Violent media use and aggression: Two longitudinal network studies

Martin Delhove and Tobias Greitemeyer

Department of Psychology, University of Innsbruck

ABSTRACT
Exposure to violent media has been widely linked to increased aggression. In the present research, we examined whether violent media exposure would be associated with increased aggression, which would then spread within social networks like a contagious disease. Two groups of first year psychology students completed a questionnaire three times over the course of a year, measuring their media exposure, aggression, personality, and social relations within the group. Cross-sectional analysis provided mixed results in regards to the link between violent media and aggression. Siena analysis found no evidence of homophily (i.e., participants were not more likely to be friends with others similar to themselves) nor of social influence (i.e., participant’s behavior did not predict a change in their friends’ behavior). However, given the relatively small sample sizes and the weak ties between participants, more work is needed to assess the spread of violent media effects.

Introduction
Social psychologists have long been interested in the relationship between violent content in the media and aggression. Although other media, such as television (e.g., Coyne, 2016), music (e.g., Fischer & Greitemeyer, 2006), or comic books (e.g., Kirsh & Olczak, 2002), have been studied in this context, most work has been focused on the role of video games. Recently, researchers have been looking for aggressive outcomes not only in those who directly consume violent media but also in those related to them (reviewed below). The present work provides some insight into the spread of violent media-related aggression within networks, by using a longitudinal network approach.

Violent media and aggression
In 2015, the American Psychological Association published a press release stating that playing violent video games is linked to aggression (APA, 2015). This decision proved controversial, as some believe that there is no link between violent media and aggression (Ferguson et al., 2020). In particular, it has been argued that experimental studies of violent games on aggression are plagued by publication bias (Hilgard et al., 2017). In fact, some recent, pre-registered, experimental studies failed to find that playing violent video games increases aggression in the short term (e.g., Engelhardt et al., 2015; McCarthy et al., 2016; see also Kühn et al., 2018).

On the other hand, correlational (e.g., Gentile et al., 2004) and longitudinal (e.g., Huesmann et al., 2003) evidence have supported the link between violent media use and aggressive behaviors. Of note, these aggressive behaviors can range from minor (e.g., arguing with a teacher, Gentile et al., 2004) to severe forms (e.g., committing a crime, Huesmann et al., 2003), but are mostly mild forms of aggression (e.g., pushing or insulting someone, Krahé & Möller, 2010). Violent media have also
been shown to influence a wide range of other aspects of aggression, such as aggressive thoughts (Gentile et al., 2017), desensitization to violence (Fanti et al., 2009), or everyday sadism (Greitemeyer & Sagioglou, 2017). Additionally, exposure to media violence has been linked to decreased empathy (Bartholow et al., 2005; Krahé & Möller, 2010) and preferences for aggressive roles in video games showed a negative relationship with the agreeableness subscale of the Big Five (Delhove & Greitemeyer, 2020).

Of note, violent media consumption has also been linked to acceptance of norms condoning aggression (Krahé & Möller, 2004). Normative beliefs about aggression have long been known to be related to aggressive behavior in children (Huesmann & Guerra, 1997), adolescents (Krahé & Busching, 2014), and young adults (Wright & Li, 2013). These norms have been found to mediate the relationship between violent media use and aggression (Shao & Wang, 2019).

Furthermore, several meta-analyses found a significant positive link between violent video game play and aggression (Anderson et al., 2010; Greitemeyer & Mügge, 2014) and there seems to be little publication bias regarding the cross-sectional (Hilgard et al., 2017) and longitudinal (Prescott et al., 2018) relationships between violent video game play and aggression. Overall, our reading of the pertinent literature is that playing violent games is associated with increased aggression, but that the relationship is only small to medium in its effect size.

Effects of violent media use in social networks

Social network analysis is interested in relationships (i.e., ties; friendships, romance, exchange of communication...) between individuals or groups (i.e., nodes) and tries to get useful information out of them (Clifton & Webster, 2017). Social network studies found a staggering amount of evidence that phenomena can spread across ties, and this up to three degrees of separation (Christakis & Fowler, 2009, 2013). It is the case, for instance, for voting behaviors (Braithwaite & De Aguiar, 2017), smoking (Christakis & Fowler, 2008), happiness (Bliss et al., 2012), or body mass index and fast-food consumption (Fletcher et al., 2011). This led us to the question of whether or not violent media-related aggression can also spread within networks.

A significant part of the violent media-aggression literature is based on the General Aggression Model (GAM, Anderson & Bushman, 2002). According to the GAM, repeated exposure to violent content reinforces hostile structures by means of learning processes, leading to an overall more aggressive personality. Importantly, witnessing friends acting aggressively or being the target of their aggression could also evoke aggression. This actually constitutes a well-known pattern of aggression (for a discussion, see Jung et al., 2019), with some researchers comparing aggression to a contagious disease (Bond & Bushman, 2017).

As noted above, violent media exposure does not have a large effect on aggression. However, low-intensity behaviors have also been found to spread in social networks (e.g., rudeness in organizations, Foulk et al., 2016). Recently, researchers have addressed the question of whether the effect of violent media use could spread through an individual’s social network. That is, is it possible that individuals who consume violent media not only become more aggressive, but also make their friends and family more aggressive, even if those do not consume violent media themselves? Greitemeyer (2018) found that individuals who had friends playing violent video games showed more aggression, and the effect was particularly pronounced when these friends did not play violent video games themselves. Similarly, Verheijen et al. (2018) found that adolescents’ violent video game exposure predicted their best friend’s aggression one year later, independent of whether they played these games together. In addition, Greitemeyer (2019) found that friends’ aggression mediated the relationship between friends’ VVE and individuals’ future aggression. Experimental studies conducted by Delhove and Greitemeyer (2019) found that individuals on the receiving hand of increased aggression following violent video game play were more aggressive themselves.

However, in the context of social networks, it is important to note that there are at least three processes (Christakis & Fowler, 2013) that can explain similarities between an individual (in the
following, termed consumer) and those connected to her/him (in the following, termed friend). First of all, people tend to bond with others that are similar to them, which is known as homophily (McPherson et al., 2001). In the case of violent media and aggression, this would mean that individuals who consume violent media (and therefore tend to be more aggressive) befriend others that also consume violent media. Any link between the consumer’s media use and the friend’s aggression could be a simple reflection of homophily. The second process is called confounding. It results from common environmental factors, which are influencing both consumer and friend at the same time. For instance, delinquency in the neighborhood of two friends could increase their level of aggression, with the link between the consumer’s media use and the friend’s aggression being due to this increased delinquency in the neighborhood (representing a spurious variable). Finally, and most interestingly from a social-psychological perspective, is social influence. That is, the consumer is actively influencing her/his friend to make her/him more alike. In the present study, we focused on the processes of homophily and social influence.

**The present research**

The present work aims to assess the potential spread of violent media exposure and violent media-related aggression, respectively, within an actual social network. To this avail, we conducted two longitudinal studies assessing media habits, personality, and relatively mild forms of aggressive outcomes of individuals within a specific social network (i.e., first-year psychology students). Data were analyzed using RSiena, allowing to evaluate changes in relationships and behaviors across time within networks. Our hypotheses were as follows:

H1 (Violent media-effect): Individuals who consume more violent media report more aggression than those who consume little or no violent media. Specifically, we expected violent media consumers to exhibit more aggressive behavior, have higher scores on a trait aggression scale, tend to the perception of aggression as more normative, and report less empathy and lower agreeableness scores.

H2 (Homophily hypothesis): Individuals are more likely to befriend others with similar media usage, personality, and behaviors.

H3 (Social influence hypothesis): Individuals whose friends consume relatively high levels of violent media report more aggression and perceive aggression as more normative, even when controlling for the level of the individuals’ own consumption of violent media.

All data and materials used in the present work can be accessed on the Open Science Framework: https://osf.io/dp3qc.

**Study 1**

**Methods**

Data were collected at three separate points in time over the course of one academic year. Participants were first-year psychology students at a European university, who were rewarded with course credit as well as with entries into a lottery to win one of ten 100€ prizes. Each data collection was conducted online and spanned over 2 weeks. One-hundred and thirty-one participants completed the survey at Time 1 (end of October 2017), 120 at Time 2 (start of March 2018), and 102 at Time 3 (start of June 2018). One participant from Time 2 and one from Time 3 were removed due to failing to an attention check and 10 participants were removed because they were outliers (i.e., they had scores that were over three standard deviations away from the mean on at least one scale or subscale). In total, 143 unique participants filled
out the questionnaire (73% female, $M_{age} = 20.47$, $SD_{age} = 1.97$). Of those, 73 completed all three data collections, and 38 completed only two.

Our study employed an online questionnaire. First, participants were asked to answer some demographics questions. Following this, they were presented with a name generator, in order to gather network information. We asked participants to name up to 10 persons they knew that were also first-year psychology students, and to indicate the type of relationship they had with each of them (acquaintance, casual friend, close friend, or intimate partner).

In order to collect data regarding media usage, we used Krahé and Möller’s (2010) media usage scale. This consists of a selection of movies, TV shows, and video game genres that have been rated by media experts in regard to their violent content. Participants indicated how often they use each of the respective genre on a five-point scale ranging from “never” (0) to “very often” (4). Genres that were rated as violent by the experts were combined to obtain a violent media usage score. To do so, the violent content score for each of those was multiplied by the frequency rating of the participants. We then averaged those new scores. Nonviolent media scores were also combined into an index of nonviolent media use. Because of an encoding error, Time 1 media use scores for eight participants and two aggressive behavior scores (at Time 1 and Time 3) were missing.

Then, we presented participants with the short version of the Big Five Inventory (BFI-S; Lang et al., 2011). This scale measures the five factors of personality (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness) with 15 items (3 per factor). Items are answered using a 5-point Likert scale ranging from “Disagree strongly” to “Agree strongly”.

Participants were also asked to complete the Interpersonal Reactivity Index (IRI; Davis, 1983). This scale assesses empathy, based on four subscales (i.e., perspective taking, fantasy, empathic concern, and personal distress). Each subscale is made of seven statements, for a total of 28 items. Using a 5-point Likert scale ranging from “Does not describe me well” to “Describes me very well”, participants are asked to indicate how well each statement describes them. Within this scale, we also added an attention check item that read: “Please select the middle point of the scale for this item (so that we can verify that you read the questionnaire carefully)”.

Aggressive behaviors were measured using a scale created by Krahé and Möller (2010). It consists of 10 items, five describing acts of physical aggression (e.g., “I have kicked another person”) and five describing acts of relational aggression (e.g., “I have dissed someone in front of others”). Using a 5-point scale, which ranged from “never” to “very often”, participants indicated how often they showed these behaviors in the past three months.

Finally, we measured trait aggression by using the short-form of the Buss and Perry Aggression Questionnaire (Diamond & Magaletta, 2006). This questionnaire comprises four dimensions (i.e., physical aggression, verbal aggression, anger, and hostility), and is formed of 12 items (3 for each dimension). Items are statements that participants evaluate with a 7-point scale ranging from “Does not describe me well” to “Describes me very well”.

**Results**

**Correlational analyses**

None of the Big Five traits correlated significantly with either of the media use scales, with the exception of conscientiousness that related negatively to violent media use ($r = -.19$, $r = -.28$, & $r = -.32$, all $p < .05$, respectively, at Time 1, 2, and 3) and neuroticism that related positively to neutral media use, only at Time 3 ($r = .24$, $p < .05$). Therefore, the Big Five was not included in the following analyses. Descriptive statistics and correlations between media use, aggressive behavior, and personality scores at Time 1, 2, and 3 are presented in Tables 1a–c.

Violent media use correlated highly with neutral media use at all time points. Furthermore, it correlated positively with trait aggression at Time 2 and Time 3 (but the relationship was only marginal at Time 1) and with aggressive behavior at Time 3 (and marginally at Time 2).
Surprisingly, neutral media correlated positively with both trait aggression and aggressive behavior at Time 2 and 3. It also showed a positive relation with empathy at Times 1 and 3.

**Social network analysis**

Longitudinal analysis of the social network was conducted using the RSiena R package (Ripley et al., 2019). The Siena approach is based on the stochastic actor-based model (Snijders et al., 2010). The analysis can distinguish two processes: on the one hand, it assesses network dynamics in order to establish how friendships are created, maintained, or terminated; on the other hand, one can evaluate behavior dynamics, that is, estimate the values of the network parameters that are influencing changes in an outcome (e.g., a behavior, an attitude...). To avoid excessive missing data, the network implemented in Siena only included individuals who completed the questionnaire at least twice (i.e., individuals named by our participants who did not take part in the study as well as individuals who completed the questionnaire only once were not included in the following analysis), leaving a sample of 111. Visual representation of the social networks created with our data is depicted in Figure 1.

Aggressive behavior was modeled as the behavioral data for the behavior dynamics. Because Siena cannot deal with continuous variables when assessing behavioral dynamics (Ripley et al., 2019), aggressive behavior scores were recoded before implementation. Scores were given a value between 1 and 4 depending on their quartile. Hence, aggressive behavior scores of 1 were coded 1, 1.1 were coded 2, 1.2 to 1.4 were coded 3 and 1.5 and higher were coded 4.

Furthermore, Siena is limited to binary networks, meaning that it only considers ties as being present or absent. Due to this limitation, friendship type indicated in our network generator was not included in the following analysis. Distribution of friendship type is nonetheless presented in Table 2.

Parameters’ estimates, as well as standard errors and significance levels, are presented in Table 3. Parameters 1 and 2 indicate the base rate of change in the network between Time 1 and 2 and Time 2 and 3, respectively. Parameters 3 to 7 relate to network properties (e.g., reciprocity indicates an increased likelihood to reciprocate friendships, if A nominated B as a friend, B is more likely to

### Table 1a. Means, standard deviation and bivariate correlations at time 1.

| Variable              | M    | SD   | Cronbach’s α | 1     | 2     | 3     | 4     |
|-----------------------|------|------|---------------|-------|-------|-------|-------|
| 1. Violent media use  | 3.43 | 1.70 |               |       |       |       |       |
| 2. Neutral media use  | 1.21 | 0.50 |               |       |       |       |       |
| 3. Trait aggression   | 2.26 | 0.78 |               |       |       |       |       |
| 4. Aggressive behavior| 1.36 | 0.35 |               |       |       |       |       |
| 5. Empathy            | 4.26 | 0.41 |               |       |       |       |       |

### Table 1b. Means, standard deviation, and bivariate correlations at time 2.

| Variable              | M    | SD   | Cronbach’s α | 1     | 2     | 3     | 4     |
|-----------------------|------|------|---------------|-------|-------|-------|-------|
| 1. Violent media use  | 3.15 | 1.50 |               |       |       |       |       |
| 2. Neutral media use  | 1.40 | 0.54 |               |       |       |       |       |
| 3. Trait aggression   | 2.25 | 0.76 |               |       |       |       |       |
| 4. Aggressive behavior| 1.29 | 0.28 |               |       |       |       |       |
| 5. Empathy            | 3.65 | 0.39 |               |       |       |       |       |

### Table 1c. Means, standard deviation, and bivariate correlations at time 3.

| Variable              | M    | SD   | Cronbach’s α | 1     | 2     | 3     | 4     |
|-----------------------|------|------|---------------|-------|-------|-------|-------|
| 1. Violent media use  | 2.97 | 1.67 |               |       |       |       |       |
| 2. Neutral media use  | 1.14 | 0.53 |               |       |       |       |       |
| 3. Trait aggression   | 2.21 | 0.80 |               |       |       |       |       |
| 4. Aggressive behavior| 1.29 | 0.26 |               |       |       |       |       |
| 5. Empathy            | 3.62 | 0.40 |               |       |       |       |       |

*p < .1; *p < .05; **p < .01; ***p < .001.
All those parameters were statistically significant. Parameters 8 to 13 indicate the impact of similarity on creating and maintaining ties. The same-sex parameter proved significant, meaning
that males were more likely to befriend other males than females and vice-versa. None of the other similarity parameters reached significance, participants befriended one another regardless of their likeness in terms of personality and behavior. This contradicts our second hypothesis in that there were no signs of homophily in our sample in regards to aggression and media consumption.

In regards to behavior dynamics, parameters 14 and 15 (indicating the base rate of change in aggressive behavior from Time 1 to Time 2 and Time 2 to Time 3) were significant. Parameters 16 and 17 indicated the presence of a negative linear shape and a positive quadratic shape in aggressive behavior. This represents, respectively, a tendency to approach the average aggression score over time and a positive feedback (i.e. more extreme scores tend to go farther away from the average). Parameters 18 to 22 tested the effect of one’s own scores and one’s friends’ scores on aggressive behavior over time. None of these were significant. This means that neither participants’ violent media score, nor their friends’ averaged score helped predict changes in aggressive behavior between the different time points. These results are in contradiction with our third hypothesis (that violent media use has a social influence on aggression). Similar results were obtained when the threshold for friendship in the network was set to a casual friend (2) rather than an acquaintance (1).

**Discussion**

Cross-sectional analyses of our data yielded mixed results. The relationship between violent media use and aggressive outcomes was not stable across the three time points, despite generally supporting our first hypothesis. Surprisingly, nonviolent media use also correlated with trait aggression. Inasmuch as individuals who consume relatively high levels of nonviolent media are also more likely to use violent media, they are likely to be subjected to the effects of the latter. Another interpretation of this correlation would be that those who show higher levels of trait aggression are more likely to use (both types of) media than those who score lower on trait aggression.

Another unexpected result comes from the lack of relationship between the Big 5 and media use. In a study assessing the relation between game character preference and personality, Delhove and Greitemeyer (2020) found that more aggressive roles were linked to lower levels of agreeableness. Although we would have expected similar results, our low sample size combined with the use of a short version of the Big Five Inventory may have not been able to unearth this type of relationship.

Finally, empathy was also not related to violent media use. We expected that empathetic individuals would be less inclined to consume violent media. Empathy, however, was related to neutral media consumption. This could be explained by the use of the IRI, which includes a fantasy subscale. This subscale takes interest in the capacity of individuals to put themselves in the shoes of characters in fiction (which should be related to an overall preference of media consumption). There was a lack of relation between empathy and aggression. In line with this non-significant finding, a meta-analysis (Vachon et al., 2014) found the relation between empathy and aggression to be surprisingly weak. The authors mentioned that the current conceptualization of empathy may be inadequate, and that measurement tools (including the IRI) might be flawed. Notably, they suggest that one should not only measure the presence or absence of empathic responses, but also the presence of negative responses.

Based on the Siena analysis of network data, media preferences and aggressive behavior do not appear to affect social relations. Homophily was not present in regards to aggression and media consumption, people were not more likely to befriend others with similar personality or media preferences. This study also failed to show signs of social influence of violent media use on aggression. This contradicts results found in previous work (Delhove & Greitemeyer, 2020; Greitemeyer, 2018, 2019; Verheijen et al., 2018) that took interest in the potential spread of violent media-related aggression.
Study 2

Study 1 provided mixed results. Cross-sectional results were ambiguous in regards to the relationship between violent media use and aggression. Furthermore, there were no signs of homophily nor of social influence. We decided to conduct a follow-up study with some changes in order to further explore the impact of violent media use on aggression in social networks. In addition, based on Krahé and Möller’s (2004) finding that adolescents exposed to more violent media had a higher perception of physical aggression as normative, we added a measure of norms about aggression as a variable of interest.

Methods

Once again, the study took place over the span of an academic year. As in Study 1, our sample consisted of first-year psychology students. Participants were rewarded with course credits and an entry into a lottery for monetary prizes. At each of the three time points, the questionnaire was accessible online during two weeks. One-hundred and fifty-three participants completed the survey at Time 1 (October 2018), 140 at Time 2 (January 2019), and 131 at Time 3 (April 2019). We excluded 18 individuals for being outliers, after which we were left with 167 unique participants (61.1% female, $M_{\text{age}} = 20.25$, $SD_{\text{age}} = 1.68$). Eighty-nine of them participated each time and 31 participated two out of three times.

We used the same network generator as well as the same media use and aggressive behaviors scales as we did for Study 1. Because the Big-Five and the IRI did not correlate with media use in Study 1, they were removed from the questionnaire. The trait aggression measure was replaced by the anger subscale of the original Buss and Perry (1992) Aggression Questionnaire. The seven items of the subscale are statements that are evaluated using a 7-point scale ranging from “Does not describe me well” to “Describes me very well”. We decided to use the complete anger subscale in order to obtain a more precise look into this dimension while keeping the questionnaire relatively short and avoiding overlaps between the complete scale and the aggressive behavior measure.

In addition, we measured the participant’s norms about aggression, that is, how normative they perceive aggressive behaviors to be, by means of the 15-items scale developed by Krahé and Möller (2004). Each item asks for respondents’ endorsement of behavior relating to physical (e.g., “To hit another person the same age as oneself”) or relational (e.g., “To tell lies about others”) aggression, using the following scale: 1 “Totally OK” – 2 “Somewhat OK” – 3 “Not really OK” – 4 “Not at all OK”. For ease of interpretation, all scores were reversed, meaning that higher scores reflected more acceptance toward aggressive behaviors.

Finally, we included a measure of personal relative deprivation, that is one’s perception of being less well off in life than others. Greitemeyer and Sagioglou (2019) found personal relative deprivation to predict aggression over time. Hence, we decided to explore the relationship between deprivation, media use, and aggression. To this aim, we used the five-items Personal Relative Deprivation Scale (PRDS) developed by Callan et al. (2011). Participants answered each item using a 7-point scale ranging from “Strongly agree” to “Strongly disagree”.

Of note, the questionnaire also comprised health-related questions as part of a different project. Namely, participants were asked about their size and weight (with the clarification that those information were not mandatory should one want to abstain from sharing these personal metrics but still take part in the study), in order to compute their BMI, their habits in terms of eating, smoking and exercising and their overall perception of their own healthiness. The aim of these questions was to assess the spread of healthy/unhealthy habits within our networks. Because these measures were not assumed to be related to the participant’s media use and/or their level of aggression, these data will not be discussed in the following sections.
Results

Correlational analyses

Descriptive statistics and correlations between media use, deprivation, and aggressive outcomes at Time 1, 2, and 3 are presented in Tables 4a–c. Contrary to our expectations, violent media use did not relate to anger and aggressive behavior, whereas neutral media use did. It appears that frequency of media use is more related to these outcomes than the overall violence level of the media consumed.

However, violent media use correlated with norms about aggression. This means that individuals who consumed more violent media tended to perceive aggressive behaviors as more acceptable. With the exception of Time 3, neutral media use did not correlate with norms about aggression.

Deprivation’s relationship with media use is unclear. Although it related to both media use scales at Time 1, the neutral media use at Time 2 was the only remaining significant relation in the other data sets. In regards to aggressive outcomes, deprivation did not significantly relate to anger nor aggressive behavior, but it consistently correlated positively with norms about aggression. Hence, individuals who saw themselves as less well off than their peers perceived aggressive behaviors as more normative.

Social network analysis

Visual representations of the networks are depicted in Figure 2. We followed the same approach as in Study 1 for the purpose of the Siena analysis. Friendship types were not included in the analyses, all individuals named by participants were considered friends regardless of the strength of the bond. Only individuals who completed the questionnaire at least twice were included in the network, leaving a sample of 120. For informative purposes, distribution of friendship type is presented in Table 5.

Norms about aggression score was modeled as the behavioral data for the behavior dynamics of the Siena model. The scores were recoded before implementation based on their quartile. That is, norms about aggression scores of 1 were coded 1, scores higher than 1 up to 1.2 were coded 2, scores of 1.2

Table 4a. Means, standard deviation, and bivariate correlations at time 1.

| Variable                      | M    | SD   | Cronbach’s α | 1    | 2    | 3    | 4    | 5    |
|-------------------------------|------|------|---------------|------|------|------|------|------|
| 1. Violent media use          | 3.38 | 1.87 | .18*          |      |      |      |      |      |
| 2. Neutral media use          | 1.11 | .46  |               | .18* |      |      |      |      |
| 3. Deprivation                | 2.47 | .76  | .49           | .21* | .17* |      |      |      |
| 4. Norms about aggression     | 1.23 | .21  | .81           | .14† | -.05 | .19* |      |      |
| 5. Anger                      | 2.25 | .57  | .80           | -.03 | .20* | .03  | .05  |      |
| 6. Aggressive behavior        | 1.30 | .25  | .72           | .05  | .24**| .15† | .20* | .19* |

Table 4b. Means, standard deviation, and bivariate correlations at time 2.

| Variable                      | M    | SD   | Cronbach’s α | 1    | 2    | 3    | 4    | 5    |
|-------------------------------|------|------|---------------|------|------|------|------|------|
| 1. Violent media use          | 3.14 | 1.81 | .16†          |      |      |      |      |      |
| 2. Neutral media use          | 1.05 | .48  |               | .16† |      |      |      |      |
| 3. Deprivation                | 2.39 | .72  | .32           | .09  | .22* |      |      |      |
| 4. Norms about aggression     | 1.27 | .22  | .84           | .26**| .04  | .26**|      |      |
| 5. Anger                      | 2.17 | .57  | .80           | -.03 | .21* | .03  | -.01 |      |
| 6. Aggressive behavior        | 1.26 | .26  | .76           | .12  | .12  | .06  | .16† | .10  |

Table 4c. Means, standard deviation, and bivariate correlations at time 3.

| Variable                      | M    | SD   | Cronbach’s α | 1    | 2    | 3    | 4    | 5    |
|-------------------------------|------|------|---------------|------|------|------|------|------|
| 1. Violent media use          | 2.85 | 1.72 | .18†          |      |      |      |      |      |
| 2. Neutral media use          | 1.03 | .47  |               | .18† |      |      |      |      |
| 3. Deprivation                | 2.31 | .70  | .40           | .06  | .08  |      |      |      |
| 4. Norms about aggression     | 1.26 | .23  | .93           | .29**| .20* | .20* |      |      |
| 5. Anger                      | 2.13 | .64  | .86           | -.02 | .13  | -.05 | .10  |      |
| 6. Aggressive behavior        | 1.27 | .24  | .79           | .16† | .25**| .09  | .46***| .30**|

*p < .1; *p < .05; **p < .01; ***p < .001.
and up to 1.4 were coded 3, and scores of 1.4 and higher were coded 4. Parameters’ estimates as well as standard errors and significance level are presented in Table 6.

The only similarity parameter that reached significance was aggressive behavior. Surprisingly this parameter was negative, meaning that participants were less likely to form and maintain friendships with others like them. None of the behavior parameters other than the default network ones reached significance. This is in contradiction with our hypotheses in that we found no signs of homophily and social influence in our network. There was a significant positive linear shape of norms about aggression, reflecting a tendency to get more extreme scores over time (i.e., participants with above-average scores tend to increase their score and those with below-average scores tend to get lower scores).2 Similar results were obtained when the threshold for friendship was set at 2 (casual friends) instead of 1 (acquaintances) with the exception of the aggressive behavior similarity parameter, which was no longer significant ($b = -0.22, s.e. = .31, p > .05$).

Discussion

Based on the mixed-results of our first study, we decided to conduct a second one with some changes. Most notably, we removed some of the scales that did not appear relevant and we changed the main dependent variable to norms about aggression. Whereas it related to violent media use, anger and aggressive behavior did not follow the same pattern. Moreover, these two measures correlated with neutral media use. That neutral more than violent media consumption was predictive of the participant’s aggression levels is in contradiction with our hypothesis. Interestingly, it also seems that individuals who feel more deprived when compared to their peers are keener on consuming media and perceive aggressive behaviors as more normative.

![Figure 2](image-url)
The longitudinal network analysis of our data also failed to support our hypotheses. Once again, there were no signs of social influence, meaning that friends’ media use did not influence one’s normative beliefs about aggression. In addition, we did not observe homophily in our network. Participants were not more likely to befriend others similar to them, and even appeared to avoid others with similar aggressive behavior scores, although this result was no longer significant when removing acquaintances ties from the network.

**General discussion**

The present work had three main goals. First, we aimed at replicating the link between violent media exposure and increased aggression, bringing new evidence in the current debate within media psychology. Second, we tried the case for homophily, the preference of individuals toward befriending others alike to themselves, in the context of aggression and media consumption. Third, and most importantly, we meant to test the recent claim that violent-media-related aggression could spread from consumers to their close ones (e.g., Greitemeyer, 2018).

Cross-sectional results provided mixed support for the link between violent media use and aggressive outcomes. In Study 1, the relationship between violent media use and aggressive behavior and trait aggression was not consistent. In Study 2, higher consumption of aggressive media was linked to the perception of aggressive behavior as more socially normative, but anger and aggressive behavior did not relate to violent media use. Across all six time points of the two studies, neutral media use related frequently to the different measures of aggressive outcomes, suggesting that frequency of media use, rather than the actual violent content one is exposed to, relates to some aspects of aggression. The longitudinal social network analyses did not support our hypotheses either. Homophily did not appear to influence the creation and continuation of relationships when looking at media use and aggression. Moreover, we could not find signs of social influence, be it on aggressive behaviors or norms about aggression. Overall, we did not find violent media to have a longitudinal effect on aggression.
Limitations

As any work, the present research has several limitations. One of which concerns our samples. We may have lacked a sufficient sample size in order to uncover some of the effects. After exclusions, we had at most 137 participants filling our questionnaire for one time point. Assuming $p < .05$, the effect size we could detect with a power of .8 was $r = .24$. Recent meta-analyses in the context of violent video game (Anderson et al., 2010; Greitemeyer & Mügge, 2014) have estimated the effect size at $r = .19$, which could even be an over-estimation (Hilgard et al., 2017). Hence, even with our best cross-sectional analysis, we were lacking sufficient power.

Unfortunately, because we conducted the study over the course of two following years, there are some potential overlap between participants in Study 1 and 2, meaning that we could not conduct an integrated data analysis to improve our statistical power. Adding to this, we had a high turn-over with only slightly over half of our participants completing all three data collection phases in both studies, hindering the capacity of our Siena analysis to establish the actual effects present in our networks.

Moreover, the use of students as participants in research has been criticized (Peterson, 2001; but see Druckman & Kam, 2009). Most importantly for the present context, participants in our study indicated that the ties to the fellow students were not very close. In fact, our participants did not know each other before data collection started, that is, all of the ties consisted of newly acquainted individuals. Our hope was that by selecting a recently formed network, we would be able to observe the creation of stronger ties as the year went by, giving us an opportunity to evaluate the many changes that would appear as students started to know each other. Although we observed stronger ties at later time points (see Tables 2 and 5) this may not have been sufficient or we may have needed to continue data collection at a later time, once our participants had the opportunity to form more significant friendships. Given that individuals are most strongly affected by their relatives and close friends (Christakis & Fowler, 2009), future work examining the impact of stronger relationships on the spread of aggressive media-related aggression might support the social influence hypothesis.

Adding to this, the specific use of psychology students may be problematic when studying aggression. Indeed, research on the differences in personality among study majors found, among other things, that psychology students tended to score higher on agreeableness (Vedel, 2016) and lower on dark triad traits (Vedel & Thomsen, 2017) than some of the other majors, especially economics or business students. This could be part of an explanation as to the low scores we found on reported aggressive behaviors and norms. Replications using a different sample would be beneficial in the future.

Finally, although it is a great tool for social network analysis, RSiena cannot make use of the whole data we collected. As we have previously stated, behavioral dynamics of continuous variables cannot be implemented yet. In combination with the aforementioned low variance in our aggressive behavior measurement, we could have failed to find some patterns that are actually present in our sample. Another piece of information that would have been beneficial for a more precise model in the future is the relationship type. As stated above, one is more likely to be influenced by those who are closer to her/him. That is, acquaintances typically have a much lesser impact than one’s best friend. Hopefully, future improvements of Siena will allow testing of more complex models in the future, which could shed a new light on works like ours.

Future perspectives

The present work provides some insight on how media use and aggression interact in human networks. However, there are still many things to explore in this field. In the following, we present some ideas that we deem interesting for future works.
First of all, aggression is manifold, and studies on the effect of violent media took interest in many different outcomes. Potential measures of interest include hostile expectation bias (Bushman & Anderson, 2002) or desensitization to violence (Bartholow et al., 2006). Similarly, in light of Vachon et al.’s (2014) finding that empathy and aggression are only weakly related, one may want to use more sound measures of empathy (i.e., by using measures which also include dissonant responses such as sadism or schadenfreude) to explore its role in the context of violent media use in society. As a matter of fact, everyday sadism (Greitemeyer, 2015) and dark personality (Delhove & Greitemeyer, 2020) have been found to relate to violent video game use. Furthermore, based on the correlations between neutral media use and some of our aggression measures, it would be pertinent to compare the effects of violent content and of overall frequency of media consumption on aggression.

Another promising direction could emerge from exploring the effect of prosocial games on prosocial behaviors. An example of such effect stems from the work of Greitemeyer and Osswald (2009, 2010). These authors asked their participants to play either a prosocial or a neutral video game and found that prosocial games decreased hostile expectation biases and the accessibility of antisocial thoughts as well as increased prosocial behaviors and the accessibility of prosocial thoughts. Outside of a laboratory setting, Prot et al. (2014) conducted a large-scale, cross-cultural correlational study and a two-year longitudinal study. They found that prosocial media use was linked to higher levels of helping behaviors which was mediated by increased empathy. Meta-analysis of prosocial video game use found that this effect was of a similar magnitude as that of violent video game use (Greitemeyer & Mügge, 2014). We would suggest that future work also delve into the eventual spread of positive effects of prosocial media.

**Conclusion**

Over the course of two academic years, two groups of first-year psychology students have filled in personality questionnaires and network generators, with the goal of assessing the link between violent media use and aggression, as well as the potential spread of media-related aggression. Our study provided little to no support for the idea of a connection between exposure to violent media and aggressive outcomes, with even stronger ties appearing between neutral media use and aggression measures, and failed to find the expected contagion. Participants did not prefer to pursue friendships with others who were more similar to them, a phenomenon known as homophily, and we could not find evidence of social influence on aggression in either study. However, more work employing larger samples and examining closer ties between participants is needed before strong conclusions are warranted.

**Notes**

1. These analyses were also ran with the media use scores for each media type separately. We found the same pattern with all three media types.

2. These analyses were also ran with the media use scores for each media type separately. We found similar patterns for all three media types with the following exceptions: neutral movie consumption similarity was a significant positive predictor of friendship formation, whereas violent movie consumption similarity was a negative predictor; violent TV shows consumption was a significant positive predictor of future increase in normative beliefs about aggression; violent video game use similarity was a significant positive predictor in friendship formation.

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Notes on contributors

Martin Delhove is a doctoral student in the Department of Psychology, University of Innsbruck. His research interests include media psychology and social networks.

Tobias Greitemeyer is a Full Professor in the Department of Psychology, University of Innsbruck. His research interests include media effects and pro- and antisocial behavior.

Ethics

The study received ethical approval from the Internal Review Board for Ethical Questions by the Scientific Ethical Committee of the University of Innsbruck.

Data availability statement

The data described in this article are openly available in the Open Science Framework at https://osf.io/dp3qc.

Open scholarship

This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at https://osf.io/dp3qc.

ORCID

Martin Delhove http://orcid.org/0000-0002-2721-0310
Tobias Greitemeyer http://orcid.org/0000-0002-1351-9210

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