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Violent Media Content and Aggressiveness in Adolescents

A Downward Spiral Model

Theory and research on media violence provides evidence that aggressive youth seek out media violence and that media violence prospectively predicts aggression in youth. The authors argue that both relationships, when modeled over time, should be mutually reinforcing, in what they call a downward spiral model. This study uses multilevel modeling to examine individual growth curves in aggressiveness and violent media use. The measure of use of media violence included viewing action films, playing violent computer and video games, and visiting violence-oriented Internet sites by students from 20 middle schools in 10 different regions in the United States. The findings appear largely consistent with the proposed model. In particular, concurrent effects of aggressiveness on violent-media use and concurrent and lagged effects of violent media use on aggressiveness were found. The implications of this model for theorizing about media effects on youth, and for bridging active audience with media effects perspectives, are discussed.

Keywords: *media effects; violent media content; aggression; selective exposure*

A substantial and growing body of research supports the claim that youth exposure to media violence leads to increased aggressiveness (for recent reviews, see Anderson & Bushman, 2002; Bushman & Anderson, 2001). Nonetheless, few if any of the studies on which such claims are based (other than laboratory experiments) systematically take into account selective

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exposure as an alternative explanation for the relationship of media exposure with aggressiveness. In other words, if the same predispositions that lead to aggressive behavior also lead to using violent media content, many of the relationships found in cross-sectional and even many longitudinal studies might be called into question.

The present study proposes and tests a so-called downward spiral model for the relationship of violent media content and aggressiveness among youth (which we have previously referred to as a "negative feedback loop" model; Slater, 2003). This model accounts for both selective exposure due to aggressive tendencies resulting in choice of violent media content and for the effects of exposure to such content on subsequent aggressiveness. The central proposition of this model is that although aggressive tendencies may lead youth to seek out media content consistent with those tendencies, the resulting exposure reinforces and exacerbates those aggressive tendencies.

Evidence for Effects of Violent Media Content on Youth

A recent review and meta-analysis by Anderson and Bushman (2002) of 284 studies strongly supported the proposition that media violence influences aggression. Effect sizes are largest (near .3) for the 124 laboratory experiments and for the 28 field experiments (just over .2), which can control for selective exposure effects through experimental manipulations. Nonexperimental studies, in contrast, have the advantage of testing behavior and responses in naturally occurring contexts. Effects for the 46 longitudinal and 86 cross-sectional studies are closer to .17, but the 95% confidence interval for each of these does not cover zero. Although the effect sizes are at best modest, they are nontrivial given the population-wide exposure to media violence. As these authors point out, the effect sizes are larger than the effects of calcium intake on bone mass or lead exposure on IQ in children, both significant public health risks.

Anderson and Bushman (2002) noted in particular a recent longitudinal study of adolescents and young adults that found evidence for television viewing effects on subsequent aggression, after incorporation of extensive statistical controls (Johnson, Cohen, Smailes, Kasen, & Brook, 2002). They lauded the study as the first to examine longitudinal effects on adolescents rather than on children. The primary limitation of the Johnson et al. (2002) study, as they noted, is the use of hours of overall television viewing as the predictor variable, rather than exposure to media violence per se. On one hand, overall television exposure is a conservative measure, being correlated with violent content on television but only imperfectly, which should diminish effects. However, it does limit estimation of selective exposure to violent media content. Johnson et al. (2002) found some evidence that aggression predicted subsequent television viewing in general, although the relationship between this differential amount of exposure and effects of aggression were not conceptually explored or explicitly modeled.

The present study, as detailed below, both uses exposure to violent media content as such among adolescents and controls for selective exposure effects by modeling such effects analytically.

Research on effects of use of violent content on interactive media such as video games and the Internet is considerably more recent, and studies are fewer in number. Most of the few correlational studies that exist rarely distinguished between violent and nonviolent video games (e.g., Fling et al., 1992; Lin & Lepper, 1987; Van Schie & Wiegman, 1997). The one study that did make such a distinction found a positive correlation between violent video game use and aggression (Anderson & Dill, 2000).

The latter study also incorporated a rigorous experimental test that found evidence for short-term increases in aggressiveness as a result of violent video game use. It should be noted, however, that extant studies as reviewed by Anderson and Dill (2000) are fairly evenly split between studies that do and do not find statistically significant effects.

Nonetheless, the potential for use of interactive violent content to influence aggression, as Anderson and Dill (2000) pointed out, is quite high, given that game players actually engage in aggressive activity in a fantasy context. Similarly, use of Internet sites that are violence oriented may be of particular concern because they can provide social support for aggressive tendencies and interests (Slater, 2003). Moreover, use of television is being displaced by use of interactive media among adolescents (Kayany & Yelsma, 2000), so the relationship of interactive media to aggressiveness among teens deserves close attention. The present study incorporates use of violent interactive media content in its measurement and analyses.

Evidence for Selective Exposure to Violent Media Content

Selective exposure theory is concerned with how and why individuals orient their attention to specific communication stimuli (Zillman & Bryant, 1985). From this perspective, people are believed to select mediated content based on their own psychological needs as well as situational influences, consistent with arguments made by uses and gratifications researchers (McGuire, 1974; Palmgreen, 1984; Palmgreen & Rayburn, 1985).

In the 1970s and 1980s, several studies did find support for the proposition that aggressiveness was linked with viewing violent programming on television (e.g., Atkin, 1985; Robinson & Bachman, 1972). More recent studies have focused on specific dispositional and psychosocial variables predicting use of violent media content. For example, several studies have established a relationship between sensation-seeking, aggressiveness, and risk-taking orientation with use of mediated violence from a variety of genres, including television (Krcmar & Greene, 1999, 2000), action films (Aluja-Fabregat, 2000; Slater, 2003), and video games and the Internet (Anderson & Dill, 2000; Slater, 2003). Although cross-sectional relationships between aggression and media violence are of uncertain causal direction, the relationships between risk-taking orientations such as sensation-seeking and media violence almost certainly represent selective exposure. There is substantial evidence that sensation-seeking is a dispositional characteristic, probably with at least some genetic basis (Bardo & Mueller, 1991; Zuckerman, 1988). Obviously, exposure to violent media content should not substantially affect an innate disposition, leading to the conclusion that selective exposure effects were operative.

A Downward Spiral Model of Media Effects on Youth

The empirical evidence, as Anderson and Bushman (2002) summarized, clearly supports a relationship between consumption of media violence and aggression among youth. Empirical evidence, as noted above, is also supportive of a selective exposure mechanism, in which predispositions and tendencies that may be related to aggression also predict use of violent-media content.

These are not competing explanations. Indeed, it would be surprising to find anything else. Recent research in uses and gratifications, for example, suggests that people select media content that meets their psychological needs (Finn, 1997; Krcmar & Greene, 2000). That does not by any means preclude the possibility that such selected exposure will increase antisocial attitudes or behavior associated with those psychological tendencies. In fact, we might expect persons attracted to violent media content because of their aggressive tendencies to be especially vulnerable to the effects of such exposure.

There is an unfortunate tendency, perhaps borne of excessive familiarity with cross-sectional data, to speak of competing causal explanations when a causal flow may move in both directions. It is only slightly less misleading, in cases such as these, to speak in terms of reciprocal relationships. Reciprocal relationships over time, by definition, should be mutually reinforcing, cumulative in impact, and directional. When the drives, the behaviors, and their consequences are positive, the long-term outcomes can be expected to be positive. When these are antisocial and potentially destructive, they represent a downward spiral, perhaps modest in slope, perhaps in some cases dramatic. Such psychological processes have been described in other contexts using terms such as “cumulative and interactive continuity” (Caspi, Elder, & Bem, 1987), “risk amplification” (Whitbeck, Hoyt, & Yoder, 1999), and the term that we are adopting in this context, downward spiral (Mullings, Marquart, & Diamond, 2001). In the context of aggressive tendencies and use of violent media content, a pattern of reciprocal relationships appearing over time would be consistent with a downward spiral model. Therefore:

Hypothesis 1: There will be a significant predictive relationship between aggressiveness and both contemporaneous and subsequent violent media use, after controlling for relevant covariates.

Hypothesis 2: There will be a significant predictive relationship between violent media content use and both contemporaneous and subsequent aggressiveness, after controlling for relevant covariates.

Methods

Participants

Participants in this study included 2,550 students from 20 middle schools across the Unites States. The students were in sixth or seventh grade at the initial survey and proceeded to provide survey data on three additional occasions over a period of 2 years. Of the 2,550 students considered in these analyses, 1,778 (69.73%) completed all four surveys, whereas 416 completed three of the four surveys, 255 completed two surveys, and 101 students completed just one survey. Of the participants, 46% were male. The mean age for the sample was 12.34 (*SD* = .77) at the first measurement occasion.

Measures

Use of violent media content. Violent media content was defined by three items, frequency of watching action movies, playing computer or video games that involve firing a weapon, and visiting Internet sites that describe or recommend violence. Each item was measured on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*very often*). The mean of the three items was used. Coefficient alpha for the scale ranged from .60 to .69 across the measurement occasions.

Aggressiveness. Aggressiveness was measured by six items that assessed cognitions about aggressive behavior, values concerning aggressive behavior, and engagement in aggressive behavior. Each item was measured on a 4-point Likert-type scale ranging from 1 (*not at all*) to 4 (*very often*). The mean of the items was used. Coefficient alpha for the scale ranged from .87 to .91. The scale was found to be positively skewed (1.81). To assess potential bias associated with aggressiveness's non-normal distribution, one-way random effects models were specified using robust standard errors. The estimate of the traditional standard errors and the robust standard errors were identical to four decimal places, indicating that the moderately skewed variable was very unlikely to lead to biased estimates.

Time. The variable representing time described the amount of time that elapsed between each measurement occasion. Different amounts of time elapsed between each survey administration across schools. The variable was group mean centered to allow for a meaningful interpretation of the intercept and to avoid bias due to the age heterogeneity present at each measurement occasion (Raudenbush & Bryk, 2002, p. 184).

Covariates. Four control variables were included in the models: gender, sensation-seeking, general Internet use, and age. All variables were grand mean centered. Sensation-seeking was described by three items that assessed the student's willingness to engage in risky activities without concern about the consequences. Each item was measured on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*very often*). Coefficient alpha for the scale ranged from .80 to .87. Frequency of Internet use was assessed by a single item measured on a 5-point Likert-type scale, from 1 (*not at all*) to 5 (*very often*). To represent stability in the constructs over time, both the sensation-seeking and Internet use variables were defined as the mean of measurement in Times 2, 3, and 4. Variable means are summarized in Table 1.

Multiple Imputation

Multiple imputation (MI) allows one to obtain unbiased and efficient parameter estimates in the presence of missing data when assumptions are met (Shafer & Graham, 2002). MI utilizes a Monte Carlo technique to replace missing values with $m > 1$ simulated versions. The resultant m versions are then analyzed and the estimates are combined. MI does not impute for the sake of replacing the individual missing values, rather it imputes the values with the goal of preserving important aspects of the data distribution.

MI operates on the assumption that missing data are missing completely at random (MCAR) or missing at random (MAR). Data are MCAR if the likelihood of having a missing value on Y is unrelated to Y itself or to any of the

Table 1
Means and Standard Deviations

Variable	*M*	*SD*
Time 1 aggression	1.37	0.58
Time 2 aggression	1.44	0.65
Time 3 aggression	1.47	0.68
Time 4 aggression	1.53	0.69
Time 1 violent media	2.67	0.85
Time 2 violent media	2.73	0.87
Time 3 violent media	2.77	0.90
Time 4 violent media	2.85	0.93
Mean sensation seeking	2.38	0.88
Mean Internet use	3.56	1.11

Note. Means were estimated based on a single data set imputed from expectation-maximization parameters.

other variables in the data set. Data may be considered MAR if the likelihood that *Y* is missing is unrelated to *Y* after controlling for other variables in the data set. It is important to note that other widely used methods of handling missing data (e.g., listwise deletion, pairwise deletion, single imputation) make the same assumptions. Furthermore, these other methods tend to introduce substantial bias, make the analysis increasingly sensitive to violations of MCAR, and/or result in standard errors that are likely too low (Allison, 2002). However, MI, when performed properly and when assumptions are met, produces estimates that are asymptotically efficient (Allison, 2002). In estimating the missing data for each variable, the variances from all of the other variables in the model are used. As such, it is quite likely that the assumption of MAR is met in the investigation presented here. However, Graham, Cumsille, and Elek-Fisk (2002) suggested than even in cases in which data are not MAR, MI is still a viable strategy as it is likely that at least part of the cause of missingness is accessible.

The percentage of missing observations across the variables of interest ranged from 1.02% to 27.73%. A total of 928 (36.39%) students had no missing data. The remaining students displayed 558 different missing data patterns.

The imputation was completed using SAS software, Version 9.0.[2] The expectation-maximization algorithm took 17 iterations to converge. In total, 10 imputed sets were created and analyzed, allowing 200 iterations between each imputation. Data augmentation diagnostics suggested a successful imputation. All analyses were performed on each of the 10 imputed data sets. The parameter estimates were then combined using the procedures outlined by Rubin (1987). Each of the combined estimates had a number of degrees of freedom associated with it. The degrees of freedom vary across estimates, representing the rate of missing information for each estimate. The number of degrees of freedom is then used to determine the correct p value for significance testing.

Statistical Model

The analyses presented here applied latent growth curve (LGC) models within a random coefficients (also known as a hierarchical linear modeling) framework to assess the relationships between aggressiveness over time, use of violent media over time, and pertinent covariates. An LGC in this framework considers measurement occasions to be nested within individuals. It was necessary to take this approach rather than a structural equation modeling approach to LGC modeling because of the variation in times of survey administration in each wave across schools. We opted for the LGC framework rather than autoregressive cross-lagged structural equation model analyses, which would have permitted simultaneous estimation of both aggressiveness and violent media content as dependent measures, because of statistical concerns about cross-lagged models (Rogosa & Willett, 1985). As noted later, such cross-lagged models were also tested on a partial data set as a check on these LGC results.

The random coefficients approach used here permits capturing within-person random effects as well as between-person effects in the model. The measurement occasions represent Level 1 of the model, whereas individuals represent Level 2. This hierarchy is what allows a multilevel model to differ from a traditional ordinary least squares model. Because of this structure, multilevel models have both fixed and random effects. The fixed part of the model describes the population average, whereas the random parts describe the variability around the fixed effects both at Level 1 (captured as the r_{ij} estimates) and Level 2 (captured as the u_j estimates). Notice in the equations presented in the Results section that the Level 1 random effect has the subscript ij, meaning that a residual exists for each measurement occasion (i) nested within each student (j). In each model, only a single Level 1 random effect exists as it represents everything unexplained by the model for measurement occasions nested within individuals. However, at Level 2, multiple variance terms may exist. That is, one Level 2 variance exists for each Level 1 predictor (including the intercept) that is specified to be random. In the models presented in this article, these variables included the intercept, time, contemporaneous effects of aggressiveness/media, and lagged effects of aggressiveness/media. Notice that the Level 2 variances (u_j) have a j subscript, indicating that they vary at the individual level. They capture the extent to which individual j varies from the fixed effect estimate.

To assess the hypotheses of interest, a series of six random coefficient growth curve models were specified for each dependent variable (aggressiveness and use of violent media). All of the models were assessed using the PROC MIXED feature in SAS, Version 9.0. First, one-way random effects analysis of variance models were specified to assess the variability of the dependent variables. Next, a measure of time was added to the model to assess change in the dependent variable as the students grew older. The third model added the necessary person-level covariates (gender, sensation-seeking, Internet use, and age). Next, the contemporaneous effect of violent media use was added to the aggressiveness model, and likewise the contemporaneous effect of aggressiveness was added to the violent-media-use model. The fifth model added the lagged effects of violent media and aggressiveness to the aggressiveness and violent-media models, respectively. The sixth and final model added the aggregated mean of violent media/aggressiveness to separate the within-person effect from the between-persons effect. These models, including the rationale for estimating them, are described in detail in the Results section.

Our primary hypotheses of interest concerned the lagged effect of violent-media use on aggressiveness as well as the lagged effect of aggressiveness on violent media use. A lagged effect (t–1) did not exist for the first measurement occasion. As such, the Time 1 measures provided by the students serve only to determine the lagged effect for Time 2.

Results

Model 1: An Unconditional Means Model

Level 1 model:

$$Y_{ij} = \pi_{0j} + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + u_{0j}$$

Combined:

$$Y_{ij} = \beta_{00} + u_{0j} + r_{ij}$$

Note. The combined model substitutes the Level 2 model into the Level 1 model such that the complete model is clearly defined as a single equation.

To begin, unconditional means models were specified to explain the variation in use of aggressive behavior and use of violent media across the three occasions of measurement. An unconditional means model, otherwise known as a one-way random effects analysis of variance, was a useful starting point because it provided an estimate of the variability of the dependent variable at both the measurement occasion (within-persons variance—the variability of r_{ij}) and the individual (between-persons variance—the variability of u_{0j}) levels.

Aggressive behavior model. The fixed estimate of the intercept (β_{00}) for the equation modeling aggressive behavior was estimated to be 1.484 (.011), $p <$ .0001, indicating that the average person in the sample had a mean score of 1.484 on the aggressiveness scale across the three measurement occasions. Within-person, the variance (r_{ij}) was estimated to be .263 (.007), $p < .0001$, and between-persons (u_{0j}), a variance of .202 (.009), $p < .0001$ was observed. All of these variances were significantly different from zero. That is, it is apparent that there was variation between individuals in their aggressive behavior and that individuals differed in their level of aggressiveness over time. These variances were used to compute the intraclass correlation (ICC). The ICC represented the proportion of variance in aggressive behavior between persons and was calculated by dividing the variance between persons by the sum of the variance between and within persons. In this model, the ICC equaled .435, indicating that approximately 44% of the variance in aggressive behavior was between persons.

Violent media model. We estimated the same model for our second variable of interest, violent media use. With violent media use as the dependent variable, the fixed effect for the intercept was 2.781 (.016), $p < .0001$, the within-persons random effect was .302 (.007), $p < .0001$, and the between-person random effect was .516 (.018), $p < .0001$. As such, the ICC was .631, indicating that 63% of the variance of violent media use was between persons.

Model 2: An unconditional growth model

Level 1 model:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(time_{ij} - \overline{time}_j) + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + u_{0j} \text{ and } \pi_{1j} = \beta_{10} + u_{1j}$$

Combined:

$$Y_{ij} = \beta_{00} + \beta_{10}(time_{ij} - \overline{time_j}) + u_{0j} + u_{1j}(time_{ij} - \overline{time_j}) + r_{ij}$$

Unconditional growth models were specified by adding the time score as an independent variable and allowing both the intercept and slope to vary across individuals.

Aggressive behavior model. The intercept of the equation modeling aggressiveness represented aggressive behavior demonstrated by the average person in the sample midway between Time 2 and Time 4 measurement occasions (because the first measurement occasion was used to determine the lagged effect only) and was estimated to be 1.484 (.011), $p < .0001$. The regression coefficient associating time with aggressive behavior represented the average rate of change over time and was estimated to be .073 (.014), $p < .0001$, indicating that students tended to become more aggressive over time. Because both the intercept and slope were treated as random coefficients, u_{0j} and u_{1j}, respectively, we were able to observe the variance around the fixed estimates due to individual variation. A significant amount of variance was observed around both the intercept, .211 (.009), $p < .0001$, and slope, .063 (.017), $p < .001$, suggesting that the adolescents differed from one another on both their value of aggressiveness at the midpoint of their assessment period and the rate at which aggressive behavior changed over time. The covariance between the intercept and slope was also significant, .025 (.008), $p < .01$, indicating that students with a higher level of aggressiveness at the midpoint of their assessment period increased aggressive behavior, on average, at a faster rate than individuals demonstrating a lower level of aggressiveness. Finally, the within-person variance was estimated to be .236 (.008), $p < .0001$. By comparing the within-person variance (r_{ij}) in the unconditional means model (Model 1) to the within-person variance of the present model, it was determined that 10.27% of the variance within individuals was explained by time.

Violent media model. Likewise, the intercept of the equation modeling use of violent media over time represented violent-media use demonstrated by the average person in the sample at the midpoint of their assessment period. The fixed intercept was 2.781 (.016), $p < .0001$, and the fixed slope for time was .105 (.014), $p < .0001$, indicating that students also tended to increase their use of violent media over time. A significant amount of variance was observed around the intercept, .524 (.018), $p < .0001$, and slope, .052 (.017), $p < .01$, and the covariance between the intercept and slope was significant and positive, .036 (.011), $p < .001$. Finally, a significant variance was observed within persons, .278 (.009), $p < .0001$. Comparison of the unconditional growth model of violent media use to the unconditional means model indicated that 7.95% of the available variance was explained by time.

Model 3: A Conditional Growth Model

Level 1 model:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(time_{ij} - \overline{time_j}) + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + u_{0j}$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(gen_j) + \beta_{12}(sen_j) + \beta_{13}(net_j) + \beta_{14}(age_j) + u_{1j}$$

Combined:

$$\begin{gathered} Y_{ij} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + \beta_{10}(time_{ij} - \overline{time_j}) + \\ \beta_{11}(gen_j)(time_{ij} - \overline{time_j}) + \beta_{12}(sen_j)(time_{ij} - \overline{time_j}) + \beta_{13}(net_j)(time_{ij} - \overline{time_j}) + \\ \beta_{14}(age_j)(time_{ij} - \overline{time_j}) + u_{0j} + u_{1j}(time_{ij} - \overline{time_j}) + r_{ij} \end{gathered}$$

Note. All Level 2 covariates were grand mean centered.

Next, the covariates of interest (gender, sensation-seeking, Internet use, and age) were added to the model as predictors of both the intercept and the slope (the variable representing time).

Aggressive behavior model. All four covariates were significant predictors of the intercept (each student's level of aggression at the midpoint of their assessment period). Males were more likely to demonstrate aggressive behavior, $\hat{\beta} = .126$ (.021), $p < .0001$; as were high sensation-seekers, $\hat{\beta} = .304$ (.012), $p < .0001$; and older students, $\hat{\beta} = .038$ (.014), $p < .01$. A negative relationship was observed for Internet use and aggressive behavior, $\hat{\beta} = -.031$ (.009), $p < .001$. None of the covariates were significant predictors of the students' rate of change in aggression; however, a marginally significant relationship was observed for gender, $\hat{\beta} = .056$ (.029), $p = .0513$. That is, males were somewhat more likely to increase their level of aggression over time at a faster rate than females. By comparing the between-persons variance around the intercept in the unconditional growth model to the between-persons variance around the intercept in the present model, we estimated that 39.81% of the available variance around the intercept at Level 2 was explained by the covariates. However, none of the variance around the slope was explained by the covariates.

Violent media model. Male gender, $\hat{\beta}$ = .596 (.025), p < .0001; sensation-seeking, $\hat{\beta}$ = .397 (.016), p < .0001; and Internet use, $\hat{\beta}$ = .153 (.012), p < .0001; were positively associated with use of violent media at the midpoint between each student's assessment period (the intercept). Age was not a significant predictor of the intercept, $\hat{\beta}$ = .020 (.016). However, both Internet use and age were significant predictors of the rate of change of violent-media use over time. That is, students who reported more frequent use of the Internet increased their use of violent media over time at a faster rate, $\hat{\beta}$ = .059 (.014), p < .0001; and older students increased their use of violent media at a slower rate, $\hat{\beta}$ = –.093 (.021), p < .0001. In comparison to the unconditional growth model, 60.88% of the available variance around the intercept and 5.77% of the available variance around the rate of change over time was attributed to the covariates of the model.

Model 4: Addition of the Contemporaneous Effect of Aggressiveness/Violent Media

Level 1 model:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(time_{ij} - \overline{time_j}) + \pi_{2j}(C.E._{ij} - \overline{C.E.}) + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + u_{0j}$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(gen_j) + \beta_{12}(sen_j) + \beta_{13}(net_j) + \beta_{14}(age_j) + u_{1j}$$

$$\pi_{2j} = \beta_{20} + u_{2j}$$

Combined:

$$\begin{gathered} Y_{ij} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + \beta_{10}(time_{ij} - \overline{time_j}) + \\ \beta_{11}(gen_j)(time_{ij} - \overline{time_j}) + \beta_{12}(sen_j)(time_{ij} - \overline{time_j}) + \beta_{13}(net_j)(time_{ij} - \overline{time_j}) + \\ \beta_{14}(age_j)(time_{ij} - \overline{time_j}) + \beta_{20}(C.E._{ij} - \overline{C.E.}) + u_{0j} + u_{1j}(time_{ij} - \overline{time_j}) + \\ u_{2j}(C.E._{ij} - \overline{C.E.}) + r_{ij} \end{gathered}$$

Note. All Level 2 covariates were grand mean centered. C.E. = contemporaneous effect.

Next, the time-varying measure of violent-media use was added to the model predicting aggressiveness and the time-varying measure of aggressiveness was added to the model predicting use of violent media. These models allowed the contemporaneous effect of violent-media use on aggression and the contemporaneous effect of aggression on use of violent media to be observed after controlling for developmental changes in the dependent variable (the time variable) and pertinent covariates.

Aggressive behavior model. The fixed effect of contemporaneous use of violent media was a significant predictor of aggressiveness, $\hat{\beta} = .111$ (.012), $p < .0001$; representing a 7.63% reduction in the within-person variance over the growth model with covariates. That is, during times when adolescents were using more violent media, they were more likely to report higher levels of aggressiveness.

Violent media model. Likewise, the fixed effect of within-time aggressiveness was a significant predictor of violent-media use, $\hat{\beta} = .165$ (.017), $p < .0001$. The addition of violent-media use to the model reduced the within-person variance by 7.58% as compared to the conditional growth model.

Model 5: Addition of the Lagged Effect of Aggressiveness/Violent Media

Level 1 model:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(time_{ij} - \overline{time}_j) + \pi_{2j}(C.E._{ij} - \overline{C.E.}) + \pi_{3j}(L.E._{ij} - \overline{L.E.}) + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + u_{0j}$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(gen_j) + \beta_{12}(sen_j) + \beta_{13}(net_j) + \beta_{14}(age_j) + u_{1j}$$

$$\pi_{2j} = \beta_{20} + u_{2j}$$

$$\pi_{3j} = \beta_{30} + u_{3j}$$

Combined:

$$Y_{ij} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + \beta_{10}(time_{ij} - \overline{time_j}) + \beta_{11}(gen_j)(time_{ij} - \overline{time_j}) + \beta_{12}(sen_j)(time_{ij} - \overline{time_j}) + \beta_{13}(net_j)(time_{ij} - \overline{time_j}) + \beta_{14}(age_j)(time_{ij} - \overline{time_j}) + \beta_{20}(C.E._{ij} - \overline{C.E.}) + \beta_{30}(L.E._{ij} - \overline{L.E.}) + u_{0j} + u_{1j}(time_{ij} - \overline{time_j}) + u_{2j}(C.E._{ij} - \overline{C.E.}) + u_{3j}(L.E._{ij} - \overline{L.E.}) + r_{ij}$$

Note. C.E. = contemporaneous effect. L.E. = lagged effect. All Level 2 covariates were grand mean centered.

Next, the lagged measure of violent media use was added to the aggressiveness model and, likewise, the lagged measure of aggressiveness was added to the violent media use model.

Aggressive behavior model. The fixed-effect estimate for the regression of aggressiveness on lagged media was found to be significant, $\hat{\beta} = .046$ (.013), $p < .001$, suggesting that use of violent media prospectively predicted aggressive behavior after controlling for pertinent covariates and contemporaneous use of violent media. The addition of lagged use of violent media described 10.09% of the within-persons variance not accounted for by the previous model (the conditional growth model with the contemporaneous effect of media).

Violent media model. The fixed-effect estimate for the regression of violent media on lagged aggressiveness was also found to be significant, $\hat{\beta} = .043$ (.018), $p < .05$. The addition of lagged aggressiveness described 6.64% of the within-persons variance not accounted for by the previous model (the conditional growth model with the contemporaneous effect of aggression).

Model 6: Separation of Within and Between Persons Effects

Level 1 model:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(time_{ij} - \overline{time_j}) + \pi_{2j}(C.E._{ij} - \overline{C.E.}) + \pi_{3j}(L.E._{ij} - \overline{L.E.}) + r_{ij}$$

Level 2 model:

$$\pi_{0j} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + \beta_{05}(media_j / agg_j) + u_{0j}$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(gen_j) + \beta_{12}(sen_j) + \beta_{13}(net_j) + \beta_{14}(age_j) + u_{1j}$$

$$\pi_{2j} = \beta_{20} + u_{2j}$$

$$\pi_{3j} = \beta_{30} + u_{3j}$$

Combined:

$$Y_{ij} = \beta_{00} + \beta_{01}(gen_j) + \beta_{02}(sen_j) + \beta_{03}(net_j) + \beta_{04}(age_j) + \beta_{05}(\overline{media}_j / \overline{agg}_j) + \beta_{10}(time_{ij} - \overline{time}_j) + \beta_{11}(gen_j)(time_{ij} - \overline{time}_j) + \beta_{12}(sen_j)(time_{ij} - \overline{time}_j) + \beta_{13}(net_j)(time_{ij} - \overline{time}_j) + \beta_{14}(age_j)(time_{ij} - \overline{time}_j) + \beta_{20}(C.E._{ij} - \overline{C.E.}) + \beta_{30}(L.E._{ij} - \overline{L.E.}) + u_{0j} + u_{1j}(time_{ij} - \overline{time}_j) + u_{2j}(C.E._{ij} - \overline{C.E.}) + u_{3j}(L.E._{ij} - \overline{L.E.}) + r_{ij}$$

Note. C.E. = contemporaneous effect. L.E. = lagged effect. All Level 2 covariates were grand mean centered.

For the final model, the mean level of violent media use across the measurement occasions was added to the aggressiveness model and the mean level of aggressiveness across the measurement occasions was added to the violent media model. By adding the aggregated mean to the model, the within-time effect of the time-varying covariates on the dependent variables may be observed after controlling for the between-persons effect. For example, consider the outcome of aggressiveness. Model 5 suggests that when students were using violent media, they were more likely to demonstrate aggressive behavior. Furthermore, use of violent media prospectively predicted aggressiveness at a subsequent point in time. However, Raudenbush and Bryk (2002) have shown that the "effect of a Level 1 predictor can be biased if the aggregate of the Level 1 predictor has a separate and distinct relationship with the intercept" (p. 183). It is not unreasonable to believe that the mean level of violent media use over the measurement occasions may have had a unique impact on aggressive behavior or that the mean level of aggressiveness over the measurement occasions may have had a unique impact on use of violent media. That is, the effects that we observed in Model 5 may be due to the overall characteristics of the adolescent (adolescents who are consistently aggressive are more likely to use violent media for example) rather than within-person changes due to the time-varying variable of interest (change in aggressiveness results in elevated use of violent media at a subsequent point in time). Raudenbush and Bryk recommended adding the aggregated mean of the time-varying covariate to the Level 2 equation to disentangle the within-persons effect from the between-persons effect. In the present application, this process allowed us to see the extent to which, for example, use of violent media at time k led to higher levels of aggressiveness at time k + 1 after adjusting for each students mean level of aggression across all measurement occasions. As such, we estimated the equations in Model 5 with the addition of the aggregated mean in the Level 2 equation.

Aggressive behavior model. The aggregated mean of violent media use was not a statistically significant predictor of aggressiveness, $\hat{\beta} = .038$ (.030); however, both the contemporaneous, $\hat{\beta} = .088$ (.016), $p < .0001$, and lagged, $\hat{\beta} = .034$ (.016), $p < .05$, effect of violent-media use on aggressiveness remained significant.

Violent-media model. In the model predicting violent-media use over time, the aggregated mean of aggressiveness did significantly predict use of violent media, $\hat{\beta} = .187$ (.041), $p < .0001$. Furthermore, the contemporaneous effect of aggressiveness was reduced to .113 (.021), $p < .0001$, and the lagged effect became insignificant, $\hat{\beta} = -.002$ (.020). The regression coefficients for the final model are summarized in Table 2.

Taken together, these findings suggest that the lagged effect of violent-media use on aggressiveness was a within-persons effect, although no lagged effect of aggressiveness on violent-media use existed after the mean level of aggressiveness across all of the measurement occasions was considered. That is, elevated use of violent media by an individual increased the likelihood of aggressive behavior in that individual at a subsequent point in time, even when controlling for that individual's overall level of media use. On the other hand, after controlling for individuals' mean level of aggressiveness across the measurement occasions, the lagged effect of aggressiveness on use of violent media content became nonexistent. This finding suggests that any predictive effect of elevated aggressiveness on subsequent use of violent-media content was due to the individual's overall level of aggressiveness. In other words, when considering the lagged effect of aggressiveness on subsequent use of violent media among young adolescents, aggressiveness should be considered as a stable characteristic of an adolescent, rather than as a time-varying predictor, whereas elevated use of violent media prospectively predicts elevated aggressiveness for a given individual.

Discussion

Results of this study largely support the downward spiral model for the relationship of violent-media content use and aggressiveness among adolescents. There is both a cross-sectional and lagged effect of violent-media content use on aggressiveness after all controls, and the predicted lagged effect of violent-media content use on aggressiveness survives controls for contemporaneous effects in both directions. The selective exposure part of the predicted downward spiral operates somewhat differently than predicted: the cross-

Table 2
Fixed Effects for Final Random-Coefficient Models

Dependent Variable Effect	$\hat{\beta}$	*t*	*df*
Aggression			
Intercept	1.471	156.19*	362
Time	0.059	4.30*	186
Contemporaneous media	0.088	5.50*	321
Lagged media	0.034	2.10*	177
Internet use	–0.056	–6.62*	424
Gender	0.025	1.18	651
Sensation-seeking	0.219	17.40*	1,269
Age	0.045	3.51*	205
Internet use by time	–0.003	–0.26	187
Gender by time	0.054	1.96	393
Sensation-seeking by time	–0.007	–0.46	316
Age by time	–0.018	–0.91	90
Mean violent media use	0.038	1.27	186
Use of violent media			
Intercept	2.781	246.87*	676
Time	0.093	6.91*	576
Contemporaneous aggression	0.113	5.31*	100
Lagged aggression	–0.002	–0.09	278
Internet use	0.159	13.86*	157
Gender	0.565	23.37*	481
Sensation-seeking	0.309	18.32*	203
Age	0.013	0.86	648
Internet use by time	0.060	4.32*	102
Gender by time	0.009	0.28	95
Sensation-seeking by time	–0.011	–0.61	151
Age by time	–0.083	–4.08*	100
Mean aggression	0.187	4.55*	201

Note. Level 2 (between-person) control variables and cross-level interactions are italicized. The degrees of freedom vary as a result of multiple imputation.
$^{*}p < .05$.

sectional effect is apparent, but the predicted lagged effect of aggressiveness on violent-media use does not appear.[3]

The downward spiral, then, is an asymmetric one. This asymmetry, in hindsight, makes intuitive sense. One would certainly expect that more aggressive teens would be more likely at any given time point to seek out violent-media content, although the prospective effects of such aggressiveness on selective exposure are problematic. The effects of that violent-media content on the youths who use it on aggressiveness is both concurrent and to a lesser extent prospective. Consistent with the downward spiral model, then, these effects can be viewed as mutually reinforcing (aggressiveness leading to violent-media use concurrently and violent-media use to aggressiveness both concurrently and prospectively), directional (leading both to increased violent-media content use and to increased aggressiveness), and, at least by inference, cumulative (these reinforcing effects can be expected to accumulate over time given continued, directional mutual influence).

It should be emphasized again that such a downward spiral model is not limited to media effects. In fact, media effects are relatively subtle and modest in scope. A variety of other developmental processes can usefully be conceptualized in the same way and may be much larger in terms of predictive impact on behavior. For example, association with alcohol-using peers may lead to subsequent alcohol use, which will, in turn, lead to greater and more exclusive association with alcohol-using peers in the future (Curran, Stice, & Chassin, 1997). In addition, exploration of positive, upward spirals involving media, relationships with parents and mentors, constructive peer associations, outside structured activities, and other communicative influences might also shed light on the direction and outcome of adolescent developmental trajectories.

One contribution of a downward spiral model to communication theory is that it takes into account the volitional, active audience member that is the focus of uses and gratifications or selective exposure research, and incorporates this perspective in understanding media effects. In so doing, it addresses possible objections to media-effects theorizing that ignores audience volition. Moreover, it also emphasizes how understanding audience volition can improve understanding of media effects. Use of growth-curve modeling, as conducted here, permits relatively fine-grained analysis of the contribution of selectivity and media effects in forming the overall process for a given individual.

The downward spiral model, then, also suggests that effects of media content that reinforce tendencies to antisocial attitudes and behavior should be most conspicuous among youth who are most vulnerable to those attitudes and behaviors. In this case, those who are male (less social disinhibition for aggressiveness), sensation-seekers (more willing to take risks, act out), or youth who for other reasons are more prone to enacting deviant behaviors may be more subject to these downward spiral effects. Such comparisons are a priority for follow-up research.

This study also has a variety of limitations. The sample of youth comprised 10 school districts and 20 middle or junior high schools. Although the districts were widely separated geographically, they were not sampled randomly, they were restricted to nonmetropolitan school districts, and there is, therefore, no basis for statistical generalization to a U.S. population. Moreover, although levels of participation in the longitudinal study were reasonably high and study mortality across the 2 years of the study reasonably low, students did self-select as participants. This is more likely to create a conservative bias, though, assuming that more antisocial students are less likely to participate in a study such as this, as they would be less likely to participate in any school-based activity.

The survey instrument included a control for overall Internet use but not for overall movie viewing or video game use. This does raise the possibility that the over-time relationship between use of violent-media content and aggressiveness may be due to a third variable: developmental change that leads to increases in both violent-media content use and aggressiveness over time, which might result in lagged associations between violent-media content use and aggressiveness that are not causal in nature. These data, however, include results that are difficult to explain from this alternative perspective. This study analyzed paths associated with intrapersonal variability as well as between-person variability. The lagged within-person effect suggests that when violent-media content use is lower than a person's average as predicted by a trend line, then aggressiveness is lower at the next time point, and when that use is higher that average for that person, aggressiveness will be higher at the next time point. Because this lagged relationship is based on such individual fluctuation in violent-media use, it is not prone to confounding by overall developmental change in the same way the between-person effect would be. That is, by modeling time and several other pertinent covariates, we were able to assess these intraindividual relationships after adjusting for normal developmental change (by controlling for the progression of time) as well as other variables known to affect the relationships of interest. Finally, by regressing both the intercept and the slope for time on each of the person-level covariates (gender, age, Internet use, and sensation-seeking), we controlled for any changes in the relationship between the covariates and the dependent variables that may have occurred over time. Nonetheless, better control over variability due to overall media use would be useful in future research to further address this alternative explanation.

The use of a composite measure of aggressiveness incorporating rumination about violence and values concerning violence as well as aggressive behavior is also worthy of note. We consider this approach a strength of the present study. Aggressive behavior is, as noted above, constrained circumstantially. A female, or a smaller male, may be less likely to physically attack peers. However, an impact on aggressiveness is still dangerous. If motivation is strong enough and a weapon is available, aggressiveness that has in the past been largely imagined can take very destructive forms. Few of the shooters in secondary school attacks have had a record of overt prior aggression against classmates, although their journals, Web sites, and so forth suggest considerable aggressiveness in their thoughts and feelings. Likewise, if aggressive tendencies are reinforced into adulthood, there is ample opportunity for even physically unintimidating individuals to enact violence against spouses and children (Huesmann, Moise-Titus, Podolski, & Eron, 2003).

Another distinctive aspect of the present study is the focus on adolescents, rather than children. As Anderson and Bushman (2002) noted, relatively few of the many studies on media violence have examined the effects of media violence on youth of an age to more destructively enact aggressive feelings. Similarly, television violence has been the traditional focus of media-violence studies. However, adolescence is increasingly characterized by the use of interactive media such as computers, video games, and in particular the Internet. Violent films with PG-13 and R ratings (traditionally targeted at adolescent and young adult males) become increasingly popular pastimes. The evidence from this study that use of violent content from such media is prospectively related to subsequent increases in aggressiveness should increase attention to the impact of such media on teens and young adults.

Finally, the implications of a downward spiral model, if supported through subsequent research, deserve close attention. Defenders of violent content in various media often argue that use of such content is a harmless pastime for normal youth. A downward spiral model suggests that although the negative effects may be slight for youth with little inclination to aggressiveness, such youth are also less likely to extensively use such media content. Those youth with such a predisposition are likely to have such predispositions reinforced, and their preexisting aggressive tendencies magnified.

Notes

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2. SAS System for Windows, Version 9.0. Copyright ©2002 by SAS Institute Inc., Cary, NC.

3. In earlier analyses with a pilot data set consisting of six schools, structural equation models using latent variables were used to identify a best-fitting model. The best-fitting model proved to include concurrent paths at each wave from aggressiveness to violent-media use, and lagged paths from violent-media use to subsequent aggressiveness, closely paralleling the results reported here. It was not possible to test concurrent paths in both directions simultaneously without identification problems, but these models did permit testing of lagged relationships from media use to aggressiveness while controlling for selective exposure effects, and those effects remained statistically significant. Although this approach was replaced with the growth-curve modeling approach reported here to avoid problems inherent in autoregressive cross-lagged

models, the comparability of findings across two very different analytic approaches served to increase our confidence in these results.

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