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A Multimethodological Study of Preschoolers' Preferences for Aggressive Television and Video Games

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ABSTRACT

The association between aggressive media and related behavior is complicated, and the role of underlying genetics has not been adequately explored. A better understanding of the role of genetics on the relationship between aggressive media and behavior, especially in young children, is critical. Using a twin/triplets sample ($N = 184$ children), the authors investigated the association between preschoolers' preferred media choices and their aggressive behaviors. A multimeasure methodology was utilized, examining children's reports of their preferred media games and shows, observed child negativity and aggression in the lab, and parent reports of their own and their children's aggressive behaviors. The results demonstrated a significant relationship between maternal aggression and parent-reported child aggression, especially for boys. Genetic analyses demonstrated significant heritability for children's parent-reported aggressive behaviors, supporting the biological basis of aggression, but not for media aggression preferences. Controlling for genetics, the authors found that the association between media preferences and aggressive behavior may be genetic in origin. These results emphasize the importance of considering shared genetics underlying the relationship between children's aggressive behaviors and their media preferences, as well as environmental influences. By examining preschoolers, the present study provides insight into the importance of media influences in children younger than those previously studied.

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The association between aggressive media and behavior is a topic that has been highly debated (e.g., Bender, Plante, & Gentile, 2017; Ferguson, Bowman, & Kowert, 2017) and currently is of great salience (e.g., Bushman, Anderson, Donnerstein, Hummer, & Warburton, 2016; Ferguson, 2015b), as some North Americans spend nearly half of their leisure time consuming media (Graber, 2010). The greatest concern centers around possible influences that television shows and video games may have on aggressive behaviors, especially for children and adolescents, who may be particularly vulnerable to media influences (Buchanan, Gentile, Nelson, Walsh, & Hensel, 2002). However, the extant literature does not clearly indicate that this association is causal. The most recent meta-analysis found a significant association between aggressive media exposure and aggressive behavior, but concluded that these effects were very small ($r_p = .05$; Furuya-Kanamori & Doi, 2016). Some authors argue that the current public outcry on this topic is unsupported (e.g., Ferguson & Beresin, 2017), whereas others emphasize the importance of investigating even minor effects (e.g., Gentile, 2016). Ferguson (2015a) and Greitemeyer and Mügge (2014) provided in-depth literature reviews from each respective viewpoint. Clearly, additional research is needed to address gaps in this literature. In the present study we used a genetically informed sample

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to investigate the association between aggressive media preferences and aggressive behaviors in early childhood.

Previous studies examining the effect of media on behavior often rely on experimentally exposing individuals to certain forms of media (e.g., Coyne et al., 2008; Gentile, Bender, & Anderson, 2017; Ramos, Ferguson, Frailing, & Romero-Ramirez, 2013). Although beneficial, this approach does not reflect specific choices that children make about what to watch or play. Thus, information about children's personal preferences for certain types of media (e.g., favorite movies or video games) is needed to supplement these laboratory studies. In theory, different individuals may gravitate toward and prefer specific types of media content (e.g., aggressiveness), and this content may differentially impact children. Conversely, children who are more aggressive may be more likely to prefer aggressive media. By focusing solely on forced exposure, we argue that the personal characteristics of the individual are not fully considered. Therefore, in the present investigation we approached the topic of media and behavior by considering the possibility of innate tendencies influencing this association.

Screen media use among children and adolescents is growing at an increased rate in recent years (Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016). Although some recent studies demonstrated a relationship between aggressive media and negative behavior (e.g., Anderson et al., 2017), other studies failed to find longitudinal evidence for this association (e.g., Fikkers, Piotrowski, & Valkenburg, 2016), and some reported no significant differences based on violent television exposure (Ramos et al., 2013). Some research has even highlighted positive outcomes related to media use. For instance, Durkin and Barber (2002) demonstrated that adolescent computer game use was related to a variety of positive development outcomes (e.g., family closeness, self-concept, positive mental health). Thus, the relationship between aggressive media exposure and consequent behavior is unclear.

Moreover, we know little about how children's preferences for aggressive media are related to their aggressive behaviors. It is important to investigate preferred media, given that these preferences may be indicative of innate personality or individual differences. It is also crucial to consider the genetic components of this relationship, given the existing gap in this literature (Ferguson et al., 2017; Glackin & Gray, 2016). Hence, it is necessary to investigate whether innate aggressive tendencies impact individual preferences for aggressive media. This approach is in line with recommendations from many theorists in this area (e.g., Ferguson & Dyck, 2012; Valkenburg & Peter, 2013).

Two types of aggression that often are studied are physical aggression, which includes hitting, kicking, punching, pulling, pushing, and taking things away from others (Dodge, Cole, & Lynam, 2006), and relational aggression, which involves behaviors that have the intention of hurting, harming, or injuring another person through social relationships (Crick & Grotpeter, 1995). Some researchers have demonstrated that boys are more likely than girls to show physical aggression, whereas girls more often engage in relational aggression (Crick & Grotpeter, 1995; Ostrov, Kamper, Hart, Godleski, & Blakely-McClure, 2014), although others have found mixed evidence supporting sex differences for relational aggression (Möller & Krahé, 2009).

One theoretical model that can be used to understand media's influence on aggressive behaviors is the general aggression model (Anderson & Bushman, 2002), which predicts that increased exposure to aggressive media results in the development of an aggressive personality through the facilitation of a hostile perception of the world. However, it has been argued that this model does not consider the biological basis of aggression (Ferguson & Dyck, 2012), which is an essential component of a theory explaining the development of aggression. The Differential Susceptibility to Media Effects Model (DSMM) proposes an all-encompassing theoretical model that examines the effects of media by also considering individual differences (Valkenburg & Peter, 2013). The DSMM provides theoretical reasoning for investigating not only the effect of media on the individual, but also the effect of the individual (e.g., dispositional traits) on choices of media. The DSMM suggests that dispositional traits such as temperament may underlie the relationship between media exposure and an individual's behaviors. This theoretical framework can also be conceptualized through an active gene-environment correlation (rGE) framework (Scarr & McCartney, 1983). Active rGE occurs when individuals who are biologically susceptible to behaving aggressively seek out forms of media to match this innate tendency. Relatedly, passive rGE could be occurring if

parents are providing both genes and environments, such as exposing their children to aggressive movies or video games, that predispose children toward behaving more aggressively.

Thus, we suggest that children who show a preference for aggressive media are also those with increased aggressive behaviors, with cause and effect difficult to ascertain. It could be that exposure to aggressive media causes increases in aggression. However, individuals who are innately aggressive may also prefer aggressive media, and their genetic make-up may impact the manner in which this media affects them. In both instances, it is predicted that youth with aggressive tendencies may seek out more aggressive media and, as a result of this exposure, their behavior may be differentially influenced based on their susceptibility to the media effects, supporting the DSMM (Valkenburg & Peter, 2013).

Children and aggressive media

Video games are one form of media that provide children with the ability to control and act out various behaviors through a character on a screen, which may relate to later aggressive behaviors (Bushman & Anderson, 2002; Greitemeyer & Mügge, 2014; Prot, Anderson, Gentile, Brown, & Swing, 2014). Gentile et al. (2017) demonstrated that violent video game exposure was positively linked to increased cortisol, cardiovascular arousal (for boys), and immediate aggressive thoughts. Although some biology-related factors were investigated, this study examined these as effects of video game exposure rather than as possible precursors. Another study also found a positive association between violent video game-induced arousal and aggression, but did not find significant long-term effects one year later (Fikkers et al., 2016). Other work has demonstrated high levels of aggressive cognition in participants; however, again, this research did not examine the role of aggressive personality (Bushman & Anderson, 2002). Furthermore, other work found no direct evidence to support the relationship between aggressive media exposure and subsequent aggressive behaviors in children with behavioral problems (Mitrofan, Paul, Weich, & Spencer, 2014). Importantly, a gap in the literature exists regarding these effects in children as young as preschoolers, who also may be exposed to aggressive video games.

As with video games, children who are exposed to aggression in TV shows and movies may be at elevated risk for a wide variety of long-term consequences, which may include desensitization to real violence, aggressive cognitions and behavior, and problematic parental and peer relationships (Buchanan et al., 2002; Johnson, Cohen, Smailes, Kasen, & Brook, 2002). For example, increased exposure to physical and relational aggression on television has been correlated with higher levels of aggression in adolescence. Coyne et al. (2017) also found that preschoolers' engagement in viewing superhero programs is related to increased physical and relational aggression, but not prosocial behaviors, one year later. However, as recent meta-analyses have indicated, many of these effect sizes are relatively modest in scope (e.g., Furuya-Kanamori & Doi, 2016). Additionally, not all studies have replicated this media-induced aggressive behavior relationship (e.g., Fikkers et al., 2016; Mitrofan et al., 2014). Thus, clear evidence for a negative impact related to aggressive media exposure is lacking. Therefore, perhaps it is necessary to focus on individual preferences for media (i.e., media that the individual is interested in sustaining engagement with) rather than simply exposure to certain types of media.

Finally, because most studies have not done this, several theorists emphasize the importance of considering how individual differences in genetic predispositions may affect the influence of environmental factors (e.g., media) on aggressive behaviors (Ferguson et al, 2017; Glackin & Gray, 2016; Tuvblad & Baker, 2011). Children who are more aggressive may be incited to aggression by aggressive media, but other children may enjoy the excitement of the media without actually engaging in aggressive acts themselves. In fact, in one twin study examining amount of television watched and later aggression, Schwartz and Beaver (2016) found that this previously found relationship disappeared when genetic influences were taken into account. Thus, it is critical to account for shared genes when examining causal relationships between such measures.

Berkowitz (1989) suggested that negative affect is related to frustration and can produce aggressive inclinations. Given the competitive element of video games, players may become frustrated with one another and may be more likely to act aggressively. For example, undesired outcomes while playing video

games (e.g., losing) can increase aggression after game play (Breuer, Scharkow, & Quandt, 2015). Further investigation is needed to better understand the role that negative affect has in relation to preferences for aggressive media. We would expect that children who exhibit greater negative affect also will report preferences for more aggressive media.

Parental genetic and social influences on aggression

Genetic influences have been demonstrated in a number of studies on child aggression (DiLalla, 2002). Genetic effects account for approximately 50–60% of the variance in children's aggression (Brendgen et al., 2005). On the other hand, heritability of social (relational) aggression appears to be weaker (DiLalla, 2002), with only about 20% of variance explained by genetics (Brendgen et al., 2005). Wahl and Metzner (2011) found that self-reported externalizing behaviors of parents were significantly related to their children's aggression (measured by parent and child report) at follow-up, three years later.

These relations between parent and child aggression could be a result of shared genes or environment, or most likely both. A genetically informative study is needed to tease these apart (Ferguson et al., 2008). Furthermore, it is important to consider children's individual characteristics, such as temperament, as some authors have suggested that the association between aggressive media and aggressive behavior is more a function of shared genetic influences on both media perception and behavior than a causal relationship between the two (e.g., Ferguson et al., 2017; Glackin & Gray, 2016; Mitrofan et al., 2014).

Present study

Most research on children's exposure to aggressive media has involved studies that experimentally expose children to such media, rather than asking what their favorite show or game is to watch or play. Thus, little is known about the media children prefer to watch in relation to their own aggressive behaviors, and little is known about this relationship in preschool-aged children. Additionally, individual differences for aggression must be considered, given that many studies in this literature fail to consider biology or innate aggression (Ferguson et al., 2017).

In the present study we used a twin sample to investigate the relationship between preschoolers' preferred media choices and their aggressive behaviors. In line with Ostrov et al. (2014), we hypothesized that media with increased physical aggression would be preferred by boys more than by girls, and media with increased relational aggression would be preferred by girls more than by boys. We further hypothesized that preschoolers' self-reported preferences for physically and relationally aggressive media, as well as parental aggression and children's negativity during a play interaction in the laboratory, would be positively related to parent reports of children's aggressive behaviors, even after controlling for genetic influences on child aggression. We hypothesized that child sex would act as a moderator, such that boys who preferred more aggressive media, were more negative in the lab, and had more aggressive parents would be rated as the most aggressive. Finally, we hypothesized that preferences for physical and relational media aggression would be heritable, and, given the expected sex differences, we also hypothesized that same-sex twins would be more similar than opposite-sex twins. Importantly, we utilized a multimeasure methodology, examining children's reports of their preferred media games and shows, observed child negativity and aggression in the lab, and parent reports of their own and their children's aggressive behaviors.

Method

Participants

Participants were 5-year-old twins or triplets and their parents who were part of the Southern Illinois Twins/Triplets and Siblings Study (SITSS; DiLalla, Gheyara, & Bersted, 2013), a longitudinal study of preschool children. Many of these children had been tested at earlier ages, but only age 5 years data were included in this study. One hundred eighty-four children from 92 families (107 [58%] girls; four sets

of triplets; 35 monozygotic [MZ] pairs; 57 dizygotic [DZ] pairs) had complete data and were included for analyses. For seven families, only one twin had complete data; those twins' data were included in nongenetic analyses. For certain analyses, one twin from each pair was included for analysis to maintain sample independence.

Families were recruited as part of a study of twins and triplets. Recruitment letters were sent to families listed in local birth announcement newspaper sections, local daycare centers were asked to provide letters to families of multiples, Facebook was used to advertise, and families were asked to share recruitment information with friends with multiples. Thus, recruitment included a broad area. Families came from within approximately a 2-hr drive of the university. This sample is typical of a volunteer sample in terms of being from fairly high income homes with educated parents, although there is a wide range. For parent education, 24% of mothers and 42% of fathers graduated from high school, 8% of mothers and 2% of fathers had a technical degree, 55% of mothers and 36% of fathers graduated from college, and 13% of mothers and 19% of fathers had an advanced degree. Most families (69%) earned at least $55,000/year, but the reported range was from $10,000 to 15,000/year to > $55,000. Mothers' mean age at time of testing was 35 years old ($SD = 4.95$ years). Most children were reported to be Caucasian (95%), with 2.5% African American and 2.5% other.

Procedure

All children were tested within two months of their fifth birthday. Families were invited to a playroom laboratory on campus and children were tested one at a time in a separate room. Before coming in for testing, parents were mailed a packet of questionnaires that they were asked to complete and bring to the lab at the time of testing. At the lab, children were administered a battery of questions one at a time in a separate testing room. After the children were tested, they and a parent participated together in an interaction task. Parents were given a puzzle for each child and were asked to play with the children for 10 min in an otherwise empty lab playroom. The interaction was recorded through a one-way mirror and later coded by trained coders. Before testing, all families gave informed consent. This study was approved by the university institutional research board.

Measures

Child-reported media preferences rated for physical and relational aggression

Children were asked to name their favorite television show or movie and their favorite video game. They were only asked to name these; they were not asked anything about their preferences, so they were not led to think of aggressive (or any other type of) media preferences. This general method of obtaining media preferences has been used in previous research (Anderson & Dill, 2000) and has been shown to be both reliable and valid. Children's choices were rated on a scale from 0 to 12 separately for degree of physical and relational aggression (see Table 1). A previous study used a similar manner of expert rating for identifying types of violent behavior (Busching et al., 2015). A score of 0 was indicative of no aggression (e.g., Barney); a score of 12 meant that the media frequently displayed major aggressive behaviors in a realistic manner (e.g., physical aggression: Power Rangers; relational aggression: American Idol). Importance was placed on what type of character was demonstrating the action. Nonhuman characters' actions were considered to be less severe because children were expected to identify more with human than nonhuman characters. Previous research has indicated that it is important to distinguish between fantasy and reality, as this may affect the association under investigation (Ferguson & Dyck, 2012). The frequency and regularity of the behaviors were also considered and aggression that happened more often was rated more severely. Two raters reviewed and rated all media choices, and any discrepancies were discussed and resolved.

Parent-reported child externalizing problem behaviors

The Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) is a 113-item parent report form that assesses the social, emotional, and behavioral functioning of children. Parents rated each behavior on a

Table 1. Coding for aggression of media preferences (television shows/movies and games).

	Description of aggression	Type of characters	Physical aggression example	Relational aggression example
0	No aggression		*Barney*	*Barney*
1	Minor aggression [infrequent]	AC (animal/alien/monster) vs. AC/H	*Cars 1 & 2*	*Baby Looney Tunes*
2	Minor aggression [infrequent]	AH vs AH	*Ed, Edd n Eddy*	*Aladdin*
3	Minor aggression [infrequent]	H vs. H	*iCarly*	*Power Rangers*
4	Major aggression [infrequent]	AC vs. AC/H	*Lion King*	*Lion King*
5	Major aggression [infrequent]	AH vs. AH	*Aladdin*	*Pocahontas*
6	Major aggression [infrequent]	H vs. H	*Jumanji*	*Full House*
7	Minor aggression [continuous]	AC vs. AC/H	*Tom & Jerry*	*SpongeBob SquarePants*
8	Minor aggression [continuous]	AH vs. AH	*Jake and the Never Land Pirates*	*The Incredibles*
9	Minor aggression [continuous]	H vs. H	*NFL*	*iCarly*
10	Major aggression [continuous]	AC vs. AC/H	*Teenage Mutant Ninja Turtles*	*Family Guy*
11	Major aggression [continuous]	AH vs. AH	*Batman*	*Rugrats*
12	Major aggression [continuous]	H vs. H	*Power Rangers*	*American Idol*

Note. Physical aggression involves hitting, kicking, punching, pulling, pushing, and taking things away from others. Minor: rough and tumble; "playful"; comical/slapstick. Major: purposeful; blood/gore/death; fighting (with malicious intent). Relational aggression involves intention of hurting, harming, or injuring someone through social relationships. Minor: teasing; sarcasm meant to be funny not necessarily cruel; poking fun. Major: malicious intent (e.g., teasing, sarcasm); makes someone cry; aims to "hurt" with words. AC = animated character; AH = animated human; H = human.

3-point Likert-type scale with responses ranging from 0 (*not at all like their child*) to 2 (*very much like their child*). The aggression score was used in this study and showed good internal consistency reliability in this sample (Cronbach's $\alpha = .86$).

Observed child negative behaviors

A Parent-Child Interaction scheme (DiLalla et al., 2013) was used by trained coders to rate children's and parents' behaviors during the triadic interaction. Coders were trained to at least 70% inter-rater reliability before coding children and parents on the interaction behaviors. To decrease rater bias, different coders rated each twin separately. Coders rated the child after each minute of interaction on a number of behaviors, including negative affect and aggression. After each minute of the interaction, coders stopped the video and rated the child and parent on all behaviors, resulting in a total of 10 ratings (over 10 min) for each behavior. These 10 ratings were averaged to create a total score for negative affect, from 1 (*no negative affect throughout the testing session*) to 4 (*some crying or complaining through the entire session*). For aggression, each minute during which the child engaged in aggressive behavior was summed, for a possible total of 10 for each child. Aggressive behaviors included behaviors such as throwing toys (not in fun), pushing someone, yelling negatively, and pushing parent's hand away angrily. Inter-rater reliability for these behaviors was good (weighted Cronbach's $\alpha = .90$ for negative affect and .89 for aggression). These two measures were significantly correlated ($r = .37$, $p < .001$) and subsequently were z-scored and then averaged to form a single measure of child observed negativity during the interaction.

Parent personality

Parents completed the aggression subscale from the Multidimensional Personality Questionnaire (Tellegen & Waller, 2008) to collect self-reported data on aggression of the parents. This scale is comprised of 19 items rated as either true or false. Both mothers and fathers completed this scale about themselves (data were unable to be collected from 14% of fathers). Internal consistency reliability was adequate (Cronbach's $\alpha = .73$ for mothers and .71 for fathers).

Data analysis

Variables were first assessed for skewness. Physical and relational media preferences, mother aggression, and CBCL aggression were square rooted to minimize skewness. These transformed variables were used in all analyses. Additionally, because this sample comprised twins and triplets, we examined whether there was a significant effect of zygosity (MZ vs. DZ) on the child aggression variables. A multivariate

Table 2. Descriptive statistics among study variables for total sample and separately for girls and boys.

	Total sample		Girls		Boys	
	M	*SD*	*M*	*SD*	*M*	*SD*
Media physical aggression[a]	4.28	4.36	3.11	3.37	5.91	5.03
Media relational aggression	3.20	2.74	3.15	2.75	3.27	2.75
Observed child negativity	− 0.02	0.81	− 0.05	0.76	0.03	0.88
Maternal aggression	2.30	2.72	2.10	2.05	2.58	3.43
Paternal aggression	3.93	2.64	4.03	2.56	3.81	3.76
CBCL aggression	4.52	4.33	4.11	4.05	5.08	4.66

[a]Boys significantly greater than girls, $F(1, 182) = 12.71$, $p < .001$.

analysis of variance (MANOVA) showed no effect of zygosity, $F(3, 210) = 0.63$, $p = .598$. Thus, there is no concern that MZ children are more or less aggressive than DZ children.

Because of the nature of our sample, with two (twins) or three (triplets) children within each family, we used mixed-model multilevel linear regression modeling to test our hypotheses. This method allowed us to include siblings within a family as a nested (random) effect in the models. We first tested a simple, non-nested model as a baseline model (Model 1), then added sibship as a random effect (Model 2), then random slopes (Model 3), and then we tested moderation models, assessing whether each independent variable significantly interacted with child sex. Before assessing interaction models, we centered the independent variables so that interpretation of results would be clearer (Aiken & West, 1991). Maximum likelihood estimation was used so that models could be compared statistically (Field, 2013).

However, the final, best-fitting model does not take into account the effect of genetic influences on children's aggression. By employing a twin design, we were able to control for shared genetic effects within a family by including a within-family measure that assessed whether higher scores on the predictor variables were related to higher aggression scores within each family. By comparing twins within pairs, we were able to control for shared genetic and familial influences that make children within a family more similar to each other (Schwartz, 2016). We employed the method described by Turkheimer and Harden (2014). For each predictor variable, we calculated the mean score within each family and then the difference between each child and the mean score. By including these in a separate mixed-model linear regression, we were able to calculate between-family (beta weight for mean family score) and within-family (beta weight for the difference score) effects.

Results

Descriptive statistics for all variables are provided in Table 2, and correlations among study variables are provided in Table 3. As can be seen, there is evidence that children who were rated as more aggressive by their parents were more likely to have more aggressive mothers. Also, children who were observed to be more negative during the parent-child interaction were more likely to have more aggressive mothers and to prefer more relationally aggressive media.

Table 3. Correlations among study variables using transformed variables.

	Sex	Media physical aggression	Media relational aggression	Child observed negativity	Maternal aggression	Paternal aggression	CBCL aggression
Sex	1.0						
Media physical aggression	.25***	1.0					
Media relational aggression	.02	.30***	1.0				
Observed child negativity	.05	.01	.05	1.0			
Maternal aggression	.02	.09	.19**	.09	1.0		
Paternal aggression	−.05	.01	−.01	.00	.28***	1.0	
CBCL aggression	.10	.10	.05	.13	.30***	.11	1.0

Note: Correlations with sex are nonparametric Spearman correlations. CBCL = Child Behavior Checklist.
**$p < .01$. ***$p < .001$.

Sex differences

To test our hypothesis that boys would prefer physically aggressive media and girls would prefer relationally aggressive media, a MANOVA was performed. Only one child from each family was used for these analyses to avoid dependence of sample. The overall test was significant, $F(2, 116) = 6.42$, $p = .002$. We found a significant sex effect for preferences for physical media aggression, $F(1, 118) = 12.06$, $p < .001$. Boys showed a significantly stronger preference for physically aggressive media (transformed $M = 2.07$, $SD = 1.35$) than did girls (transformed $M = 1.32$, $SD = 0.97$). However, for relationally aggressive media preferences, boys (transformed $M = 1.55$, $SD = 0.90$) and girls (transformed $M = 1.47$, $SD = 0.98$) were similar, $F(1, 118) = 0.22$, $p = .637$. Additionally, a MANOVA testing sex differences across all study variables was significant, $F(6, 84) = 2.25$, $p = .046$, and the only significant sex difference was for physical media aggression preferences.

Mixed-model analyses

To test our full hypothesis predicting child aggression, we used mixed-model multilevel linear regression modeling. Our first baseline model included six main effects (child sex, child physical aggression media preference, child relational aggression media preference, child negative behavior during interaction, maternal aggression, and paternal aggression) as fixed factors and also included random intercepts (see Table 4). We then modeled the hierarchical structure of our data set by including sibship as a random effect (Model 2), which provided a significantly improved model fit, meaning that the intercepts for the regression equations vary across families. Model 3 added random slopes, which did not improve the model fit and were therefore not included in future models. We then separately tested all sex moderation models. As can be seen in Table 4, including sex by media physical aggression preferences significantly improved the model fit. Examination of the residual variances across models shows that 6% of the variance in child aggression was attributable to this interaction. In this best fitting model, maternal aggression and sex by media physical aggression preferences significantly contributed to the prediction of child aggression (see Table 5).

The significant interaction was further examined by re-running the final model separately by child sex after removing sex and the interaction from the model (Field, 2013). Results showed only a marginally significant prediction for girls from media physical aggression preferences, $t(97.87) = 1.93$, $p = .056$. For boys, the prediction from media physical aggression to child aggression was significant, $t(45.29) = -2.18$, $p = .034$, and maternal aggression also significantly predicted child aggression, $t(51.06) = 2.30$, $p = .026$. However, the direction of effect from media preferences to aggression was the opposite of what we had expected.

These results did not take into account the possible confounding effects of genetic influences. Thus, we then computed within-family mean scores and each child's deviation from their family's mean score and entered these into the final mixed-model regression equation (equivalent to Model 4). This allowed us to test for within-family effects and thus determine whether the independent variables were significantly predictive of child aggression after accounting for latent shared genetic and familial factors.

Table 4. Mixed-model multilevel linear regression modeling results, with child CBCL aggression as the dependent variable and sex, media physical aggression preference, media relational aggression preference, child observed negativity, maternal aggression, paternal aggression, and interactions by sex as independent fixed effects.

Model	χ^2 (*df*)	AICc	Versus model	$\Delta\chi^2$ (*df*)	*p*
1. Main fixed effects and random intercepts	552.86 (8)	569.68			
2. Adding sibship as random effect	490.74 (9)	509.78	1	62.12 (1)	< .001
3. Adding media physical aggression as random slope	490.69 (10)	511.96	2	0.05 (1)	*ns*
4. Adding Media Physical Aggression × Sex	**484.87 (10)**	**506.15**	**2**	**5.87 (1)**	**< .05**
5. Adding Media Relational Aggression × Sex	490.11 (10)	511.38	2	0.63 (1)	*ns*
6. Adding Observed Child Negativity × Sex	490.74 (10)	512.02	2	0.00 (1)	*ns*
7. Adding Maternal Aggression × Sex	489.74 (10)	511.01	2	1.00 (1)	*ns*
8. Adding Paternal Aggression × Sex	490.60 (10)	511.87	2	0.14 (1)	*ns*

Note. AICc (Hurvich & Tsai, 1989) = AIC + [2 k(k + 1)/(n – k – 1)], where k = number of estimated parameters and n = sample size. Model 4, bolded, is the best-fitting model, with lowest Akaike information criterion (AIC) value and significantly better fitting chi-square value than the other models.

Table 5. Mixed-model multilevel linear regression modeling parameter estimates for best model (Model 4), predicting CBCL aggression.

	Estimate	95% CI	*p* value
Fixed effects			
Intercept	1.79	[1.54, 2.03]	.000
Sex	0.07	[−0.21, 0.36]	.608
Media physical aggression	0.11	[−0.06, 0.27]	.198
Media relational aggression	0.02	[−0.12, 0.16]	.749
Observed child negativity	0.14	[−0.01, 0.28]	.061
Maternal aggression	0.30	[0.06, 0.55]	.015
Paternal aggression	0.01	[−0.07, 0.10]	.776
Media Physical × Sex	0.27	[−0.49, −0.05]	.015
Random effects			
Within-family effect	0.84	[0.59, 1.21]	.000

We re-ran Model 4, but for each independent variable we calculated the within-family mean score, the deviation of each child's score from their family's mean score, and the interaction between the deviation and zygosity (0 = MZ, 1 = DZ), as per Turkheimer and Harden (2014). The only variables that we included without these transformations were maternal and paternal aggression, because these scores cannot differ for children within a family. The interaction term of a difference score by zygosity estimates the difference between MZ and DZ twins for the association between the independent and dependent variables. If the estimate is significant and positive, then DZ twins are less similar to each other than are MZ twins, suggesting that genetic factors are significant influences on the relationship between the independent variable and child aggression.

This mixed-model linear regression replicated the significant prediction from maternal aggression to child aggression (see Table 6). In addition, the estimate of the difference score for physical media aggression by zygosity was significant. This means that the within pair effect is significantly larger for DZs than for MZs, suggesting that the association between preferences for physically aggressive media and child aggression is genetic in origin.

Finally, we attempted to replicate the sex by physical aggression media preference interaction using this method. We re-ran our model, including only physical aggression media preferences (the within-family mean score, the deviation of each child's score from their family's mean score, and the interaction between the deviation and zygosity) and maternal aggression, separately by sex of child. We found that maternal aggression predicted child aggression for boys, $t(46.98) = 2.11$, $p = .041$ but not for girls, $t(63.94) = 1.31$, $p = .197$. The interaction between physical aggression media preference and zygosity

Table 6. Results from mixed-effects models of media preferences, child negativity, and parent aggression predicting child aggression, controlling for shared genetic effects.

	Estimate (s.e.)	t (df)	*p* value
Fixed Effects			
Intercept	1.65 (.28)	5.88 (102.35)	.000
Media Physical Aggressive (MPA) Deviation	− 0.15 (.12)	− 1.33 (91.07)	.188
MPA Deviation ∗ Zygosity (DZ Effect – MZ Effect)	0.33 (.13)	2.56 (91.08)	.012
MPA Deviation Pair Average	0.10 (.11)	0.86 (92.66)	.393
Media Relational Aggressive (MRA) Deviation	− 0.04 (.16)	− 0.26 (88.78)	.799
MRA Deviation ∗ Zygosity	− 0.06 (.19)	− 0.31 (91.69)	.756
MRA Deviation Pair Average	− 0.07 (.14)	− 0.55 (90.63)	.586
Child Negativity (CN) Deviation	− 0.09 (.19)	− 0.45 (88.15)	.651
CN ∗ Zygosity	− 0.10 (.22)	− 0.45 (88.16)	.657
CN Pair Average	0.15 (.17)	0.86 (92.62)	.390
Mother Aggression	0.33 (.13)	2.48 (87.24)	.015
Father Aggression	0.00 (.04)	0.05 (87.33)	.961
Zygosity	− 0.10 (.21)	− 0.47 (136.93)	.643
Sex	0.18 (.15)	1.16 (150.65)	.248
Random Effects			
Family (Within Family Variance)	0.85 (.16)	Wald Z = 5.47	.000

Note. CN = child negativity; MRA = media relational aggressive; MPA = media physical aggressive.

Table 7. Intraclass correlations by zygosity for child aggression variables.

Variable	MZ ($n = 36$)	Same-sex DZ ($n = 34$)	Opposite-sex DZ ($n = 25$)
Media physical aggression[a]	$r = .40, p = .006$	$r = .39, p = .009$	$r = -.27, p = .906$
Media relational aggression	$r = .55, p = .000$	$r = .42, p = .006$	$r = .28, p = .093$
Observed child negativity	$r = .10, p = .281$	$r = -.03, p = .576$	$r = .21, p = .153$
CBCL aggression[b]	$r = .79, p = .000$	$r = .49, p = .001$	$r = .63, p = .000$

[a] rSSDZ > rOSDZ, $z = 2.47$, $p = .007$.
[b] rMZ > rSSDZ, $z = 2.14$, $p = .016$; SSDZ not significantly different from OSDZ, $z = 0.74$, $p = .230$.

was marginal for boys, $t(30.50) = 1.87$, $p = .071$, but not for girls, $t(62.45) = 0.40$, $p = .691$, suggesting that any association between preferences for physically aggressive media and actual aggressive behaviors for boys is attributable to shared genes, although this association is weak.

Heritability analyses

Intraclass correlations were computed separately for MZ pairs, same-sex DZ (SSDZ) pairs, and opposite-sex DZ (OSDZ) pairs for each of the child aggression variables (see Table 7). There were no significant differences between MZ and SSDZ correlations, and therefore there was no evidence for heritability of preferences for physically or relationally aggressive media or on children's negative behaviors during the parent-child interactions. Interestingly, though, the correlation between OSDZ pairs for preferences for relationally aggressive media was negative and significantly less than for SSDZ pairs ($z = 2.47$, $p = .007$). This suggests possible environmental sibling effects that differ for same versus opposite sex sibling pairs. However, for CBCL aggression, the MZ correlations were significantly greater than the DZ correlations ($z = 2.14$, $p = .016$), with a heritability estimate of .60. To ensure that our data are consistent with other studies on child aggression, we used LISREL and bootstrapping to model genetic, shared environmental, and nonshared environmental variance for CBCL aggression. We found that the best fitting model included significant effects of additive genes and nonshared environment. This is consistent with many other studies of parent-rated aggression (DiLalla, 2002), and therefore details of the analyses are not included here.

Discussion

Although some studies have examined the role of aggressive media exposure on children's subsequent aggression, most of this research uses experimental manipulations to expose children to such media (e.g., Anderson & Bushman, 2002; Coyne et al., 2008; Gentile et al., 2017; Ramos et al., 2013), rather than asking children what type of shows or games they prefer. The present study importantly adds to the literature by using a genetically informed design to examine the role of genetics in the relationship between preschoolers' self-reported media preferences and their parent-rated aggressive behaviors, using a multimeasure methodology. We demonstrated a significant sex difference in preferences for physically aggressive media, with boys reporting greater preferences for this type of media. We also found that more aggressive mothers rated their children as more aggressive, again especially for boys.

Most importantly, we found a small but significant interaction between child sex and self-reported preferences for physically aggressive shows and games that predicted parent ratings of children's aggressive problem behaviors. Surprisingly, examination of this separately for boys and girls showed that boys who preferred nonaggressive media were rated by their parents as the most aggressive, which is the reverse of what we had expected. However, further examination of this interaction also showed that for children who preferred media experiences that were low in physical aggression, boys were significantly more aggressive than girls, while there were no aggressive behavior differences between boys and girls for children who preferred highly aggressive media. This interaction somewhat parallels the findings of DiLalla, Elam, and Smolen (2009), who demonstrated that preschoolers were more aggressive themselves if they played with a highly aggressive peer, but if the peer was low in aggression, only those children at

greater genetic risk for aggression were highly aggressive. Supporting the DSMM theoretical framework, these results emphasize both a genetic and environmental component to this association. That is, children may demonstrate an innate tendency toward aggression, which can then be influenced by various aspects of the child's environment (e.g., media exposure, peers, parental modeling or exposure), as well as vice-versa.

However, these analyses failed to control for possible genetic influences. Therefore, we repeated our analyses but this time controlled for possible genetic influences on the relationship between our independent variables and child aggression. Again, we found that maternal aggression predicted child aggression, albeit only for boys. Interestingly, we also found a significant genetic influence on the association between media preferences and behavior. This must be interpreted in light of the finding that boys who preferred the least aggressive media were the ones who were rated as most aggressive by their parents. It may be that boys' biological drive toward aggression explains their actual aggressive behaviors, but not preferences for engaging with this type of media, per say. However, it also is possible that parents of highly aggressive children actively help them to choose less aggressive media, which the boys then report as their preferences. Additionally, we must consider the genetic analyses showing that the relationship between preference for physically aggressive media and child aggression is not causal in nature. Further research is needed to better understand why aggressive boys overall seemed to prefer less aggressive TV shows or video games.

We did find overall that boys, compared with girls, reported preferences for media with more physical aggression. However, we found no sex differences in preferences for relational aggression. These findings partially replicate those previously reported by Ostrov et al. (2014), who suggested that boys and girls differ in their preferences for physical and relational media aggression. Although some researchers have reported sex differences in preferences for relational aggression, other researchers have failed to replicate these findings within the media literature (e.g., Möller & Krahé, 2009), consistent with our current findings.

Finally, we replicated previous findings demonstrating that children's parent-reported aggressive behaviors were significantly heritable. However, there was no evidence for heritability of media preferences, despite our analyses suggesting possible genetic influences on the relationship between media and behavior. Interestingly, same-sex pairs were more similar in preferences for both physical and relational aggressive media than were opposite-sex pairs, and for physical aggression this difference was significant. These results suggest that having a same-sex co-twin has a stronger influence on children's aggressive preferences, although our analyses cannot determine whether this influence is genetic or environmental in origin. It is possible that shared interests with a same-sex sibling are an environmental influence on media preferences. The role of siblings is something that will need to be explored in future research.

In sum, our results provide partial support for a negative relationship between the aggressiveness of preschool boys' preferred media and the aggressive behaviors they exhibit. Additionally, our results demonstrate that this association has both genetic and environmental influences. Unexpectedly, given earlier research (Wahl & Metzner, 2011), mothers' aggression was significantly related to parent ratings of their child's aggression, but fathers' aggressiveness was not. Furthermore, children's observed negativity was marginally significant in our multilevel model, suggesting that independent observations of negative affect and aggression are only marginally reflective of aggressive behaviors reported by parents. We also found significant evidence of genetic effects for parent-rated preschoolers' aggressive behaviors, which is in line with previous findings (e.g., Brendgen et al., 2005; DiLalla, 2002). Thus, children with aggressive parents may not only learn these behaviors from their parents, but also may inherit a biological tendency toward aggression, which may then influence their media preferences (possibly through passive, reactive, or active rGE). In sum, our study used a twin-based design to demonstrate genetic and environmental influences on the relationship between preferences for aggressive media and aggressiveness in preschoolers, which is in line with previous recommendations (e.g., Ferguson et al., 2008). Importantly, these results emphasize genetic underpinnings on the relationship between aggressive preferences and behaviors, which challenges the literature claiming aggressive media increases aggressiveness (e.g., Anderson et al., 2017; Gentile, 2016).

Strengths/Implications

To the best of our knowledge, this is the first study that specifically asked preschoolers about their media preferences and then rated these preferences quantitatively in terms of character type (e.g., humans vs. nonhumans) and realism (e.g., animated vs. real). It is important to make these distinctions because previous research has demonstrated differences in later creativity based on preschoolers' engagement with realistic play (Mullineaux & DiLalla, 2011). Additionally, given that children were not asked to describe the contents of the media, demand characteristics related to aggressiveness did not affect the present study. Furthermore, by using a multimeasure methodology for assessing preschoolers' aggressiveness (i.e., parent rated, child rated, and observed), we feel confident that ratings of the child's aggressiveness were valid and reliably measured. Finally, our use of a twin sample allowed for the examination of genetic and environmental influences on the relationship between preferred media aggression and behavioral aggression, an area previously unexamined.

Limitations

The strengths of the present study notwithstanding, a few limitations must be acknowledged. For one, the preferred video game or TV show that the child reported as their favorite may not actually coincide with the media that parents let their preschoolers interact with. It may be that children were exposed to their preferred media in another manner (e.g., television commercial, a friend's house, older siblings) and this preference does not necessarily capture the media they are typically exposed to. Similarly, our study did not assess the magnitude of media exposure that children experience, and it is possible that increased exposure exacerbates the effects seen. This would be in line with previous findings that assessed the duration of children's interaction with media and found poorer outcomes associated with increased or sustained exposure (Hinkley et al., 2014; Mistry, Minkovitz, Strobino, & Borzekowski, 2007).

Conclusions and future directions

We examined possible causes of parent-reported preschoolers' aggressive behaviors by focusing on the aggressiveness of their preferred media, as well as examining parental aggression and observations of children's negativity during a parent-child interaction. We have demonstrated an important link between children's choices of preferred TV and video media and their aggressive behaviors. By using a genetically informed design, we have shown that the association between aggressive behaviors and preferences for aggressive media is likely a combination of shared genetics and environmental influences. Importantly, we examined preschoolers in the hopes that we could begin to address the importance of media influences at a younger age than typically is studied. Investigating child aggression is critical because, if not managed properly, it can result in horrible outcomes, as seen in recent school violence in this country.

Because few studies have examined the role of aggressive media exposure on preschoolers' behaviors, it will be important to further examine this relationship and replicate the findings demonstrated here, especially given the field's disagreement regarding the detrimental effects of aggressive and violent media exposure (e.g., Bender et al., 2017; Bushman et al., 2016; Ferguson et al., 2017). It may also be helpful to supplement child-reported media preferences by collecting parent reports of their children's preferred media as well as the frequency of media consumption. Given current technological advancements (e.g., three-dimensional media, virtual reality simulations, motion-based video games), it would also be interesting to examine how these different platforms and manners of media interaction affect the outcomes of exposure. We predict that the more realistic and immersive the media experience, the stronger the effect will be on related behaviors and outcomes. Future researchers should investigate these various platforms to determine whether they differentially affect children's aggression.

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