behavior. In line with their Downward Spiral Model, Slater et al. found significant paths both from earlier media violence exposure to subsequent aggression and from earlier aggressiveness to subsequent media violence exposure, controlling for within-construct stability over time. However, when adding the aggregated scores of trait aggression and media violence exposure, respectively, only the path from media violence exposure to aggression remained significant. They concluded that the downward spiral works in an asymmetric fashion: Higher trait aggression predicts a preference for violent media concurrently, whereas media violence exposure predicts aggressive behavior both concurrently and prospectively. Unfortunately, Slater et al. did not report separate findings for the different types of media included, so the specific impact of violent games remains unclear.

Beyond demonstrating a link between violent video game usage and aggression, it is critical to explain the underlying mechanisms. Social learning theory points to the impact of media characters as role models triggering the processes of observational learning that promote the acquisition and performance of aggressive behavior, particularly when media characters are rewarded for their aggressive behavior [Bandura, 1973; Eron et al., 1971]. In addition, media violence can act as a prime serving as an aggressive cue that enhances the availability of aggression-related cognitions, both in the short term and chronically as a result of repeated exposure [Berkowitz, 1993]. Building on these seminal contributions, recent theoretical models have elaborated the specific cognitive paths from exposure to media violence to aggression. According to the *General Aggression Model* [GAM; e.g., Carnegy and Anderson, 2004], media violence exposure not only leads to an immediate increase in aggression in a particular situation but also contributes to the development of an aggressive personality of the game player over time. Repeated confrontation with virtual violence activates and strengthens aggression-related knowledge structures, such as perceptual and expectation schemas and behavioral scripts. It also reinforces normative beliefs about the appropriateness of an aggressive act in a particular situation. According to Huesmann's [1998] script theory, normative beliefs control whether or not an aggressive script an individual has encoded and stored in memory will be retrieved and translated into action. A variety of studies analyzed the relationship between normative beliefs condoning physical aggression [e.g., Huesmann and Guerra, 1997; Slaby and Guerra, 1988] as well as indirect/relational aggression [e.g., Crick et al., 1996; Erdley and Asher, 1998] and the performance of aggressive acts, showing that in older children and adolescents those beliefs function as antecedents of aggressive behavior. There is also some evidence that aggression-related normative beliefs and attitudes toward violence are influenced by exposure to media violence [see Bushman and Huesmann, 2001].

Information processing on the basis of aggressive scripts can lead to the development of a "hostile attributional style", i.e., the habitual tendency to interpret ambiguous situations in terms of hostility and aggression, as suggested in the *Social Information Processing Model* by Crick and Dodge [1994]. As Dill et al. [1997, p 275] graphically put it, people characterized by a hostile attributional style "tend to view the world through blood-red tinted glasses". Every time hostile intent is attributed to another person's ambiguous action and aggressive behavior is shown as a reaction, the link between the perception of hostile intent and aggression is reinforced, a cycle that may account for the long-term stability of aggressive behavior [Burks et al., 1999]. There is consistent empirical support for the relationship between a hostile attribution bias and physical aggression in children and adolescents [e.g., Dodge and Coie, 1987; VanOostrum and Horvath, 1997], and further studies indicate that indirect/relational aggression can also be influenced by hostile attributional style [e.g., Crick, 1995]. The relationship between media violence exposure and hostile attributional style is less well established.

Kirsh [1998] found the emergence of a short-term bias in children after playing a violent game in the laboratory. In a cross-sectional study, Krahé and Möller [2004] reported a relationship between exposure and attraction to violent games and hostile attribution, which was mediated through aggressive normative beliefs. Furthermore, as noted above, Anderson et al. [2007] found that high usage of violent video games at the beginning of the school year predicted hostile attributions at the end of the year.

Normative beliefs are assumed to be precursors to hostile attributions in our line of reasoning because they contain beliefs about what is appropriate and also what is common in terms of acting aggressively. Making a hostile attribution implies a probability judgement about the actor's hostile intent that is likely to be influenced by the perceivers' generalized assumptions about the prevalence of hostile intentions. Perceivers who believe that aggression is normative, in a descriptive as well as evaluative sense, are likely to be more inclined to believe that the particular person whose behavior they are asked to assess was driven by aggressive motives. Therefore, normative beliefs are held to precede hostile attributions in the path from video game violence to aggressive behavior.

In line with social-cognitive learning theories, video game characters can be seen as role models. They are attractive and successful, they use aggressive tactics mainly in an instrumental way, and the plot of the game usually justifies the use of weapons or martial arts to kill the opponents. Sometimes special "finishing moves" that require particularly brutal forms of harmful action are rewarded by extra points and cheering sound effects. Thus, violent acts are rewarded immediately, whereas failure to destroy the enemy is instantly punished. By rewarding aggressive acts, the games promote the view that aggression is a useful and appropriate way of dealing with interpersonal conflict and of venting hostility or frustration. In the same vein, game violence that fails to show the effects of aggression on the victims or presents violent actions as justified by a moral purpose affects the formation of aggressive scripts by weakening the normative beliefs that would inhibit aggressive behavior. Finally, the players can easily identify with the video game character as they actually control its actions themselves. First-person perspective and the use of special technical equipment such as light guns can increase this process of identification, which, in turn, facilitates social learning.

Based on the evidence reviewed so far, this study was designed to examine the concurrent and longitudinal relationships between exposure to violent electronic games and antecedents of aggression, namely normative beliefs and hostile attribution, as well as aggressive behavior. The theoretical constructs and instruments were based on the cross-sectional study by Krahé and Möller [2004] with 12–14-year-old German adolescents. That study found that exposure to violent games was linked directly to the acceptance of norms condoning physical aggression and indirectly to hostile attributions through aggressive norms.

Of the long-term studies reviewed above, only Anderson et al. [2007] provided specific evidence on the effects of violent video games. The other studies used measures of general media exposure regardless of violent content or aggregated exposure to violent content across different media. This study focused on violent content in electronic games in an age group where the use of this particular medium is at its peak. It was predicted that exposure to violent games would be related to a heightened level of aggression, both cross-sectionally and over time. In line with the GAM, we expected normative acceptance of aggression and hostile attributional style to function as mediators in the relationship between media violence and aggression.

A growing body of evidence indicates that boys and girls differ not so much in the extent to which they show aggressive behavior than in their preferred modality of expressing it. Although boys feature more prominently than girls on measures of physical aggression in some research, girls were found in other studies to be more prominently represented on measures of indirect/relational aggression, i.e., behaviors designed to harm the social relationships of the target person [e.g., Bjorkqvist et al., 1992; Crick and Grotpeter, 1995; Rys and Bear, 1997]. By covering both physical and indirect/relational forms of aggression in our measures, we sought to accommodate potential gender differences in the preferred modality of aggression.

In addition, obtaining the measures of both physical and indirect/relational aggression enabled us to look at the potential transfer effects of exposure to the depictions of physical violence to another form of aggressive behavior. Violent video games focus almost exclusively on physical harm, and given the different mechanisms by which media violence is assumed to affect players' cognitions and behaviors, effects are expected to show up primarily on physical aggression as an outcome measure. A recent longitudinal study by Ostrov et al. [2006]

looked at media violence exposure and aggression in early childhood (mean age was 47 months at T1) over four data points separated by 4-month intervals, including physical, verbal, and indirect/relational aggression as outcome variables. Media violence exposure was associated with all subtypes of aggression for boys, but only with verbal aggression for girls. However, given that levels of physical violence in media depictions are likely to increase as users get older, these findings cannot be generalized to older age groups. This study was therefore designed to examine the consequences of exposure to physical aggression in video games and aggressive norms and behavior as well as hostile attributions with respect to indirect/relational aggression and compare them with physical aggression in an adolescent sample.

Three hypotheses were examined in our study:

Hypothesis 1 predicted a cross-sectional relationship between exposure to video game violence and aggression, which would be mediated, at least partly, by the normative acceptance of aggression and a hostile attributional bias.

Hypothesis 2 predicted that the frequency with which adolescents play violent electronic games at T1 would predict their aggressive behavior 30 months later.

Hypothesis 3 assumed that the link between exposure to video game violence and aggression over time would be mediated through norms condoning aggressive behavior and a hostile attribution bias.

METHOD

Participants

A total of 295 secondary school students (153 girls and 142 boys) took part in the study at the first wave of data collection (T1). The mean age of the sample was 13.34 years (SD = .83). Sixty-five percent of participants were German nationals, 22% were of Turkish origin, and the remaining 13% were of different nationalities. All attended mainstream secondary schools and were proficient in German. Of the total sample, 143 students could be recruited for a second measurement 30 months later (T2). These participants (72 male, 71 female) provided the data for the longitudinal analyses. The drop-out rate was incurred owing to school absence at the days of the second data collection, parents' moving within the two and a half years time, and incomplete codes. The drop-outs did not differ from the participants that remained in the study at T2 on any of the T1 measures.

Instruments

Four instruments were included in both parts of the study. Measures for normative beliefs, hostile attribution, and aggressive behavior were identical at both times; the assessment of game violence exposure differed, as described below.

Exposure to video game violence at T1. A list of 40 electronic games, which were popular and widely available at the time of data collection in the second half of 2003, was presented based on a pilot study.[1] The list is shown in Appendix A. Participants were asked to indicate, for each of the games they knew, how often they played the game on a five-point scale ranging from "never" (0) to "very often" (4). Students' general use of electronic games was measured with two questions: (a) How often do you play electronic games in the course of the week (six-point scale: "every day" (6), "every other day" (5), "2–3 times a week" (4), "once a week" (3), "every other week" (2), "less than every other week" (1)) and (b) For how long do you normally play electronic games on the days you play (four-point scale: "less than half an hour" (1), "between 30 min and an hour" (2), "1–2 hrs" (3), "more than 2 hrs" (4)).

All games on the list were rated by adult experts for violent content. Six male students of communication studies doing research on video games were asked to provide an overall rating of violence for each game they knew, using a five-point scale that ranged from "free of violent content" (1) to "high level of violent content" (5).

Exposure to video game violence at Time 2. To assess exposure to violent video games at T2 in the same way as at T1 was impossible because participants' game preferences had changed very much in the course of 30 months, new games

[1]In the pilot study, a list of electronic games compiled on the basis of sales hit lists as provided in computer and games magazines and on web sites, sales ranks quoted by internet shops and stocks in pertinent shops were given to a sample of 112 girls and boys in Grade 7. Participants were asked to indicate, for each of the games they knew, how often they played the game on a five-point scale ranging from "never" to "very often" and how much they liked it, again on a five-point scale from "not at all" to "very much." To ensure the comprehensiveness of the list to be used in the main study, participants were given the opportunity to write down, in an open-ended format, up to five further games not included in the list that they particularly liked playing. All games that were regularly played by more than one quarter of the sample and the most frequently named games in the free nomination category were included in the list for the main study.

had appeared on the market, and games from the old list had gone out of fashion. Although a list of games seemed the most appropriate format for the sample of a younger age, comparisons of different methods showed that category-based questionnaires are more reliable for older respondents [Möller, 2006]. Therefore, at T2 participants were presented with a list of 15 categories of electronic games (including a prototypical example for each category), and asked to indicate for each category how often they played those games, using a five-point scale ranging from "never" (0) to "very often" (4). The list is shown in Appendix B. All categories were rated by a new group of adult experts for violent content. Eight students of computer science involved in video game research indicated the level of violence for each category using the same five-point scale described above. Finally, participants were asked to estimate the number of occasions per week they played electronic games and the length of time per session spent with this medium, using the same questions as at T1.

Normative beliefs about aggression. To measure the normative acceptance of aggression, a modified version of the normative beliefs scale by Krahé and Möller [2004] was used at both T1 and T2. It presented participants with a scenario describing a provocation by a peer that had the potential for eliciting various forms of aggressive responses. The vignette read as follows:

> Imagine you are extremely angry with a boy (girl) from your class because he/she treated you in a mean and unfair way in front of other classmates that morning. After school you meet him/her again and this time the two of you are alone. Immediately he/she starts quarrelling with you again, saying nasty things…

The scenario was framed in a male and a female form so that each student read about a confrontation with a same-sex peer. Following the scenario, a list of 12 possible reactions was presented and participants were asked to indicate how acceptable it would have been for them to respond in that particular way if they had been in the situation. Eight physically aggressive responses (e.g., "to kick and push him/her," "to destroy something belonging to him/her" or "to threaten to gang up with others to beat him/her up") and four responses reflecting indirect/relational aggression (e.g., "to spread rumors about him/her" or "to stir others up against him/her") were presented. Responses were made on a five-point scale ranging from "not at all ok" (1) to "totally ok" (5).

Hostile attribution bias. To measure participants' tendency to interpret ambiguous interactions in a hostile fashion, four vignettes were used. Two scenarios described a situation that led to physical harm. For example, one scenario read as follows:

> Imagine it is break time at school. You and your friends are hanging out in the school yard, standing together in a group and chatting. Next to you a group from another class is standing. You are thirsty and so you open a can of coke. You are about to take the first sip when someone from behind gives you a push. The coke is spilt all over your new white shirt and you are wet and sticky all over…

Two scenarios described a social interaction potentially leading to relational harm. An example was as follows:

> Imagine you are the last one in the changing room after a sports lesson. All your classmates have already left. You are in the washroom next door when two of your friends come back to collect a forgotten item. You overhear them talking about an upcoming party at the house of one of your friends where most of your classmates will be present. You have not been invited to that party…

Following each vignette, participants' hostile attribution bias was measured with an item that was tailored to the content of the scenario. For the spillage scenario, the item read: "Do you think the other person pushed you on purpose?" For the party invitation scenario, the item read: "Do you think your friend deliberately failed to invite you to the party?" Ratings were made on a five-point scale ranging from "not at all" (1) to "very much" (5). The scenarios were also framed in different forms for girls and boys, so that each participant imagined an interaction with a same-sex peer.

Aggressive behavior. To assess aggressive behavior, a German translation of seven items of the physical aggression subscale of the Buss and Perry [1992] aggression questionnaire was used (e.g., "If somebody hits me, I hit back" or "I have threatened people I know"). One further item referred to another form of physical aggression, "In a fight I have pulled the hair of another person, have scratched or have bitten someone." To measure indirect/relational aggression, seven items were developed on the basis of the indirect aggression scale by Buss and Warren [2000], such as "I sometimes spread gossip about people I don't like," or new items such as "I have spread rumors about

someone for revenge,'' yielding a total of 15 items for the aggression measure. Participants were asked to rate for each item how well it described their behavior within the present term of the school year (at both T1 and T2 this covered a time span of about 4 months). These ratings were made on a five-point scale ranging from ''not at all like me'' (1) to ''completely like me'' (5).

Procedure

All measures were administered during regular school lessons. Passive consent was obtained from parents in line with the regulations of the local school authority. None of the parents refused to give permission for their child to participate in the study. To control for possible order effects, the order of presentation of the three aggression-related instruments was counterbalanced across participants. Exposure to video games was always measured first to fit the introduction that the study was about media habits of adolescents. Following the completion of the measures, participants were informed about the aim of the study and engaged in a class discussion about electronic games and their potential effects on thoughts, feelings, and behavior. At the end of the T2 session, students and teachers were also informed about the cross-sectional results at T1. In addition, all participating schools received a written report about the findings.

RESULTS

Descriptive Results

To obtain a picture of participants' overall media use as a background for the analysis of exposure to violent media content, frequency of playing
electronic games per week and the duration of playing per session were computed for the total sample and broken down by participant sex. At T1, 40% used electronic games every day or every other day, 30.9% played between one and three times a week, 29.2% played less than once a week. Eighty-eight percent of boys played at least once a week, whereas only 54.9% of girls reported a regular game play of at least once a week. Boys also played longer than girls per session. Although 84.5% of boys played more than 1 hr per session, the same was true for only 39.8% of girls. Over time, boys showed a relatively stable pattern of video game usage, whereas girls showed a decrease in both frequency and duration per session. Analyses of variance with repeated measures yielded significant interaction effects for time and gender, with $F(1, 135) = 7.65$, $P < 0.001$ for frequency and $F(1, 135) = 17.71$, $P < 0.001$ for duration.

The ratings of violent content of games (T1) and categories (T2) provided by two separate groups of experts showed high inter-rater agreement. For the six raters who classified the games at T1, the intra-class correlation was .95. Across the eight raters for the categories at T2, the intra-class correlation was .98. On the basis of these high levels of agreement, violence ratings were averaged across raters to provide an index of violent content for each game and each category, respectively. The second columns of Appendices 1 and 2 display the mean violence ratings.

To create a measure of exposure to video game violence at T1, a violence frequency index was computed by multiplying the frequency rating for each game (0–4) by the expert violence rating for that game (possible range: 1–5) and then averaging across the 40 games. At T2, the violence frequency index was produced by multiplying the frequency rating for each category (0–4) with the violence rating for that category (1–5) and then averaging the products across the 15 categories. The descriptive statistics for the violence exposure measures are shown in Table I.

Table I also provides descriptive statistics for the aggression-related constructs. At both T1 and T2, a mean score was computed for the measure of normative beliefs regarding physical aggression by averaging ratings across the eight physical responses to the provocation scenario. The four items assessing normative beliefs about indirect/relational aggression were averaged into a normative belief score addressing indirect/relational aggression. For hostile attribution bias, the two items measuring perceived hostile intent for the two physical scenarios were averaged, as were the two items of hostile intent for the two relational scenarios. Finally, a physical aggression score was computed by aggregating across the eight physical aggression items, and an indirect/relational aggression score was computed by averaging responses across the seven indirect/relational items. Reliabilities for all measures were good, as indicated in Table I, with the exception of the measures of hostile intent pertaining to the two scenarios of physical and relational harm, respectively. As noted above, no differences were found on any of the measures between participants who dropped out after T1 and those who completed both T1 and T2.

Multivariate analyses of variance were conducted for both occasions to examine gender differences on all constructs. At T1, a significant multivariate effect

TABLE I. Internal Consistency, Means, and Standard Deviations of the Measures Included in the Analyses

	T1				T2			
	α	M (SD) total	M (SD) boys	M (SD) girls	α	M (SD) total	M (SD) boys	M (SD) girls
Violent video game exposure[c]	.92	2.08 (1.73)	2.96[a] (1.77)	1.22[b] (1.18)	.91	1.78 (2.16)	3.08[a] (2.27)	0.48[b] (.91)
Normative beliefs[d]								
Physical	.90	2.10 (1.10)	2.23 (1.09)	1.98 (1.09)	.92	1.94 (1.07)	2.35[a] (1.15)	1.53[b] (.79)
Indirect/relational	.73	2.28 (0.98)	2.30 (1.00)	2.26 (0.97)	.84	1.86 (0.86)	1.96 (0.91)	1.75 (.80)
Hostile attribution bias[d]								
Physical	.23	3.26 (0.90)	3.40[a] (0.93)	3.12[b] (0.86)	.25	3.25 (0.83)	3.43[a] (0.86)	3.07[b] (.76)
Indirect/relational	.45	3.29 (1.00)	3.10[a] (0.97)	3.48[b] (1.00)	.54	3.40 (1.02)	3.35 (1.15)	3.45 (.87)
Aggressive behavior[d]								
Physical	.81	2.35 (0.85)	2.37 (0.72)	2.34 (0.96)	.80	2.29 0(.80)	2.50[a] (0.72)	2.07[b] (.83)
Indirect/relational	.74	1.88 (0.73)	1.91 (0.71)	1.86 (0.75)	.75	1.71 (0.70)	1.87[a] (0.72)	1.56[b] (.65)

[a,b]Sex difference significant with at least $P < .05$.
[c]Range: 0–20.
[d]Range: 1–5.

TABLE II. Correlations Between the Model Variables at T1 (Columns; $N = 295$) and T2 (Rows; $N = 143$)

	Time T1 variables						
Time T2 variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Violent video game exposure	**.58*****	.25***	.12	.10	−.02	.18**	.21***
(2) Normative beliefs: physical aggression	.38***	**.28*****	.64***	.21***	.07	.55***	.38***
(3) Normative beliefs: indirect/relational aggression	.14	.62***	**.14**	.12*	.12*	.39***	.48***
(4) Hostile attribution bias: physical aggression	.20**	.27**	.16	**.28*****	.20***	.29***	.16**
(5) Hostile attribution bias: indirect/relational aggression	−.06	.12	.22**	.14	**.45*****	.19**	.08
(6) Physical aggression	.39***	.61***	.44***	.21*	.14	**.29*****	.60***
(7) Indirect/relational aggression	.22**	.53***	.55***	.14	.21*	.60***	**.11**

$^{***}P < .001$, $^{**}P < .01$.
Note: Figures in bold in the diagonal indicate stability coefficients from T1 to T2.

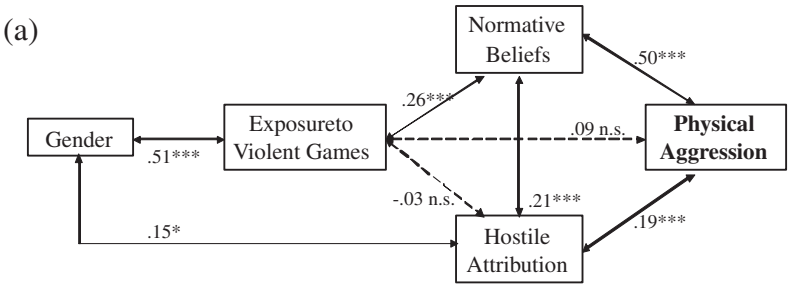
was found, $F(7, 258) = 16.54$, $P < .001$. Three univariate effects were significant. On game violence exposure, boys scored higher than girls, as can be seen from Table I, $F(1, 264) = 88.31$, $P < .001$. Boys also scored higher on hostile attribution bias for the physical scenarios, $F(1, 264) = 6.54$, $P < .05$, and girls scored higher on hostile attribution bias for the relational scenarios, $F(1, 264) = 9.94$, $P < .01$.

At T2, the multivariate gender effect was also significant, $F(7, 132) = 13.09$, $P < .001$. Five of the univariate effects were significant, all reflecting higher scores for boys than for girls. Boys scored higher on violent video game usage, $F(1, 138) = 78.61$, $P < .001$, on the normative acceptance of physical aggression, $F(1, 138) = 23.78$, $P < .001$, and on the attribution of hostile intent for the physical scenarios, $F(1, 135) = 6.64$, $P < .001$. Boys also reported more physical aggression, $F(1, 138) = 6.59$, $P < .01$, as well as indirect/relational aggression, $F(1, 138) = 7.25$, $P < .01$. All means are displayed in Table I.

The correlations between exposure to violent electronic games, endorsement of aggressive norms, hostile attributional style, and aggressive behavior at both times as well as the stability coefficients of the constructs over time are displayed in Table II. The highest stability was found for exposure to violent video games over the 30-months period ($r = .58$), suggesting that despite the difference in format the two operationalizations tap into the same underlying construct. Indirect/relational and physical aggression were also substantially correlated cross-sectionally at both points in time (rs = .60).

Cross-Sectional Findings at T1

To examine the cross-sectional relationship between gender and violent game usage as predictors of aggression-related norms, hostile attribution bias, and aggressive behavior, two path analyses were conducted with the T1 sample, using the *Mplus* statistical programme [Muthén and Muthén, 2007]. As one of the objectives of the study was to examine potential carry-over effects from physical to indirect/relational aggression, separate models were



***$p < .001$, **$p < .01$, *$p < .05$

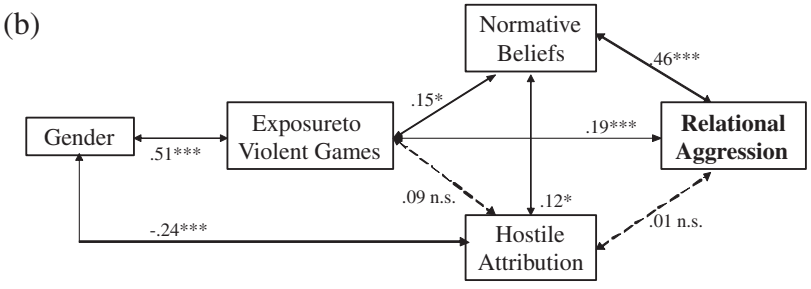
R^2 = .26 for Exposure to Violent Games;

R^2 = .06 for Normative Beliefs (phy);

R^2 = .07 for Hostile Attribution (phy);

R^2 = .34 for Aggressive Behavior (phy).

Note: Paths from gender to normative beliefs and aggressive behavior were non-significant and are not shown in the model.



***$p < .001$, * $p < .05$

R^2 = .26 for Exposure to Violent Games;

R^2 = .02 for Normative Beliefs (rel);

R^2 = .06 for Hostile Attribution (rel);

R^2 = .26 for Aggressive Behavior (rel).

Note: Paths from gender to normative beliefs and aggressive behavior were non-significant and are not shown in the model.

Fig. 1. Path analysis for the cross-sectional relationships at T1 for physical aggression (Panel a) and indirect/relational aggression (Panel b).

tested for physical and indirect/relational aggression and the corresponding normative beliefs and attributions of hostile intent. The findings of these analyses are displayed in Figure 1.[2] The decision to use the T1 data for the cross-sectional analyses was based on the larger *N* and hence greater power compared with T2. We decided to run these analyses for the combined sample of boys and girls despite differences in the mean level of violent video game usage because preliminary regression analyses on the T1 data showed no interactions between gender and violent game usage on norms, attributional bias, and aggressive behavior. This indicates that although boys and girls differed in the extent to which they used violent games, accepted aggression as normative and tended to attribute hostile intent, the relationship between the variables was similar for both gender groups.

The top panel of Figure 1 displays the model for physical aggression and norms as well as hostile attributions with respect to physical aggression. Gender was a strong predictor of violent game usage, with boys playing more than girls. No direct path was found from exposure to violent games and

[2]For the path models shown in Figures 1 and 2, the fit indices are CFI = 1.00, RMSEA = .00. They cannot be interpreted as meaningful because all possible paths were allowed into the model.

aggressive behavior, but exposure to violent games had an indirect effect on aggressive behavior via the normative acceptance of aggression. Finally, a significant path was also found from hostile attribution bias to aggressive behavior. In combination, the indirect paths identified by the model support the mediation effect predicted in Hypothesis 1.Overall, exposure to video game violence, aggression-enhancing norms, and hostile attribution in ambiguous situation explained 34% of the variance in physical aggression cross-sectionally at T1.

The bottom panel of Figure 1 shows the pathways from exposure to video game violence to indirect/relational aggression via norms and attributions pertaining to that form of aggression. In this model, a direct path was found from violent video game usage to indirect/relational aggression. In addition, there was evidence of an indirect path from violent game usage to indirect/relational aggression via normative beliefs. Hostile attributional bias was not linked to indirect/relational aggression. In total, 26% of the variance in indirect/relational aggression was explained by violent video game usage, normative beliefs, and hostile attribution bias regarding indirect/relational aggression.

Longitudinal Analyses

To examine the longitudinal relationships between video game violence exposure and aggressive behavior, two further sets of path analyses were performed. The first focussed on aggressive behavior and exposure to video game violence as the two critical variables specified in Hypothesis 2, looking at physical aggression and indirect/relational aggression separately. The results, presented in Figure 2, show that video game exposure at T1 was a significant predictor of physical aggression at T2, whereas the path from physical aggression at T1 to violent video game exposure at T2 was nonsignificant. This pattern suggests that a preference for violent video games is a contributory factor to subsequent physical aggression over a period of 30 months rather than indicating a reverse causal relationship as argued in the selection hypothesis. For indirect/relational aggression, exposure to violent games was unrelated to aggressive behavior 30 months later. Thus, there are no indications in the present data that exposure to (physical) violence in video games contributes to an increase in indirect/relational aggression over time.

To test the long-term mediational role of normative beliefs and hostile attributions predicted in Hypothesis 3, we conducted two path analyses, one for physical and one for indirect/relational aggression, in which T1 violent video game use was included as predictor and T2 normative beliefs and hostile attributions were included as mediators, controlling for T1 normative beliefs, hostile attributions, and aggressive behavior. The results are shown in Figure 3.

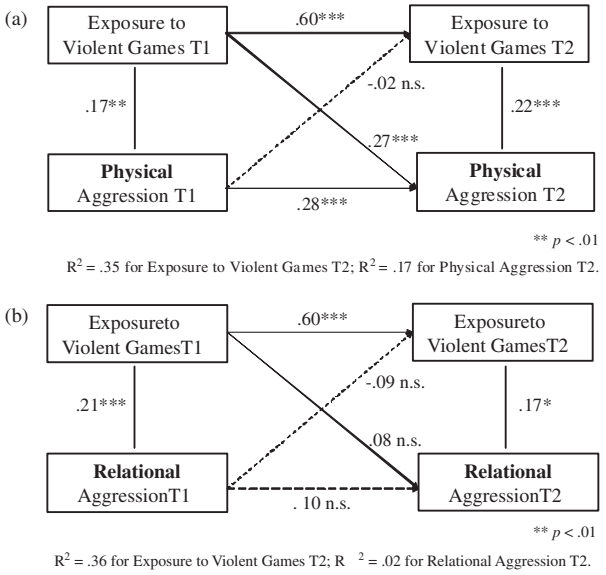


Fig. 2. Path model for longitudinal relationships between exposure to violent video games and aggression over a 30-month period for physical aggression (Panel a) and indirect/relational aggression (Panel b).

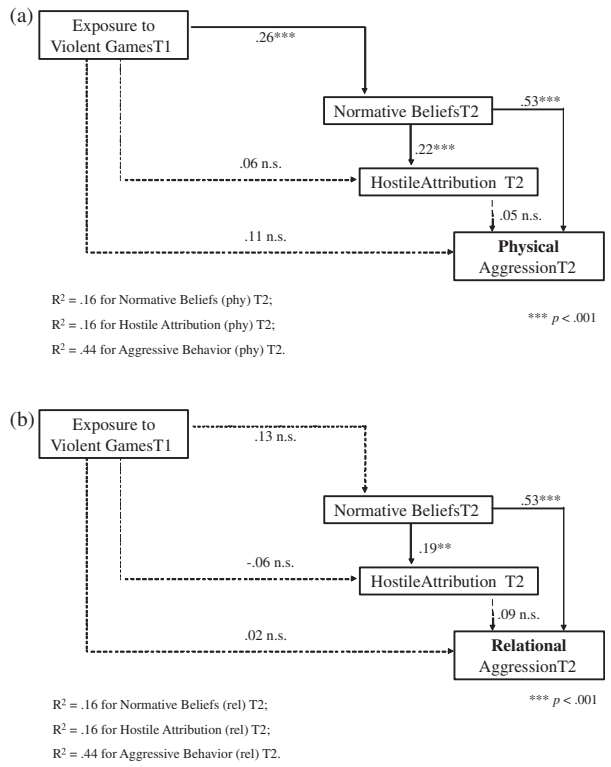


Fig. 3. Path model for the longitudinal prediction of physical aggression (Panel a: χ^2 (6) = 4.46, P = .59, CFI = 1.00, RMSEA = .00, SRMR = .03) and indirect/relational aggression (Panel b: χ^2 (6) = 13.13, P = .04; CFI = 0.93, RMSEA = .06, SRMR = .04).

The model for physical aggression, displayed in the top panel of Figure 3, shows an acceptable fit, $\chi^2(6) = 4.46$, $P = .59$ CFI = 1.00, RMSEA = .00, SRMR = .03. In line with Hypothesis 3, exposure to video game violence at T1 was a significant predictor of the normative acceptance of aggression at T2, which in turn predicted aggressive behavior at T2. Although the pathway from violence exposure to hostile attributions via normative beliefs was significant, hostile attribution bias did not predict aggressive behavior.

The model fitted the data less well for indirect/relational aggression, $\chi^2(6) = 13.13$, $P = .04$; CFI = 0.93, RMSEA = .06, SRMR = .04. Video game violence exposure was unrelated to normative beliefs about indirect/relational aggression 30 months later and was also unrelated to hostile attributions and aggressive behavior. The only significant path identified in this model was from normative acceptance of indirect/relational aggression to actual indirect/relationally aggressive behavior. In combination, the data presented in Figure 3 suggest that the usage of violent video games is linked to an increase in normative acceptance and behavioral performance of physical aggression over time, but there is no indication of a transfer to indirect/relational aggression.

DISCUSSION

This study sought evidence for the predicted pathway from exposure to violent video games to aggressive behavior, both cross-sectionally and over a period of 30 months, and examined the role of aggression-enhancing normative beliefs and hostile attributional style as mediators in this relationship. A group of German secondary school students was measured twice with an interval of 30 months between the ages of 13 and 16. In terms of general amount of time spent playing electronic games, the present sample was similar to a much larger representative sample studied in the recent KIM study [Medienpädagogischer Forschungsverbund Süd-West, 2006].

Corroborating earlier research, exposure to violent video games was higher in boys than in girls. Boys not only spent more time with playing those games in general but also showed a higher interest in violent themes, as reflected in their preference for action and shooter games. The only other game category with a similarly high frequency of playing was sport games (especially soccer and racing games). It is also interesting to note that boys' frequency of playing remained stable across age, whereas girls' playing time decreased significantly over the 30 months time. Overall, exposure to violent games was low in the present sample, with means of just over 2 on a measure ranging from 0 to 20. However, the fact that significant relationships between playing violent games and aggressive cognitions as well as behaviors could be identified even at a low level of exposure points to the risks involved in this type of leisure activity, not just cross-sectionally but also over an extended period of time.

The longitudinal design of the study enabled us to examine the directionality of the link between exposure to violent games and aggression, looking separately at physical and indirect/relational aggression. The findings for physical aggression provide no support for the "selection hypotheses," assuming that those who are more aggressive are more attracted to and spend more time playing violent games. In contrast, the results of the path analysis clearly support the "socialization hypothesis," stipulating that those who spend more time playing violent video games become more physically aggressive. The pattern of gender differences observed at

T1 and T2 fit in well with this explanation. Although no gender differences were found at T1 on the measures of physical aggression and normative acceptance of physical aggression, boys did score higher than girls on these measures at T2. For indirect/relational aggression, a cross-sectional link was found between violent video game usage and aggression. However, there was no link from violent video game usage at T1 to subsequent aggressive behavior, suggesting that the long-term consequences of violent video game play are specific to the physical violence portrayed by these games. The longitudinal study by Ostrov et al. [2006] did find evidence of a longitudinal relationship between media violence exposure and indirect/relational aggression, but their study differed from the present research in that the time span covered was considerably shorter, participants were considerably younger and the level of violence to which they were exposed was likely to be lower.

The data are also relevant to the Downward Spiral Model by Slater et al. [2003] that assumed a mutual reinforcement of aggressive behavioral tendencies and media violence exposure, leading to an escalation of aggression over time. Just like Slater et al., who studied the combined effect of different media, we failed to find that trait aggression prospectively predicted exposure to violent media content when focussing on the category of violent video games.

In line with our predictions, exposure to violent games increased the acceptance of physical aggression as a conflict-solving strategy as reflected in the normative beliefs measure. Furthermore, norms were shown to mediate the relationship between media violence and attribution, supporting earlier findings from a cross-sectional study by Krahé and Möller [2004]. The data also support previous research by Huesmann and Guerra [1997], who found that normative beliefs condoning aggression predicted aggressive behavior in older children and adolescents.

In contrast to other studies [e.g., Anderson et al., 2007; Kirsh, 1998] that found a direct link between exposure to media violence and the hostile attribution bias, no such link was found in this study. Instead, exposure to game violence affected hostile attributional tendencies via the normative acceptance of physical aggression. Social-cognitive theories provide a basis for explaining the mediating function of norms [Bandura, 1973; Berkowitz, 1993; Eron et al., 1971]. They suggest that normative beliefs are the components of knowledge structures that are a part of aggressive scripts [Huesmann, 1998] and interact with affect and arousal to pave the way for aggressive behavior [Carnegy and Anderson, 2004]. They feed into dynamic strategies of information processing in a given situation, such as interpreting the behavior of a stimulus person in ambiguous situations in terms of hostile intent. Norms are conceptualized as filter variables directing information processing in specific situations, both in terms of the perception and interpretation of critical events and in terms of decision-making about an appropriate response. The present findings fit in well with this line of reasoning in that normative beliefs served as an antecedents of hostile attributions in a specific (although hypothetical) situation. However, the proposed path from hostile attributions to aggressive behavior, apparent cross-sectionally at T1, was not found in the longitudinal analysis.

Some limitations need to be noted about this study. The first is the relatively small sample size for the longitudinal analysis. Owing to the long interval between the two measurement occasions, only half of the participants at T1 could be measured again at T2. Therefore, future studies covering a similar length of time should start with a larger sample to compensate for inevitable drop-outs and increase the power for detecting significant paths. The second limitation is the low reliability of the two-item measures of hostile intent attributed to the actors in the physical and indirect/relational harm scenarios. The items had to be tailored to the scenarios and did not show high intercorrelations within each type of scenario, thereby undermining not just the reliability but also the validity of this measure. Although a significant path from hostile attributions to physical aggression was identified in the cross-sectional analysis, the failure to demonstrate the mediating role of hostile attributions may be explained at least partly by this problem. Third, additional variables that could have moderated the link between violent game exposure and aggression, such as the level of aggression in participants' social environment, were not considered in this study. Finally, our data are based exclusively on self-report measures, which may have led to an overestimation of the relationships owing to common method variance. Although this is a feature of many, if not most other studies in this area [see Anderson et al., 2007, for a notable exception], there is clearly a need to include other sources of information, such as peer or teacher ratings of aggression.

Despite these limitations, this study was able to contribute to the small body of longitudinal evidence on the link between media violence and aggression. It complements earlier studies conducted

with younger children [Anderson et al., 2007; Huesmann et al., 2003] by showing that for adolescents the use of violent electronic games also has a long-term effect on aggressive behavior in the form of physical aggression. There is no indication in the present data that the effects transfer to indirect/relational aggression, which is not commonly addressed by the contents of the games. This finding is also in line with the results reported by Anderson et al. [2007] for indirect/relational aggression. In addition, it was demonstrated that the normative acceptance of physical aggression is an important cognitive mediator in this relationship. These normative beliefs could be addressed in interventions aimed at reducing the harmful effects of media violence exposure by "active mediation", challenging the normative acceptance of aggression inherent in violent video games that reward aggression [Kirsh, 2006, p 293]. For planning effective interventions, however, additional risk factors such as arousability or sensation seeking should be considered in further research to identify high-risk groups for the detrimental effects of media violence.

APPENDIX A

List of electronic games included at T1.

Name of game	Violence rating[a]	% Played of total sample	Frequency[b] M (SD) for total sample	Age recommendation[c]
Age of Empires	2.33	34.7	0.74 (1.15)	12
Anno 1503	1.67	17.0	0.34 (0.87)	6
Command & Conquer	2.83	29.3	0.73 (1.18)	16
Counterstrike	4.33	50.0	1.42 (1.61)	18
Delta Force	3.00	19.9	0.35 (0.89)	16
Diablo	3.00	26.7	0.54 (1.07)	16
Die Siedler	1.69	27.6	0.61 (1.10)	12
Die Sims	1.17	50.9	1.38 (1.48)	6
DTM Race Driver	1.00	23.7	0.51 (1.08)	6
Enter the Matrix	3.40	38.1	0.86 (1.33)	16
FiFa Football	1.00	60.2	1.64 (1.62)	No limit
Final Fantasy	2.84	31.4	0.81 (1.33)	12
Formel 1	1.33	44.1	0.97 (1.30)	6
Fußball Manager	1.17	31.4	0.82 (1.36)	6
Gran Turismo	1.00	28.4	0.73 (1.31)	No limit
Grand Theft Auto	4.50	55.1	1.53 (1.64)	16
Harry Potter	1.33	42.8	0.87 (1.22)	6
Indiana Jones	2.60	14.8	0.26 (0.70)	12
James Bond 007	3.50	43.2	0.98 (1.31)	16
Jedi Knight	3.50	18.2	0.37 (0.92)	16
Mafia	4.25	36.9	0.98 (1.48)	16
Max Payne	4.83	26.7	0.46 (1.07)	18
Medal of Honor	4.75	25.9	0.75 (1.34)	18
Moorhuhn	2.80	56.4	1.15 (1.29)	12
Need for Speed	1.17	48.7	1.47 (1.65)	No limit
Quake	4.50	15.3	0.28 (0.86)	18
Rayman	1.50	37.7	0.80 (1.19)	No limit
Resident Evil	4.50	37.3	1.08 (1.49)	18
Stronghold	1.50	12.3	0.29 (0.84)	12
Tekken	3.50	61.0	1.59 (1.54)	16
The Legend of Zelda	1.60	28.4	0.73 (1.28)	6
Tomb Raider	2.33	59.3	1.26 (1.37)	12
Tom Clancy's Splinter Cell	3.00	22.5	0.60 (1.22)	16
Tony Hawks Pro Skater	1.00	39.0	1.07 (1.46)	6
Unreal 2	3.75	12.7	0.27 (0.80)	16
Unreal Tournament	3.83	16.1	0.41 (1.01)	16
Vampire	3.17	28.0	0.63 (1.17)	16
Vietcong	4.00	10.2	0.10 (0.42)	16
WarCraft	2.67	19.5	0.52 (1.16)	12
Yu-Gi-Oh!	2.00	34.8	0.86 (1.41)	6

[a]Scale ranging from 1 = free of violent content to 5 = high level of violent content.
[b]Scale ranging from 0 = never to 4 = very often.
[c]Age recommendation as provided by the USK, the German Entertainment Software Self-Regulating Board.

APPENDIX B

List of categories of electronic games included at T2.

Name of category (example)	Violence rating[a]	% Played of total sample	Frequency[b] M (SD)
Beat'em Ups (Tekken)	3.71	29.8	0.47 (0.82)
Shoot'em Ups (Space Invaders)	3.33	14.6	0.23 (0.62)
1st-Person-Shooter (Half-Life)	5.00	46.5	0.97 (1.20)
3rd-Person-Shooter (Max Payne)	5.00	31.8	0.61 (0.99)
Tactics-Shooter (Rainbow Six)	4.43	32.8	0.65 (1.04)
Survival Horror (Resident Evil)	5.00	34.8	0.70 (1.08)
Genremix (Grand Theft Auto)	3.57	48.5	1.13 (1.28)
Classic Adventures (Runaway)	1.57	18.7	0.27 (0.63)
Action Adventures (Tomb Raider)	3.00	31.3	0.52 (0.89)

Role-Playing Games (Gothic)	2.94	29.3	0.57 (1.01)
Simulation (The Sims)	1.21	28.3	0.46 (0.84)
Military Simulation (IL-2 Sturmovik)	3.38	24.7	0.45 (0.90)
Sports (team sports; racing games)	1.19	49.5	1.06 (1.22)
Strategy Games (The Settlers)	1.88	39.9	0.76 (1.06)
Military Strategy (Command & Conquer)	3.13	35.4	0.74 (1.12)

[a]Scale ranging from 1 = free of violent content to 5 = high level of violent content.
[b]Scale ranging from 0 = never to 4 = very often.

REFERENCES

Anderson CA. 2004. An update on the effects of playing violent video games. J Adolesc 27:113–122.

Anderson CA, Bushman BJ. 2001. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. Psychol Sci 12:353–359.

Anderson CA, Gentile DA, Buckley KE. 2007. Violent Video Game Effects on Children and Adolescents: Theory, Research, and Public Policy. Oxford: Oxford University Press.

Bandura A. 1973. Aggression: A Social Learning Theory Analysis. Englewood Cliffs, NJ: Prentice-Hall.

Berkowitz L. 1993. Aggression: Its Causes, Consequences, and Control. Philadelphia, PA: Temple University Press.

Bjorkqvist K, Lagerspetz K, Kaukiainen A. 1992. Do girls manipulate and boys fight? Developmental trends in regard to direct and indirect aggression. Aggr Behav 18:117–127.

Braun CM, Giroux J. 1989. Arcade video games: Proxemic, cognitive and content analyses. J Leis Res 21:92–105.

Burks VS, Laird RD, Dodge KA, Pettit GS, Bates JE. 1999. Knowledge structures, social information processing, and children's aggressive behavior. Soc Dev 8:220–236.

Bushman BJ, Huesmann LR. 2001. Effects of televised violence on aggression. In: Singer D, Singer J (eds). Handbook of Children and the Media. Thousand Oaks, CA: Sage, pp 223–254.

Buss AH, Perry M. 1992. The aggression questionnaire. J Pers Soc Psychol 63:452–459.

Buss AH, Warren WL. 2000. Aggression Questionnaire. Manual. Los Angeles, CA: WPS.

Carnagey NL, Anderson CA. 2004. Violent video game exposure and aggression: A literature review. Minerva Psichiatr 45:1–18.

Crick N. 1995. Relational aggression: The role of intent attributions, feelings of distress, and provocation type. Dev Psychopathol 7:313–322.

Crick N, Dodge KA. 1994. A review and reformulation of social information-processing mechanisms in children's social adjustment. Psychol Bull 115:74–101.

Crick N, Grotpeter JK. 1995. Relational aggression, gender, and social-psychological adjustment. Child Dev 66:710–722.

Crick N, Bigbee MA, Howes C. 1996. Gender differences in children's normative beliefs about aggression: How do I hurt thee? Let me count the ways. Child Dev 67:1003–1014.

Dietz TL. 1998. An examination of violence and gender role portrayals in video games: Implications for gender socialization and aggressive behavior. Sex Roles 38:425–442.

Dill KE, Dill JC. 1998. Video game violence: A review of the empirical literature. Aggression Violent Behav 3:407–428.

Dill KE, Anderson CA, Anderson KB, Deuser WE. 1997. Effects of aggressive personality on social expectations and social perceptions. J Res Pers 31:272–292.

Dodge KA, Coie JD. 1987. Social information-processing factors in reactive and proactive aggression in children's playgroups. J Pers Soc Psychol 53:1146–1158.

Erdley CA, Asher SR. 1998. Linkages between children's beliefs about the legitimacy of aggression and their behavior. Soc Dev 7:321–339.

Eron LD, Walder LO, Lefkowitz MM. 1971. The Learning of Aggression in Children. Boston: Little, Brown.

Gentile DA, Anderson CA. 2006. Violent video games: Effects on youth and public policy implications. In Dowd NE, Singer DG, Wilson RF (eds). Handbook of Children, Culture, and Violence. Thousand Oaks, CA: Sage Publications, pp 225–246.

Griffiths M. 1999. Violent video games and aggression: A review of the literature. Aggression Violent Behav 4:203-212.

Höynck T, Mößle T, Kleimann M, Pfeiffer C, Rehbein F. 2007. Jugendmedienschutz bei Gewalthaltigen Computerspielen. Forschungsbericht Nr. 101. Hannover: Kriminologisches Forschungsinstitut Niedersachsen.

Huesmann LR. 1998. The role of social information processing and cognitive schema in the acquisition and maintenance of habitual aggressive behavior. In Geen RG, Donnerstein E (eds). Human Aggression. Theories, Research, and Implications for Social Policy. San Diego: Academic Press, pp 73–109.

Huesmann LR, Guerra NG. 1997. Children's normative beliefs about aggression and aggressive behavior. J Pers Soc Psychol 72:408–419.

Huesmann LR, Kirwil L. 2007. Why observing violence increases the risk of violent behavior by the observer? In Flannery D, Vazinsyi A, Waldman I (eds). Cambridge Handbook of Violent Behavior. Cambridge: Cambridge University Press, pp 545–570.

Huesmann LR, Moise-Titus J, Podolski C-L, Eron LD. 2003. Longitudinal relations between children's' exposure to TV violence and their aggressive and violent behavior in young adulthood: 1977–1992. Dev Psychol 39:201–221.

Kirsh SJ. 1998. Seeing the world through Mortal Kombat-colored glasses: Violent video games and the development of a short-term hostile attribution bias. Childhood 5:177–184.

Kirsh SJ. 2003. The effects of violent video games on adolescents: The overlooked influence of development. Aggression Violent Behav 8:377–389.

Kirsh SJ. 2006. Children, Adolescents, and Media Violence. Thousand Oaks, CA: Sage.

Klimmt C. 2004. Computer- und videospiele. [Computer and video games]. In: Mangold R, Vorderer P, Bente G (eds). Lehrbuch der Medienpsychologie. Göttingen: Hogrefe, pp 696–716.

Krahé B, Möller I. 2004. Playing violent electronic games, hostile attributional style, and aggression-related norms in German adolescents. J Adolesc 27:53–69.

Medienpädagogischer Forschungsverbund Süd-West (Hg.) 2006. KIM-Studie 2006. Kinder+Medien, Computer und Internet. Retrieved July 30, 2008, from http://www.mpfs.de/fileadmin/KIM-pdf06/KIM2006.pdf.

Möller I. 2006. Violent video games and aggression: Methodological considerations and results of online and offline surveys. Paper presented at the XI. Workshop of Aggression Research, November 2006, Marburg, Germany.

Muthén LK, Muthén BO. 2007. Mplus User's Guide. Statistical Analysis with Latent Variables. Los Angeles, CA: Muthén & Muthén.

Ostrov J, Gentile DA, Crick NR. 2006. Media exposure, aggression and prosocial behavior during early childhood: A longitudinal study. Soc Dev 15:612–627.

Rys GS, Bear GG. 1997. Relational aggression and peer relations: Gender and developmental issues. Merrill-Palmer Q 43:87–106.

Sherry JL. 2001. The effects of violent video games on aggression. A meta-analysis. Human Commun Res 27:409–431.

Slaby RG, Guerra NG. 1988. Cognitive mediators of aggression in adolescent offenders: 1. Assessment. Dev Psychol 24:580–588.

Slater MD, Henry KL, Swaim RC, Anderson LL. 2003. Violent media content and aggressiveness in adolescents: A downward spiral model. Commun Res 30:713–736.

Smith SL, Lachlan K, Tamborini R. 2003. Popular video games: Quantifying the presentation of violence and its context. J Broadcasting and Electronic Media 47:58–76.

Thompson KM, Haninger K. 2001. Violence in E-rated video games. J Am Med Assoc 286:591–598.

VanOostrum N, Horvath P. 1997. The effects of hostile attribution on adolescents' aggressive responses to social situations. Can J Sch Psychol 13:48–59.