Computers in Human Behavior 159 (2024) 108341

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Does violence in video games impact aggression and empathy? A longitudinal study of Czech adolescents to differentiate within- and between-person effects☆

David Lacko *, Hana Machackova, David Smahel

Interdisciplinary Research Team on Internet and Society, Faculty of Social Studies, Masaryk University, Jostova 10, Brno, Czech Republic

ARTICLE INFO

Handling editor: Marianna Sigala

Keywords:
Violent video games
Aggression
Empathy
Within-person effects
Adolescents
Longitudinal research

ABSTRACT

The associations between exposure to violent video games (VVG) and aggression/empathy have been extensively studied. VVG are often depicted as triggers for increased aggression and decreased empathy in line with the General Aggression Model. However, longitudinal evidence that distinguishes within- and between-person effects and focuses on various dimensions of aggression/empathy remains scarce. Drawing on representative sample of 3010 Czech adolescents (aged 13–17), data were collected over four waves to measure physical and verbal aggression, and cognitive and affective empathy. VVG was evaluated based on open-ended responses. A random-intercept cross-lagged panel model was employed to differentiate within- and between-person associations. VVG positively correlated with cognitive empathy, verbal aggression, and physical aggression at the between-person level. At the within-person level, two hypotheses were examined: the selection effect (effects of changes in aggression/empathy on changes in VVG) and the desensitization effect (effects of changes in VVG on alterations in aggression/empathy). All desensitization effects were statistically insignificant. Regarding selection effects, an increase in affective empathy was linked to a decrease in VVG. Conversely, an increase in physical aggression was associated with an increase in VVG, both positively and negatively, depending on the wave of data collection. Furthermore, the moderation effects of age and gender were tested at the within-person level. The positive (but not negative) effect of physical aggression on exposure to VVG was moderated by age, with a stronger effect evident among younger participants. These findings challenge the portrayal of VVG as a significant contributor to heightened aggression and decreased empathy in adolescents.

1. Does violence in video games impact aggression and empathy? A longitudinal study of Czech adolescents to differentiate within- and between-person effects

Video games have emerged as a ubiquitous and influential form of entertainment in the modern world. Within several decades, video games have evolved from simple pixelated graphics to immersive, life-like experiences that encompass various genres and platforms. Their impact reaches far beyond the realm of entertainment, having influenced technology, education, the economy, and culture. As of 2023, the active global gaming community is an estimated 2.7 billion individuals, which is approximately 25% of the global population (Statista, 2023). Scientific research has delved into various facets of video gaming, with a predominant focus on assessing both the positive and negative effects. Crucial to this research is the investigation of the potential influence of violent video games (VVG), which are often among the most popular titles, on aggressive and prosocial behaviors.

The exploration of exposure to violent content, in general, is examined through various theoretical models. Widely employed is the General Aggression Model (GAM; Anderson & Bushman, 2018), which posits two primary processes - proximate and distal. Proximate processes outline the immediate impact of violent content on internal states in three stages: inputs, routes, and outcomes. Inputs encompass personal (e.g., attitudes toward aggression, behavioral scripts, trait aggression) and situational (e.g., social stress, exposure to violence, aggressive cues) factors. These factors influence the individual's present internal state in

☆ We have no conflict of interest to disclose. This study was supported by the project "*Research of Excellence on Digital Technologies and Wellbeing CZ.02.01.01/00/22_008/0004583*", which is co-financed by the European Union. The data are openly available in Open Science Framework at https://osf.io/q5wv6/.

* Corresponding author.
E-mail address: david.lacko@mail.muni.cz (D. Lacko).

https://doi.org/10.1016/j.chb.2024.108341
Received 27 February 2024; Received in revised form 20 May 2024; Accepted 10 June 2024
Available online 10 June 2024

the second stage - routes, including affect (e.g., mood, emotions), cognition (e.g., aggressive thoughts, scripts), and physiological and psychological arousal. Interconnected, these routes represent short-term effects, directly influencing behavior in the third stage, termed outcomes. This final stage involves the individual's assessment of the situation and subsequent aggressive or non-aggressive reactions. The GAM distinguishes between immediate, impulsive actions driven by automatic appraisal and more controlled, thoughtful actions stemming from conscious reappraisal. Following behavior, social encounters may alter personal and situational factors, impacting long-term outcomes. Thus, the social encounter represents long-term effects in the GAM framework.

Distal processes elucidate the long-term effects of frequent and repeated exposure to violent content on personality changes, including increased aggression and heightened desensitization, which are characterized by a decrease in empathy. They focus on the influence of biological (e.g., ADHD, testosterone) and persistent environmental (e.g., maladaptive families or parenting, chronic exposure to violent media) factors. The changes in personality caused by these factors can subsequently alter an individual's reactions within proximate processes.

Since childhood and adolescence can be characterized as sensitive periods for social, emotional, and cognitive development (Blakemore & Mills, 2014; Crone & Dahl, 2012; Dahl et al., 2018), the media effects described in GAM can be even more prominent. Indeed, aggression and empathy significantly change and develop during the lifespan, with adolescence being one of the key periods in such development (e.g., Decety & Holvoet, 2021; Farrell & Vaillancourt, 2023; Kahhale et al., 2024; Silke et al., 2018). The effects of factors that may promote the formation of higher aggression and lower empathy might contribute to higher chances of antisocial and aggressive behavior (e.g., Chen et al., 2019; Michalska, et al., 2016).

While the effects of VVG on increased aggression and aggressive behavior, as well as decreased empathy and prosocial behavior, have been frequently examined in prior research, the evidence is still mixed. This is reflected also in contrasting systematic synthesizing studies. Some meta-analyses support the proposed detrimental links, even though they have rather small effect sizes of $r \approx 0.20$ (e.g., Anderson et al., 2010; Greitemeyer & Mügge, 2014). By contrast, other meta-analyses conclude that the effects are negligible and non-significant after correction for publication bias and that the effects are smaller in studies that follow good research practices (e.g., Ferguson et al., 2020; Ferguson & Kilburn, 2009). Thus, conflicting syntheses fuel the ongoing debate about the impact of violent gaming on aggression and empathy, particularly in the sensitive period of youth development, and demand robust evidence, especially of a longitudinal nature. Therefore, using longitudinal data, this study contributes to this salient line of research with a precise examination of the long-term effects within the distal processes of VVG on changes in aggression and empathy. Based on the findings, the aim of the article is to provide further evidence that allows a deeper understanding of the role of VVG in youth development.

1.1. The role of aggression and empathy

Aggression refers to actions intended to harm others (Anderson & Bushman, 2002). It is commonly perceived as a multidimensional construct that encompasses physical (causing physical harm to others), verbal (using spoken words to inflict harm), and relational (manipulating and damaging others' relationships) dimensions (Dewi & Kyranides, 2022). Particularly within the realm of VVG, physical and verbal aggression emerge as key elements that are embedded in the foundations of such gameplay (Yao et al., 2019). While previous research has frequently combined verbal and physical aggression (Sherry, 2007), this study adopts an independent analysis of these factors. This approach is vital because verbal aggression may be perceived as more socially acceptable than physical aggression (Ramirez, 1993), which indicates distinct roles for each. Furthermore, gender differences (e.g., Björkqvist, 2018) and age effects (e.g., Tremblay et al., 2018) appear to be more pronounced in the context of physical aggression.

Prior literature predominantly focused on the examination of physical aggression. However, some scholars found that VVG is linked to verbal, rather than physical aggression (Olejarnik & Romano, 2023), while others suggest the opposite (Li et al., 2020). Additionally, there are findings that indicate the effects of VVG on both types of aggression (Lee et al., 2020). This diversity in the research underscores the importance of considering both verbal and physical aggression independently, as is done in this study.

Empathy is also understood to be a multidimensional construct. Typically, it is conceptualized as having two dimensions: an affective component (a bottom-up process), which involves the ability to share others' emotions; and a cognitive component (a top-down process), which pertains to the ability to infer and understand others' emotional experiences (Singer & Lamm, 2009). Although affective and cognitive empathy have a strong relationship, they remain distinct concepts. Research indicates that different brain structures are engaged in affective empathy compared to cognitive empathy (Shamay-Tsoory et al., 2009). Meta-analytical evidence also suggests weak associations between cognitive and affective empathy and verbal and physical aggression, with slightly higher effects observed in associations with verbal aggression (Vachon et al., 2014).

However, prior studies have not distinguished between affective and cognitive components. Instead, they often combined them into a single summed score or focused on only one component. Such differentiations were made primarily in research on general media violence (Vossen et al., 2017; Vossen & Fikkers, 2021), violent video streaming (Lacko et al., 2023), and prosocial video games (Li et al., 2023). While studies involving general media violence did not find associations with both cognitive and affective empathy (Vossen et al., 2017; Vossen & Fikkers, 2021), research on prosocial video games found an association with affective but not cognitive empathy (Li et al., 2023).

Furthermore, based on the expanded version of the GAM (Carnagey et al., 2007), repeated exposure to VVG is expected to induce desensitization and selection effects. Desensitization involves a decrease in the physiological, emotional, and cognitive responses to violence, while the selection effect entails increased exposure to media violence due to reduced emotional distress (Vossen et al., 2017). Previous research examining the impact of violent content on adolescents has produced varied findings. For instance, while Vossen et al. (2017) did not observe selection and desensitization effects on both cognitive and affective empathy, others have reported such effects (Hopf et al., 2008; Mößle et al., 2014). Moreover, certain studies have found evidence solely for a selection effect (Breuer et al., 2015; von Salisch et al., 2011), while others have supported only a desensitization effect (Krahé & Möller, 2010; Möller & Krahé, 2009; Willoughby et al., 2012). As these effects may serve as pivotal mechanisms in the interplay between aggression/empathy and VVG exposure, unraveling their dynamics, especially during the adolescence, is crucial for informed interventions and behavioral insights.

To address these gaps and inconsistencies, this study newly examines both dimensions of empathy and aggression. As a result, this multidimensional approach should provide deeper insight into the specific effects of VVG.

1.2. The longitudinal evidence

Despite the methodological advantages of longitudinal designs, particularly in adequately capturing the long-term effects (von Salisch et al., 2011), they still seem to be under-examined (Anderson et al., 2010; Ferguson et al., 2020). Therefore, the aim of this study is to contribute to this research line by utilizing longitudinal data and distinguishing within-person effects from between-person effects, a crucial aspect in the examination of VVG (Ballou, 2023; Teng et al., 2019).

Situational within-person effects allow for the investigation of how

individuals change over time when exposed to VVG, which provides valuable insights into causal fluctuations in behavior and psychological states. Instead of focusing on broad trends, this level of analysis delves into the dynamic relationship between an individual's gaming habits and their corresponding changes in aggression and empathy. On the other hand, stable between-person effects concentrate on individual differences, aiding in the identification of characteristics or traits that make certain individuals more susceptible to the effects of video games than others. Consequently, if scholars disregard within-person effects, the found effects can be attributed to inter-individual factors (i.e., between-person level), intra-individual factors (i.e., within-person level), or a combination of both (Hamaker et al., 2015). Thus, it is imperative to distinguish between these levels of analysis, especially because adolescence is characterized by significant social, emotional, and cognitive developmental changes, potentially leading to fluctuating levels of empathy and aggression. These fluctuations during adolescence highlight the dynamic nature of individual responses to VVG exposure and underscore the necessity of examining within-person variability to capture the nuanced interplay between gaming habits and behavioral outcomes over time.

Several meta-analyses (e.g., Ferguson et al., 2020; Ferguson & Kilburn, 2009; Greitemeyer & Mügge, 2014) consistently show that longitudinal studies report lower effects compared to experimental and cross-sectional designs, with Anderson et al.'s study (2010) being an exception. Additionally, specific meta-analyses of the longitudinal effects reveal minimal effects, approximately $r \approx 0.10$ with stronger effects for younger participants (Burkhardt & Lenhard, 2022; Prescott et al., 2018), and sometimes non-significant effects (Drummond et al., 2020). However, the majority of prior longitudinal studies of VVG utilize only two measurement time points, which hinders the meaningful differentiation between the within-person and between-person effects. And studies with more measurement waves often lack statistical procedures for this distinction (e.g., Coyne et al., 2018; Hull et al., 2014), focus on modeling developmental trajectories while disregarding within-person changes (e.g., Coyne & Stockdale, 2020; Willoughby et al., 2012), or measure VVG only once, treating it as a time-invariant predictor (e.g., Coyne et al., 2023). Consequently, the meta-analytical findings may be influenced by the between-person effects, which complicates their interpretation within a causal inference framework. Therefore, this study uniquely explores the longitudinal effects while distinguishing between the within-person and between-person levels.

1.3. The within-person effects of violent video gaming

The exploration of the within-person effects of VVG has garnered significant attention in recent years. Notably, these effects have been examined in relation to various outcomes, such as hostile thoughts and aggressive behavior (Wallace et al., 2023), alcohol use (Boers et al., 2020), sleep problems (Guo et al., 2022), well-being (Vuorre et al., 2022), and prosocial behavior (Fitzpatrick & Boers, 2022). However, these studies primarily concentrated on video games in general, rather than specifically focusing on VVG. Only a limited number of studies have employed designs with three or more waves of data collection and simultaneously analyzed the within- and between-person effects of VVG.

Teng et al. (2022) explored the relationship between exposure to VVG, aggression, and bullying perpetration in a three-wave study. Their findings revealed that exposure to VVG significantly predicted bullying at the within-person level, with a stronger effect observed among individuals who display higher levels of general aggression and lower levels of moral identity. In another three-wave study, Teng et al. (2019) found that an increase in violent gaming was associated with an increase in aggression, but not in moral disengagement. However, in both studies, they did not distinguish between physical and verbal aggression, because they summarized their scores under one category. Furthermore, they utilized self-report assessments of violence in video games, which may be less reliable than the usage of independent ratings (Ferguson, 2011).

In contrast, Johannes et al. (2022) explored the impact of objectively measured time spent in VVG (specifically *Apex Legends* and *Outriders*) on aggressive affect in a three-wave study. They concluded that there was no discernible effect. Due to their specific focus on aggressive affect, they did not differentiate between various facets of aggression, and it is important to note that their findings are limited to the specific gaming audience of the two mentioned games.

Additionally, Kersten and Greitemeyer (2022) investigated the connection between violent gaming, aggression, and aggressive feelings with an experience sampling methodology across 27 sessions. The effect they identified was statistically significant but virtually non-existent in Study 1 ($\beta = 0.01$) and it was also found to be statistically insignificant in Study 2. Similar to other studies, they did not distinguish between the various dimensions of aggression and instead utilized a sum score. Additionally, they employed a self-report assessment of violence.

In summary, findings regarding the within-person effects of violent gaming are quite mixed. Some authors identified the within-person effects of VVG on aggression (Teng et al., 2019, 2022), while others did not observe such effects (Johannes et al., 2022; Kersten & Greitemeyer, 2022). Furthermore, it is noteworthy that all these studies relied on self-report assessments of violence in video games, which could introduce bias (Ferguson, 2011), or focused solely on a gamer audience of two specific games. Importantly, none of the studies independently examined the roles of verbal and physical aggression. Moreover, while a focus on aggression seems to dominate the field, it seems that the longitudinal evidence for cognitive and affective empathy and violent gaming is completely absent.

1.4. Current study

To overcome the aforementioned shortcomings, a four-wave longitudinal study on a representative sample of Czech adolescents was conducted, and a random-intercept cross-lagged panel model (RI-CLPM) to reliably separate the within- and between-person effects was utilized. Additionally, participants were allowed to report the games they played the most, and then the independent violence ratings of Common Sense Media (https://www.commonsensemedia.org/) were used. For games not included in these ratings, two independent raters for coding were employed. Recognizing the multi-dimensional nature of empathy and aggression, the analyses independently incorporated verbal and physical aggression as well as cognitive and affective empathy.

The hypotheses were formulated based on the GAM and prior meta-analytical evidence. At their core, the hypotheses presume the same direction for the studied dimensions (i.e., positivity for aggression and negativity for empathy). However, as they are tested separately, the investigation aims to avoid inaccurate findings that may arise from mixing the potentially diverse effects of the respective dimensions.

At the between-person level, it was hypothesized that verbal aggression (H1) and physical aggression (H2) are positively associated with VVG. Similarly, it was expected cognitive empathy (H3) and affective empathy (H4) to be negatively linked with VVG.

At the within-person level, it was assumed a selection effect for verbal aggression (H5) and physical aggression (H6), as well as cognitive empathy (H7) and affective empathy (H8), meaning that an increase in aggression and a decrease in empathy should be positively associated with VVG. Regarding the desensitization effect, it was assumed that VVG is negatively associated with verbal aggression (H9) and physical aggression (H10), and positively associated with cognitive empathy (H11) and affective empathy (H12).

Furthermore, in a more explorative manner, the influence of age and gender on the target variables at both levels of the analysis was examined.

2. Methods

2.1. Sample

Representative data from 3087 Czech adolescents in four waves of data collection was collected. After removing participants who did not play a single game during the data collection ($N = 77$), the final sample consisted of 3010 participants (T1 = 3,010, T2 = 1,969, T3 = 1,590, T4 = 1052). Descriptive statistics for each wave are in Table 1.

The attrition across the waves was done via probit regressions. Gender was not significantly associated with dropouts at a 5% level of significance. However, age was consistently associated with dropouts in all of the waves. Specifically, individuals aged 15 and 16 were higher dropouts at T1 - > T2 ($bs = -0.16$ and -0.49, respectively), and individuals aged 16 and 17 were higher dropouts at T2 - > T3 ($bs = -0.31$ and -0.32, respectively) and T3 - > T4 ($bs = -0.44$ and -0.51, respectively).

Data collection took place from June 30, 2021, to December 15, 2022, with waves occurring every six months. Participants were recruited from an existing online panel maintained by the agency STEM/MARK, in cooperation with the agency Data Collect. These agencies specialize in non-probability quota collection and they are reliable members of ESOMAR. Quota sampling was conducted based on participant gender, age, household income, and place of residence, following the NUTS-3 region scheme. Participants were rewarded with 160 CZK (approximately 6€) for their participation. To increase motivation for participation in all of the waves, the agency used a high-incentive lottery with prizes worth 50,000 CZK (approximately 1980€) and three mobile phones with a total value of 45,000 CZK (approximately 1780€). This research was approved by the Ethics Board of Masaryk University.

2.2. Measures

2.2.1. Aggression

Aggression was measured with the Buss-Perry Aggression Questionnaire-Short Form (BPAQ-SF; Bryant & Smith, 2001), a short version of the BPAQ (Buss & Perry, 1992). It consists of 12 Likert-type items that range from 1 (does not apply at all) to 5 (absolutely applies) organized into four three-item subscales: physical aggression, verbal aggression, anger, and hostility. Only two subscales were administered, namely physical aggression and verbal aggression.

The BPAQ-SF showed excellent psychometric properties in our sample. Confirmatory factor analysis supported the original two-dimensional structure, $\chi^2(188) = 497.257$, $p < 0.001$, $CFI = 0.982$, $TLI = 0.974$, $RMSEA = 0.033$ [0.029, 0.037], $SRMR = 0.033$. Measurement invariance in time was successfully established on both the metric ($\Delta CFI = 0.001$, $\Delta TLI < 0.001$, $\Delta RMSEA < 0.001$, $\Delta SRMR = 0.002$) and scalar ($\Delta CFI = 0.005$, $\Delta TLI = 0.004$, $\Delta RMSEA = 0.002$, $\Delta SRMR = 0.001$) levels. It also showed high composite reliability (verbal aggression: $\omega_{T1} = 0.725$, $\omega_{T2} = 0.740$, $\omega_{T3} = 0.741$, $\omega_{T4} = 0.763$; physical aggression: $\omega_{T1} = 0.794$, $\omega_{T2} = 0.823$, $\omega_{T3} = 0.807$, $\omega_{T4} = 0.834$) and an average variance extracted (verbal aggression: $AVE_{T1} = 0.480$, $AVE_{T2} = 0.497$, $AVE_{T3} = 0.498$, $AVE_{T4} = 0.527$; physical aggression: $AVE_{T1} = 0.580$, $AVE_{T2} = 0.617$, $AVE_{T3} = 0.591$, $AVE_{T4} = 0.635$).

Table 1
Descriptive statistics of the research sample.

Variable	Category	Time 1	Time 2	Time 3	Time 4
Gender	Girls	1467 (48.7%)	977 (49.6%)	728 (49.6%)	515 (49.0%)
Age	11	538 (17.9%)	260 (13.2%)	98 (6.2%)	31 (3.0%)
	12	553 (18.4%)	341 (17.3%)	278 (17.5%)	147 (14.0%)
	13	472 (15.7%)	377 (19.2%)	311 (19.6%)	207 (19.7%)
	14	456 (15.2%)	293 (14.9%)	273 (17.2%)	212 (20.2%)
	15	493 (16.4%)	320 (16.3%)	269 (16.9%)	186 (17.7%)
	16	498 (16.6%)	286 (14.5%)	239 (15.0%)	168 (16.0%)
	17	0 (0.0%)	92 (4.7%)	122 (7.7%)	76 (7.2%)
	18	0 (0.0%)	0 (0.0%)	0 (0.0%)	25 (2.4%)

2.2.2. Empathy

Empathy was measured by the Adolescent Measure of Empathy and Sympathy (AMES; Vossen et al., 2015). AMES contains 12 Likert-type items on a scale of 1 (never) to 5 (very often) grouped into three factors (four items per factor): cognitive empathy (i.e., comprehension of another person's emotions); affective empathy (i.e., experience of another person's emotional state); and sympathy (i.e., concerns and sorrow for another person's distress). Only two subscales were administered, namely cognitive empathy and affective empathy.

AMES showed good psychometric properties in our sample. Confirmatory factor analysis supported the original two-dimensional structure, $\chi^2(388) = 810.011$, $p < 0.001$, $CFI = 0.986$, $TLI = 0.982$, $RMSEA = 0.026$ [0.023, 0.030], $SRMR = 0.027$. Longitudinal measurement invariance was successfully established on both metric ($\Delta CFI < 0.001$, $\Delta TLI = -0.001$, $\Delta RMSEA < 0.001$, $\Delta SRMR = 0.003$) and scalar ($\Delta CFI = 0.003$, $\Delta TLI = 0.002$, $\Delta RMSEA = 0.001$, $\Delta SRMR < 0.001$) levels. The scale also showed high composite reliability (cognitive empathy: $\omega_{T1} = 0.877$, $\omega_{T2} = 0.880$, $\omega_{T3} = 0.899$, $\omega_{T4} = 0.896$; affective empathy: $\omega_{T1} = 0.811$, $\omega_{T2} = 0.832$, $\omega_{T3} = 0.841$, $\omega_{T4} = 0.857$) and average variance extracted (cognitive empathy: $AVE_{T1} = 0.640$, $AVE_{T2} = 0.648$, $AVE_{T3} = 0.691$, $AVE_{T4} = 0.683$; affective empathy: $AVE_{T1} = 0.518$, $AVE_{T2} = 0.555$, $AVE_{T3} = 0.570$, $AVE_{T4} = 0.601$).

2.2.3. Exposure to violence in video games

The objective rating of VVG was used. These independent ratings (e.g., ESRB, PEGI) are often recommended (e.g., Drummond et al., 2020) because they are more reliable and valid than self-report assessments of violence (Ferguson, 2011). They also correlate highly with each other (e.g., Busching et al., 2015; Dogruel & Joeckel, 2013; Przybylski & Weinstein, 2019) and with self-report estimates (Fikkers et al., 2017). The Common Sense Media rating was chosen because it contains a scale focused solely on VVG, whereas age ratings usually take into account other non-violent aspects (e.g., nudity, abusive language, drugs). Moreover, it includes not only video games but also mobile games and browser games that were also reported in our sample. It uses a 6-point scale that ranges from 0 (violence not present) to 5 (extreme violence). It was already used in research and was found to be highly reliable ($r = 0.80$; see Coyne et al., 2023, Supplementary Material).

Exposure to VVG was measured with open answers. Participants could name up to three games in each wave that they play the most, as is often done in similar research (e.g., Coyne et al., 2023; Ferguson, 2019; Ferguson & Wang, 2019; Lemmens et al., 2011; Teng et al., 2019). This resulted in 4249 unique answers. The first author carefully checked all of the responses and recoded the following: 1) answers related to "don't remember" ($N = 3$); 2) titles that did not represent games but were software (e.g., "Spotify", $N = 34$); 3) titles with overly general answers (e.g., "PlayStation games", $N = 70$); and 4) titles that did not match an existing game ($N = 67$). After that, games that belonged to one series with an identical play style merged (e.g., "Call of Duty games", $N = 2513$). Unspecified titles with particular play styles were also merged (e.g., "Puzzle games", $N = 262$). This cleaning procedure resulted in 1300 game titles reported across all of the participants in all of the waves. The most frequent titles included Minecraft ($N = 2250$), Roblox ($N = 1037$), Fortnite ($N = 906$), Grand Theft Auto games ($N = 475$), and Brawl Stars ($N = 448$).

Among these titles, 474 were rated by Common Sense Media. The violence score obtained by Common Sense Media (up to three titles)

correlated highly with PEGI ($r = 0.881$, $p < 0.001$) and ESRB ($r = 0.751$, $p < 0.001$) ratings in the first wave of data collection.

The remaining items ($N = 826$) constituted 21.06% of the total observations. These missing titles were evaluated with the assistance of two independent raters who were psychology students and self-identified gamers. These raters were trained by the first author to align their assessments as closely as possible to the ratings found on Common Sense Media. In the course of their evaluations, they took into account age ratings (i.e., PEGI, ESRB), game reviews, game descriptions, and gameplay records. Their inter-rater reliability was sufficient (ordinal Krippendorff's $\alpha = 0.833$). The intra-rater reliability of the raters with Common Sense Media was also satisfactory ($ICC_{\text{Rater 1}} = 0.930$, $ICC_{\text{Rater 1}} = 0.848$). Each rater coded a randomly selected half of the uncoded titles.

The newly created violence score (i.e., Common Sense Media rating + expert rating) was assigned to 1283 titles (17 titles were excluded because it was not possible to estimate the level of violence in the game). The maximum value was used, considering at most three titles per wave, to serve as the proxy indicator for VVG.

2.3. Procedure

The scales underwent a collaborative iterative translation process that involved multiple experts (Douglas & Craig, 2007), along with cognitive interviews (e.g., Wildy & Clarke, 2009). Firstly, one of the authors translated all of the scales. Given the translator's extensive experience in conducting similar surveys in the Czech Republic, which made them familiar with the relevant linguistic equivalents, parallel translation was not necessary in this phase (Douglas & Craig, 2007). Secondly, the initial translation was subject to iterative consultation regarding its accuracy and suitability with another expert researcher. Through consensus, some items were slightly modified to arrive at the most appropriate translation. Thirdly, before the data collection, the comprehensibility of all of the used items was assessed through pilot testing conducted via face-to-face interviews in the participants' households, involving 195 participants (51.3% girls). Fourthly, cognitive interviews were conducted with 30 adolescents (50% girls). No significant modifications were required, because only minor adjustments were made during the interviews to ensure that certain terms in the translations were age-appropriate.

2.4. Data analysis

In the first step, the assumptions of the main analysis were verified. actor structure and metric and scalar measurement invariance across all four waves of data collection via a set of increasingly restricted confirmatory factor analyses were analyzed. To evaluate the configural model, criteria proposed by Hu and Bentler (1999) were used. To assess measurement invariance, criteria proposed by Chen (2007) were applied. The internal consistencies and average variances extracted (*AVE*s) from the subscales were also verified.

In the next step, the random-intercept cross-lagged panel model (RI-CLPM; Hamaker et al., 2015; Mulder & Hamaker, 2021) was performed. RI-CLPM represents an extension to the recently criticized CLPM. It distinguishes between the between-person part and the within-person part, which allows for the differentiation of the stable trait factors that account for stable intra-individual differences from the between-person changes. The usage of the multiple-indicator extension did not converge, probably because of the large complexity of the model (it consisted of four latent variables). Hence, the arithmetic means of the indicators was inserted into the model instead of all of the indicators separately. This was possible due to the excellent psychometric properties of the scales. Gender and age were inserted into the model as time-invariant predictors of random intercepts. The possibility of constraining regression coefficients at the within-person level to be equal over time was also examined. To do so, two nested single-group models using a chi-squared difference test were compared. The first model featured constrained regressions, covariances (innovations), residual variances, and grand means over time, while the second model had unconstrained estimates. Additionally, the possibility of constraining only grand means over time to identify potential trends in the data was also explored.

After that, the moderation effects of gender (girls, boys) and age (13- at the first wave, 14+ at the first wave) were verified via a second extension of RI-CLPM (i.e., multi-group RI-CLPM). This was done via a chi-square difference test that compared two nested multi-group models, one with regression paths constrained to be equal across groups and the second with unconstrained paths. Measurement invariance testing across genders and age categories can be found in the Supplementary Material section.

Because all of the items had five or more categories (Rhemtulla et al., 2012) and data showed high multivariate non-normality (Li, 2016) according to Henze-Zirkler (AMES: $HZ = 1.178$, $p < 0.001$; BPAQ-SF: $HZ = 1.211$, $p < 0.001$; arithmetic means of scales: $HZ = 1.036$, $p < 0.001$) and univariate non-normality according to Anderson-Darling (all $ps < 0.001$), a robust maximum likelihood (MLR) estimator was used in all of the analyses. Furthermore, full information Maximum likelihood (FIML) was used to handle missing values. The interpretation of within-person cross-lagged effect sizes followed the guidelines outlined by Orth et al. (2022), wherein effect sizes of 0.03 were categorized as small, 0.07 as medium, and 0.12 as large.

Data analysis was performed in *R* (v4.3.1; R Core Team, 2023), packages *lavaan* (Rosseel, 2012), *semTools* (Jorgensen et al., 2022), *irr* (Gamer et al., 2019), and *MVN* (Korkmaz et al., 2014). The main analysis was cross-verified in *Mplus* (v8.10; Muthén & Muthén, 1998-2017). Data and all syntaxes are available online: https://osf.io/q5wv6/.

3. Results

3.1. Between-person associations

The RI-CLPM model fit the data well, $\chi^2(90) = 129.769$, $p = 0.004$, $CFI = 0.997$, $TLI = 0.992$, $RMSEA = 0.017$ [0.007, 0.025], $SRMR = 0.018$. Constraining regressions, covariances (innovations), residual variances, and grand means over time, however, worsened model fit significantly, $\Delta\chi^2 = 124.52$, $\Delta df = 95$, $\Delta AIC = 47$, $p = 0.023$. Therefore, it proceeded with the model with time-varying effects in time in all analyses. Moreover, when constraining only grand means over time to be equal, the overall single group RI-CLPM model fit was not worsened ($\Delta\chi^2 = 9.847$, $\Delta df = 15$, $p = 0.829$), suggesting the absence of change on the trait level (trend, growth, etc.).

At the between-person level, VVG was positively associated with cognitive empathy ($r = 0.08$, $p = 0.039$), verbal aggression ($r = 0.12$, $p = 0.004$), and physical aggression ($r = 0.24$, $p < 0.001$). Associations with aggression were small-to-medium, and the effect size of the association with cognitive empathy was very weak. Participants who generally played more VVG also showed a higher level of the mentioned stable traits. Hence, H1 and H2 were supported while H3 and H4 were not, because those associations were statistically insignificant (for cognitive empathy) or statistically significant but in the opposite direction (for affective empathy). All correlations at the between-person level are shown in Table 2.

At the between-person level, the associations of the variables with participants' gender and age were explored. While age was not associated with VVG ($\beta = -0.02$, $p = 0.500$), gender showed a statistically significant association with a large effect size ($\beta = 0.41$, $p < 0.001$). Boys generally played more VVG than girls. All standardized regression coefficients are in Table 3.

3.2. Within-person associations

On the within-person level, an increase in the level of VVG was not associated with a change in aggression or empathy. All hypothesized

Table 2
Correlations at the between-person level.

	1.	2.	3.	4.	5.
1. Cognitive empathy	–				
2. Affective empathy	0.264 [a] [0.185, 0.343]	–			
3. Verbal aggression	−0.002 [-0.083, 0.080]	0.191 [a] [0.110, 0.273]	–		
4. Physical aggression	−0.007 [-0.081, 0.067]	0.091 [c] [0.013, 0.169]	0.584 [a] [0.531, 0.638]	–	
5. VVG	0.077 [c] [0.004, 0.150]	0.009 [-0.069, 0.086]	0.115 [b] [0.035, 0.195]	0.240 [a] [0.167, 0.313]	–

Note.
[a] $p < .001$.
[b] $p < .01$.
[c] $p < .05$.

Table 3
Effects of gender and age at the between-person level.

Outcome	Predictor	β [95% *CI*]	*SE*	*p*
Cognitive empathy	Gender	−0.307 [-0.347, −0.266]	0.030	<0.001
	Age	0.242 [0.200, 0.284]	0.016	<0.001
Affective empathy	Gender	−0.328 [-0.371, −0.284]	0.030	<0.001
	Age	0.068 [0.023, 0.114]	0.015	0.001
Verbal aggression	Gender	−0.008 [-0.055, 0.038]	0.031	0.726
	Age	0.070 [0.022, 0.118]	0.016	0.004
Physical aggression	Gender	0.268 [0.226, 0.310]	0.031	<0.001
	Age	−0.050 [-0.093, −0.007]	0.016	0.023
VVG	Gender	0.406 [0.365, 0.448]	0.032	<0.001
	Age	−0.015 [-0.059, 0.029]	0.016	0.500

associations for the desensitization effects were statistically insignificant and most of them showed negligible effect sizes (β ≈ 0.03). Therefore, H9–H12 were not supported.

As for the opposite (selection) effects (i.e., whether changes in empathy and aggression are associated with changes in VVG), three associations were statistically significant, with medium-to-large effect sizes. Firstly, it was discovered that participants who experienced an increase in their level of affective empathy during the third wave also showed a decrease in their VVG during the fourth wave ($\beta = -0.12$, $p = 0.017$). H8 was partially supported because this effect was found only from T3 to T4.

Secondly, it was found that participants who displayed an increase in physical aggression during the third wave also demonstrated an increase in their consumption of VVG in the fourth wave ($\beta = 0.12$, $p = 0.035$). Surprisingly, the effect was exactly the opposite when it came to an increase in physical aggression during the first wave, which was associated with a decrease in VVG during the second wave ($\beta = -0.10$, $p = 0.034$). Hence, H6 was not supported because the found evidence was mixed across different waves of data collection. H5 and H7 were also not supported. All hypothesized cross-lagged effects are shown in Table 4 (for auto-regressive and non-hypothesized cross-lagged effects, see Supplementary Material). All statistically significant effects are depicted in Fig. 1.

3.3. Moderation effects

As for the moderation effects of gender on within-person associations, the omnibus effect was statistically insignificant, $\Delta\chi^2 = 74.894$, $\Delta df = 75$, $\Delta AIC = 61$, $p = 0.482$. Since this effect also contains non-hypothesized paths, the omnibus moderation effect was reanalyzed solely for the effect of the target effects (i.e., those related to violence in video games). Again, the omnibus moderation effect was insignificant, $\Delta\chi^2 = 25.288$, $\Delta df = 27$, $\Delta AIC = 27$, $p = 0.559$. No gender differences across within-person effects were found.

Concerning the age moderation effects, the omnibus effect was also statistically insignificant, $\Delta\chi^2 = 86.088$, $\Delta df = 75$, $\Delta AIC = 49$, $p = 0.179$, but the omnibus moderation effect of the target associations was statistically significant, $\Delta\chi^2 = 44.100$, $\Delta df = 27$, $\Delta AIC = 8$, $p = 0.021$. Hence, moderating effects on individual hypothesized associations were analyzed. Neither the negative effect of physical aggression at T1 on VVG at T3, nor the negative effect of affective empathy at T3 on VVG at T4, was found to be statistically significant. However, the positive effect of physical aggression from T3 on VVG at T4 was moderated by age, $\Delta\chi^2 = 9.521$, $\Delta df = 1$, $\Delta AIC = 6$, $p = 0.002$. The effect was strong for younger participants ($\beta = 0.29$, $p < 0.001$), but basically non-existent for older adolescents ($\beta < 0.01$, $p = 0.967$).

Table 4
Hypothesized cross-lagged effects at the within-person level.

Outcome	Predictor	β [95% *CI*]	*SE*	*p*
Cognitive empathy T2	VVG T1	0.029 [-0.053, 0.110]	0.043	0.489
Cognitive empathy T3	VVG T2	−0.040 [-0.125, 0.044]	0.046	0.351
Cognitive empathy T4	VVG T3	−0.074 [-0.155, 0.007]	0.042	0.073
VVG T2	Cognitive empathy T1	0.057 [-0.026, 0.139]	0.041	0.178
VVG T3	Cognitive empathy T2	−0.064 [-0.155, 0.027]	0.046	0.170
VVG T4	Cognitive empathy T3	−0.023 [-0.123, 0.076]	0.050	0.647
Affective empathy T2	VVG T1	0.018 [-0.057, 0.093]	0.041	0.637
Affective empathy T3	VVG T2	−0.032 [-0.113, 0.049]	0.046	0.437
Affective empathy T4	VVG T3	−0.023 [-0.114, 0.068]	0.049	0.622
VVG T2	Affective empathy T1	−0.037 [-0.114, 0.040]	0.035	0.344
VVG T3	Affective empathy T2	0.024 [-0.067, 0.115]	0.044	0.602
VVG T4	Affective empathy T3	−0.117 [-0.212, −0.023]	0.046	0.017
Verbal aggression T2	VVG T1	−0.001 [-0.078, 0.076]	0.042	0.980
Verbal aggression T3	VVG T2	−0.021 [-0.112, 0.071]	0.051	0.659
Verbal aggression T4	VVG T3	−0.073 [-0.162, 0.017]	0.048	0.111
VVG T2	Verbal aggression T1	−0.016 [-0.095, 0.063]	0.036	0.692
VVG T3	Verbal aggression T2	−0.017 [-0.108, 0.075]	0.045	0.722
VVG T4	Verbal aggression T3	−0.046 [-0.148, 0.055]	0.050	0.370
Physical aggression T2	VVG T1	−0.021 [-0.099, 0.057]	0.039	0.601
Physical aggression T3	VVG T2	−0.078 [-0.170, 0.014]	0.048	0.097
Physical aggression T4	VVG T3	0.060 [-0.036, 0.157]	0.047	0.223
VVG T2	Physical aggression T1	−0.096 [-0.185, −0.007]	0.044	0.034
VVG T3	Physical aggression T2	0.020 [-0.068, 0.109]	0.047	0.657
VVG T4	Physical aggression T3	0.118 [0.009, 0.226]	0.059	0.035

4. Discussion

The impact of VVG on aggression and empathy has been a topic of both academic and public debate for decades. These games have frequently been portrayed as significant factors that contribute to

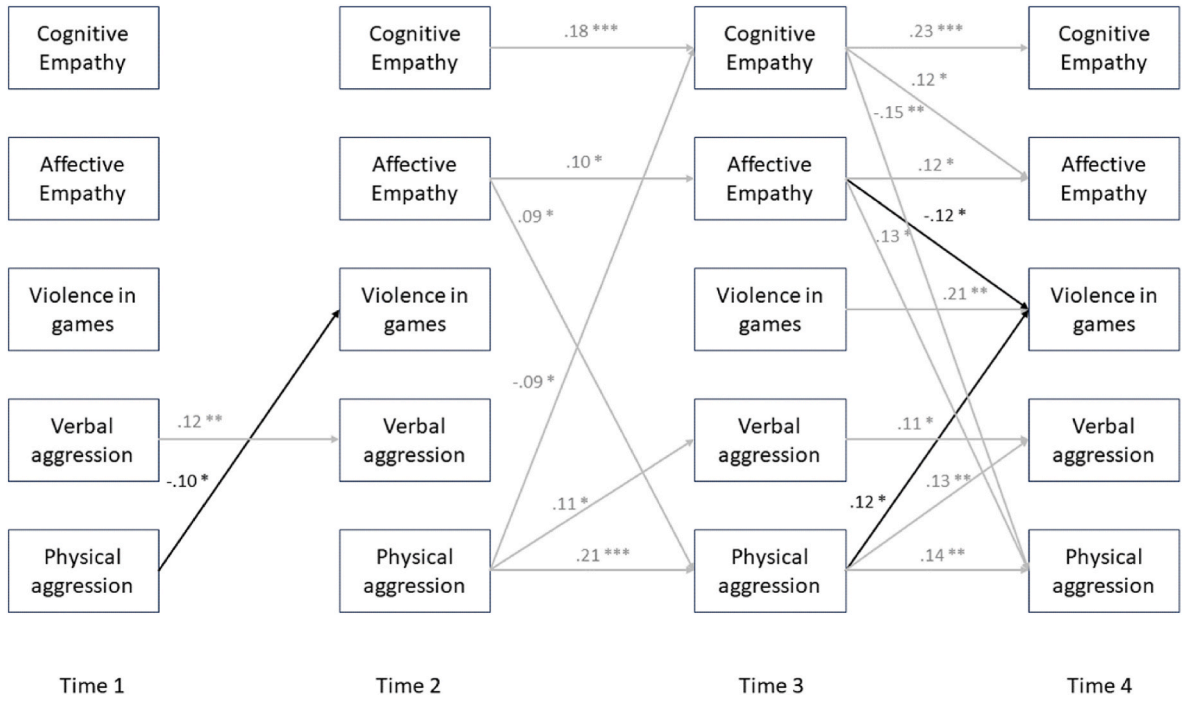

Fig. 1. Statistically significant effects at the within-person level.
Note: Black arrows represent hypothesized effects, and gray arrows represent non-hypothesized and auto-regressive effects. Only statistically significant associations are shown. Due to its complexity, the figure was simplified to include only within-person effects (so, it does not represent the whole RI-CLPM model).

increased aggression and decreased empathy in adolescents. The presented findings challenge this perspective. Employing a longitudinal design and differentiating between within-person and between-person effects, no causal evidence to support the desensitization hypothesis (i.e., that VVG impacts physical and verbal aggression or cognitive and affective empathy) was discovered. Presented findings contradict the GAM, which posits that repeated exposure to violent content results in an increase in aggression and a decrease in empathy (Anderson & Bushman, 2018; Carnagey et al., 2007).

Since the GAM was already criticized for underestimating personal and environmental factors, overestimating the effects of violent media content exposure, lacking practical significance criteria (Ferguson & Dyck, 2012), insufficiently proved axioms and measures with inadequate psychometric properties (Ferguson & Kilburn, 2009), and its inability to be falsified by negative results (Finkel, 2014), the findings of this article underscore the limitations of relying solely on this model and emphasize the need for nuanced methodologies and theoretical frameworks to better understand media effects on adolescents.

These findings are, however, in line with some studies that focus on within-person effects (Johannes et al., 2022; Kersten & Greitemeyer, 2022), as well as some recent longitudinal evidence (e.g., Breuer et al., 2015; Ferguson, 2019; Ferguson & Wang, 2019; Kühn et al., 2019, see also Drummond et al., 2020). They are also aligned with studies that demonstrated the lack of the desensitization effect on neural brain activity using fMRI (e.g., Gao et al., 2017; Goodson et al., 2021; Kühn et al., 2018; Lengersdorff et al., 2023; Szycik, Mohammadi, Hake, et al., 2017; Szycik, Mohammadi, Münte, & te Wildt, 2017). Hence, our evidence does not support the presumption that exposure to video games and the violence present therein is responsible for changes in the development of adolescents' aggression and empathy.

Concerning the selection effect (i.e., whether changes in empathy and aggression are associated with changes in VVG), the evidence presented in this article is inconclusive; most of the associations were not significant. The absence of the effects of the changes in cognitive and affective empathy on VVG aligns with a study by Vossen et al. (2017), which found that sympathy, but not cognitive and affective empathy, is associated with violent media content. The only effect observed in this context was that an increase in affective empathy is associated with a decrease in VVG. This is consistent with the selection hypothesis; however, since the effect was observed only from T3 to T4, it is possible that these effects are less stable than assumed and could change under various circumstances that were not captured in this longitudinal study focused on long-term effects (e.g., exposure patterns to other digital media, individual life events, changes in social environment).

Regarding the impact of changes in aggression on VVG, no effects of verbal aggression were identified. However, it was observed that changes in physical aggression could influence VVG, contrary to expectations, in both positive and negative directions. The negative effect from T1 to T2 does not align with the selection hypothesis, but the positive effect from T3 to T4 does. The latter finding is consistent with a study by Breuer et al. (2015), which provided evidence for the selection hypothesis (see also von Salisch et al., 2011). Additionally, in their study, the effect was moderated by age, and, similar to the presented findings, they noted that the effect is significant only for younger participants. Therefore, the selection effect might be pertinent primarily to younger adolescents, and it is a more intricate process than assumed, which could even potentially yield opposing effects.

Furthermore, the mixed effects of physical aggression on VGG are likely not inherently stable or caused by developmental processes, as indicated by the absence of discernible trends in the data. Instead, they may be influenced by unmeasured situational variables, such as the COVID-19 pandemic. Therefore, another potential explanation could stem from the COVID-19 situation that arose during our data collection period, particularly in the impact upon the initial waves of data collection. This global crisis led to significant changes in behavior, notably among isolated children and adolescents, who reported increased gaming hours, especially in multiplayer games, as a coping mechanism for psychological distress and to mitigate social isolation (for reviews, see e.g., Han et al., 2022; Pallavicini et al., 2022). Therefore, the observation of a negative association of physical aggression from T1 on VVG from T2 could notably be influenced by this global situation.

Regarding between-person effects, this study observed that boys engage more in VVG than girls, which is consistent with findings from numerous previous studies (e.g., Kasumovic et al., 2015). Surprisingly, age showed no association with VVG. This may appear counterintuitive, especially considering the recommended age limits for many violent games. However, given the widespread disregard for age ratings by parents (Childcare, 2018), the lack of association between age and VVG is understandable, because younger individuals often play violent games inappropriate for their age.

In contrast to the within-person level, a tendency for adolescents with generally higher affective empathy to play fewer VVG was not observed at the between-person level. However, it was discovered a counterintuitive positive correlation between these variables. Despite its small effect size, this finding contradicts previous research that identified the opposing effects but primarily relied on self-reported time spent in video games, in general, and not specifically in violent ones (Shin & Ahn, 2013). This finding, however, corresponds to the counterintuitive positive association between the trait of affective empathy and state hostility found by Lacko et al. (2023). They explain that, in contrast to sympathy, adolescents with higher affective empathy focus more on the main playable character with whom they identify. In line with that argumentation, adolescents with generally higher affective empathy could engage more with VGG because they might enjoy the whole story and become more immersed in violent scenarios. In other words, these individuals may be drawn to complex narratives or character-driven games, some of which may involve violence. This challenges the simplistic assumption that higher empathy necessarily leads to a rejection of violent content in media. However, further research focused on other explanatory variables, such as the emotional experiences during gameplay, the motives for VGG, and sensation seeking, as warranted to delve deeper into the underlying mechanisms that drive this unexpected correlation.

Of significant importance, these findings also highlight a trend at the between-person level, where individuals with higher levels of verbal and physical aggression tend to engage more with VVG, particularly with a more pronounced effect observed for physical aggression. This observation aligns with traditional perspectives regarding VVG as a potential trigger for aggression. However, it is critical to emphasize that this association does not necessarily imply causality. While previous studies have often overlooked the within-person level, where fluctuations in aggression and VVG engagement occur over time within individuals, this study acknowledges the influence of both within-person and between-person effects. In essence, while adolescents with higher general aggression may prefer VVG, it is not indicative that increased engagement in VVG leads to heightened aggression. Therefore, much of the prior evidence may have been influenced by the higher variability present at the between-person level. This study underscores the imperative need to differentiate between these two levels of analysis to elucidate the genuine causal relationships between VVG and aggression.

5. Limitations and future research

The findings presented in this research need to be contextualized within its limitations. Firstly, despite VVG not being assessed by the criticized self-report of the assessment of violence (e.g., Drummond et al., 2020; Ferguson, 2011) and instead by expert ratings obtained from Common Sense Media and two independent raters, it still relies on the self-reports of participants for video game names and their order. Thus, it might not be entirely reliable, because participants could omit or forget some played video games. Time spent in games was also not assessed. Future research should, therefore, utilize objective measurements for played video games and time spent on them.

Secondly, given that long six-month intervals between each measurement were applied, many other unmeasured factors could influence the within-person associations, and the short-term dynamic within-person associations remain unknown (with the only exception being Kersten & Greitemeyer, 2022). This aspect should be the focus of future research. For instance, employing ecological momentary assessment research could provide valuable insights into both of the above-mentioned limitations, specifically to measure the time spent in video games objectively and to explore the dynamic and person-specific associations between within-person changes in VVG and empathy/aggression.

Thirdly, RI-CLPM was selected as the primary analytical approach because the aim was to infer a reciprocal relation between VGG and other variables (cf., Johannes et al., 2022; Teng et al., 2022), rather than to infer a relation between developmental processes and their changes over time (cf., Coyne & Stockdale, 2020; Willoughby et al., 2012). However, it is acknowledged that RI-CLPM might introduce biased cross-lagged effects when certain serially correlated unobserved time-varying confounders exist (Usami et al., 2019). Hence, future research could focus on identifying these potentially serially correlated time-varying confounders that could influence physical aggression and VGG in both directions.

The fourth limitation arises from the time and place of data collection, especially during the first two waves, which occurred during the COVID-19 pandemic. These findings could be significantly influenced by this global situation. As a result, the generalizability of the findings may be limited to more typical times outside the context of the pandemic. The generalizability of the findings may also be limited to the cultural region of Central Europe. Even though the proportion of gaming among Czech adolescents is average compared to other European countries (Smahel et al., 2020, previous meta-analytical evidence suggests that the effects of VGG on aggression and empathy could be slightly higher in Western countries while lower in Eastern countries (Anderson et al., 2010; Ferguson, 2015; Prescott et al., 2018). As Czech culture is typically characterized as being “in the middle” between analytic Western countries and holistic Eastern countries (e.g., Lacko et al., 2020), it is possible that the observed effects could differ in other cultural regions.

Finally, attrition analysis revealed significant systematic dropouts for the oldest participants across all of the waves. While there is no methodological justification for this finding, it is assumed that the parents of the older participants were just not as motivated as those of younger ones. This, however, has an impact on the interpretation of the findings, especially upon the moderation effects of age on the within-person level, which could be influenced by selective dropout and thus needs to be interpreted with caution. It seems desirable to focus on a broader age spectrum of children and adolescents in future research to either support or disprove our age-related findings.

CRediT authorship contribution statement

David Lacko: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Hana Machackova:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **David Smahel:** Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare that they have no conflicts of interest to disclose regarding this research project or its publication.

Data availability

The link for data is shared in the manuscript

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2024.108341.

References

Anderson, C. A., & Bushman, B. J. (2002). Human aggression. *Annual Review of Psychology, 53*(1), 27–51. https://doi.org/10.1146/annurev.psych.53.100901.135231

Anderson, C. A., & Bushman, B. J. (2018). Media violence and the general aggression model. *Journal of Social Issues, 74*(2), 386–413. https://doi.org/10.1111/josi.12275

Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., Rothstein, H. R., & Saleem, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and Western countries: A meta-analytic review. *Psychological Bulletin, 136*(2), 151–173. https://doi.org/10.1037/a0018251

Ballou, N. (2023). A manifesto for more productive psychological games research. *Games: Research and Practice, 1*(1), 1–26. https://doi.org/10.1145/3582929

Björkqvist, K. (2018). Gender differences in aggression. *Current Opinion in Psychology, 19*, 39–42. https://doi.org/10.1016/j.copsyc.2017.03.030

Blakemore, S.-J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual Review of Psychology, 65*(1), 187–207. https://doi.org/10.1146/annurev-psych-010213-115202

Boers, E., Afzali, M. H., & Conrod, P. (2020). A longitudinal study on the relationship between screen time and adolescent alcohol use: The mediating role of social norms. *Preventive Medicine, 132*(105992), Article 105992. https://doi.org/10.1016/j.ypmed.2020.105992

Breuer, J., Vogelgesang, J., Quandt, T., & Festl, R. (2015). Violent video games and physical aggression: Evidence for a selection effect among adolescents. *Psychology of Popular Media Culture, 4*(4), 305–328. https://doi.org/10.1037/ppm0000035

Bryant, F. B., & Smith, B. D. (2001). Refining the architecture of aggression: A measurement model for the buss–perry aggression Questionnaire. *Journal of Research in Personality, 35*(2), 138–167. https://doi.org/10.1006/jrpe.2000.2302

Burkhardt, J., & Lenhard, W. (2022). A meta-analysis on the longitudinal, age-dependent effects of violent video games on aggression. *Media Psychology, 25*(3), 499–512. https://doi.org/10.1080/15213269.2021.1980729

Busching, R., Gentile, D. A., Krahé, B., Möller, I., Khoo, A., Walsh, D. A., & Anderson, C. A. (2015). Testing the reliability and validity of different measures of violent video game use in the United States, Singapore, and Germany. *Psychology of Popular Media Culture, 4*(2), 97–111. https://doi.org/10.1037/ppm0000004

Buss, A. H., & Perry, M. (1992). The aggression Questionnaire. *Journal of Personality and Social Psychology, 63*(3), 452–459. https://doi.org/10.1037/0022-3514.63.3.452

Carnagey, N. L., Anderson, C. A., & Bushman, B. J. (2007). The effect of video game violence on physiological desensitization to real-life violence. *Journal of Experimental Social Psychology, 43*(3), 489–496. https://doi.org/10.1016/j.jesp.2006.05.003

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*(3), 464–504. https://doi.org/10.1080/10705510701301834

Chen, C.-Y., Chiou, C.-R., & Ko, C.-H. (2019). Juveniles with a history of violent behavior show cognitive performance and electrophysiology consistent with inhibitory control and emotional feedback processing problems. *Aggressive Behavior, 45*(1), 6–17. https://doi.org/10.1002/ab.21792

Childcare. (2018). Half of parents allow young kids to play 18+ games unsupervised. Retrieved from https://www.childcare.co.uk/blog/video-games.

Coyne, S. M., & Stockdale, L. (2020). Growing up with grand Theft auto: A 10-year study of longitudinal growth of violent video game play in adolescents. *Cyberpsychology, Behavior, and Social Networking*. https://doi.org/10.1089/cyber.2020.0049

Coyne, S. M., Warburton, W. A., Essig, L. W., & Stockdale, L. A. (2018). Violent video games, externalizing behavior, and prosocial behavior: A five-year longitudinal study during adolescence. *Developmental Psychology, 54*(10), 1868–1880. https://doi.org/10.1037/dev0000574

Coyne, S. M., Warburton, W., Swit, C., Stockdale, L., & Dyer, W. J. (2023). Who is most at risk for developing physical aggression after playing violent video games? An individual differences perspective from early adolescence to emerging adulthood. *Journal of Youth and Adolescence, 52*(4), 719–733. https://doi.org/10.1007/s10964-023-01739-0

Crone, E. A., & Dahl, R. E. (2012). Understanding adolescence as a period of social–affective engagement and goal flexibility. *Nature Reviews Neuroscience, 13*(9), 636–650. https://doi.org/10.1038/nrn3313

Dahl, R. E., Allen, N. B., Wilbrecht, L., & Suleiman, A. B. (2018). Importance of investing in adolescence from a developmental science perspective. *Nature, 554*(7693), 441–450. https://doi.org/10.1038/nature25770

Decety, J., & Holvoet, C. (2021). The emergence of empathy: A developmental neuroscience perspective. *Developmental Review: Developmental Review, 62*(100999), Article 100999. https://doi.org/10.1016/j.dr.2021.100999

Dewi, I. D. A. D. P., & Kyranides, M. N. (2022). Physical, verbal, and relational aggression: The role of anger management strategies. *Journal of Aggression, Maltreatment & Trauma, 31*(1), 65–82. https://doi.org/10.1080/10926771.2021.1994495

Dogruel, L., & Joeckel, S. (2013). Video game rating systems in the US and Europe: Comparing their outcomes. *International Communication Gazette, 75*(7), 672–692. https://doi.org/10.1177/1748048513482539

Douglas, S. P., & Craig, C. S. (2007). Collaborative and iterative translation: An alternative approach to back translation. *Journal of International Marketing, 15*(1), 30–43. https://doi.org/10.1509/jimk.15.1.030

Drummond, A., Sauer, J. D., & Ferguson, C. J. (2020). Do longitudinal studies support long-term relationships between aggressive game play and youth aggressive behaviour? A meta-analytic examination. *Royal Society Open Science, 7*(7), Article 200373. https://doi.org/10.1098/rsos.200373

Farrell, A. H., & Vaillancourt, T. (2023). Indirect aggression, anxiety, and empathy: Disaggregating between and within person longitudinal associations during childhood and adolescence. *Development and Psychopathology, 35*(1), 228–240. https://doi.org/10.1017/S0954579421001450

Ferguson, C. J. (2011). Video games and youth violence: A prospective analysis in adolescents. *Journal of Youth and Adolescence, 40*(4), 377–391. https://doi.org/10.1007/s10964-010-9610-x

Ferguson, C. J. (2015). Do angry birds make for angry children? A meta-analysis of video game influences on children's and adolescents' aggression, mental health, prosocial behavior, and academic performance. *Perspectives on Psychological Science, 10*(5), 646–666. https://doi.org/10.1177/1745691615592234

Ferguson, C. J. (2019). A preregistered longitudinal analysis of aggressive video games and aggressive behavior in Chinese youth. *Psychiatric Quarterly, 90*(4), 843–847. https://doi.org/10.1007/s11126-019-09669-6

Ferguson, C. J., Copenhaver, A., & Markey, P. (2020). Reexamining the findings of the American psychological association's 2015 task force on violent media: A meta-analysis. *Perspectives on Psychological Science, 15*(6), 1423–1443. https://doi.org/10.1177/1745691620927666

Ferguson, C. J., & Dyck, D. (2012). Paradigm change in aggression research: The time has come to retire the General Aggression Model. *Aggression and Violent Behavior, 17*(3), 220–228. https://doi.org/10.1016/j.avb.2012.02.007

Ferguson, C. J., & Kilburn, J. (2009). The public health risks of media violence: A meta-analytic review. *The Journal of Pediatrics, 154*(5), 759–763. https://doi.org/10.1016/j.jpeds.2008.11.033

Ferguson, C. J., & Wang, J. C. K. (2019). Aggressive video games are not a risk factor for future aggression in youth: A longitudinal study. *Journal of Youth and Adolescence, 48*(8), 1439–1451. https://doi.org/10.1007/s10964-019-01069-0

Fikkers, K. M., Piotrowski, J. T., & Valkenburg, P. M. (2017). Assessing the reliability and validity of television and game violence exposure measures. *Communication Research, 44*(1), 117–143. https://doi.org/10.1177/0093650215573863

Finkel, E. J. (2014). The I3 model. In *Advances in experimental social psychology* (pp. 1–104). Elsevier.

Fitzpatrick, C., & Boers, E. (2022). Developmental associations between media use and adolescent prosocial behavior. *Health Education & Behavior: The Official Publication of the Society for Public Health Education, 49*(2), 265–271. https://doi.org/10.1177/10901981211035702

Gamer, M., Lemon, J., Fellows, I., & Singh, P. (2019). Irr: Various coefficients of interrater reliability and agreement. *R package version*, 0.84.1 https://CRAN.R-project.org/package=irr.

Gao, X., Pan, W., Li, C., Weng, L., Yao, M., & Chen, A. (2017). Long-time exposure to violent video games does not show desensitization on empathy for pain: An fMRI study. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.00650

Goodson, S., Turner, K. J., Pearson, S. L., & Carter, P. (2021). Violent video games and the P300: No evidence to support the neural desensitization hypothesis. *Cyberpsychology, Behavior, and Social Networking, 24*(1), 48–55. https://doi.org/10.1089/cyber.2020.0029

Greitemeyer, T., & Mügge, D. O. (2014). Video games do affect social outcomes: A meta-analytic review of the effects of violent and prosocial video game play. *Personality and Social Psychology Bulletin, 40*(5), 578–589. https://doi.org/10.1177/0146167213520459

Guo, N., Tsun Luk, T., Wu, Y., Lai, A. Y.-K., Li, Y., Cheung, D. Y. T., Wong, J. Y.-H., Fong, D. Y. T., & Wang, M. P. (2022). Between- and within-person associations of mobile gaming time and total screen time with sleep problems in young adults: Daily assessment study. *Addictive Behaviors, 134*(107408), Article 107408. https://doi.org/10.1016/j.addbeh.2022.107408

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods, 20*(1), 102–116. https://doi.org/10.3389/fpsyg.2023.1155807, 10.1037/a0038889.

Han, T. S., Cho, H., Sung, D., & Park, M.-H. (2022). A systematic review of the impact of COVID-19 on the game addiction of children and adolescents. *Frontiers in Psychiatry, 13*. https://doi.org/10.3389/fpsyt.2022.976601

Hopf, W. H., Huber, G. L., & Weiß, R. H. (2008). Media violence and youth violence. *Journal of Media Psychology, 20*(3), 79–96. https://doi.org/10.1027/1864-1105.20.3.79

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hull, J. G., Brunelle, T. J., Prescott, A. T., & Sargent, J. D. (2014). A longitudinal study of risk-glorifying video games and behavioral deviance. *Journal of Personality and Social Psychology, 107*(2), 300–325. https://doi.org/10.1037/a0036058

Johannes, N., Vuorre, M., Magnusson, K., & Przybylski, A. K. (2022). Time spent playing two online shooters has no measurable effect on aggressive affect. *Collabra: Psychology, 8*(1). https://doi.org/10.1525/collabra.34606

Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2022). semTools: Useful tools for structural equation modeling. *R package version 0.5-6*. Retrieved from https://CRAN.R-project.org/package=semTools.

Kahhale, I., Hanson, J. L., Raine, A., & Byrd, A. L. (2024). Associations between subtypes of empathy and aggression in high-risk adolescents. *Journal of Psychopathology and Behavioral Assessment, 46*(1), 62–75. https://doi.org/10.1007/s10862-023-10112-1

Kasumovic, M. M., Blake, K., Dixson, B. J., & Denson, T. F. (2015). Why do people play violent video games? Demographic, status-related, and mating-related correlates in men and women. *Personality and Individual Differences, 86*, 204–211. https://doi.org/10.1016/j.paid.2015.06.018

Kersten, R., & Greitemeyer, T. (2022). Why do habitual violent video game players believe in the cathartic effects of violent video games? A misinterpretation of mood improvement as a reduction in aggressive feelings. *Aggressive Behavior, 48*(2), 219–231. https://doi.org/10.1002/ab.22005

Korkmaz, S., Goksuluk, D., & Zararsiz, G. (2014). Mvn: An R package for assessing multivariate normality. *The R Journal, 6*(2), 151–162.

Krahé, B., & Möller, I. (2010). Longitudinal effects of media violence on aggression and empathy among German adolescents. *Journal of Applied Developmental Psychology, 31*(5), 401–409. https://doi.org/10.1016/j.appdev.2010.07.003

Kühn, S., Kugler, D., Schmalen, K., Weichenberger, M., Witt, C., & Gallinat, J. (2018). The myth of blunted gamers: No evidence for desensitization in empathy for pain after a violent video game intervention in a longitudinal fMRI study on non-gamers. *Neurosignals, 26*(1), 22–30. https://doi.org/10.1159/000487217

Kühn, S., Kugler, D. T., Schmalen, K., Weichenberger, M., Witt, C., & Gallinat, J. (2019). Does playing violent video games cause aggression? A longitudinal intervention study. *Molecular Psychiatry, 24*(8), 1220–1234. https://doi.org/10.1038/s41380-018-0031-7

Lacko, D., Machackova, H., & Dufková, E. (2023). *Does aggressive commentary by streamers during violent video game affect state aggression in adolescents?* New Media & Society. https://doi.org/10.1177/14614448231182620

Lacko, D., Šašinka, Č., Čeněk, J., Stachoň, Z., & Lu, W. (2020). Cross-cultural differences in cognitive style, individualism/collectivism and map reading between central European and East Asian University students. *Studia Psychologica, 62*(1), 23–42. https://doi.org/10.31577/sp.2020.01.789

Lee, E.-J., Kim, H. S., & Choi, S. (2020). Violent video games and aggression: Stimulation or catharsis or both? *Cyberpsychology, Behavior, and Social Networking*. https://doi.org/10.1089/cyber.2020.0033

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). The effects of pathological gaming on aggressive behavior. *Journal of Youth and Adolescence, 40*(1), 38–47. https://doi.org/10.1007/s10964-010-9558-x

Lengersdorff, L., Wagner, I., Mittmann, G., Olsson, A., Petrovic, P., & Lamm, C. (2023). Grand Theft empathy? Evidence for the absence of effects of violent video games on empathy for pain and emotional reactivity to violence. *PsyArXiv*. https://doi.org/10.31234/osf.io/u2g6k

Li, C.-H. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods, 48*(3), 936–949. https://doi.org/10.3758/s13428-015-0619-7

Li, Y., Deng, T., & Kanske, P. (2023). Affective empathy mediates the positive effect of prosocial video games on young children's sharing behavior. *Cognitive Development, 67*(101343), Article 101343. https://doi.org/10.1016/j.cogdev.2023.101343

Li, J., Du, Q., & Gao, X. (2020). Adolescent aggression and violent video games: The role of moral disengagement and parental rearing patterns. *Children and Youth Services Review, 118*(105370), Article 105370. https://doi.org/10.1016/j.childyouth.2020.105370

Michalska, K. J., Zeffiro, T. A., & Decety, J. (2016). Brain response to viewing others being harmed in children with conduct disorder symptoms. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 57*(4), 510–519. https://doi.org/10.1111/jcpp.12474

Möller, I., & Krahé, B. (2009). Exposure to violent video games and aggression in German adolescents: A longitudinal analysis. *Aggressive Behavior, 35*(1), 75–89. https://doi.org/10.1002/ab.20290

Mößle, T., Kliem, S., & Rehbein, F. (2014). Longitudinal effects of violent media usage on aggressive behavior—the significance of empathy. *Societies, 4*(1), 105–124. https://doi.org/10.3390/soc4010105

Mulder, J. D., & Hamaker, E. L. (2021). Three extensions of the random intercept cross-lagged panel model. *Structural Equation Modeling: A Multidisciplinary Journal, 28*(4), 638–648. https://doi.org/10.1080/10705511.2020.1784738

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Muthén & Muthén.

Olejarnik, S. Z., & Romano, D. (2023). Is playing violent video games a risk factor for aggressive behaviour? Adding narcissism, self-esteem and PEGI ratings to the debate. *Frontiers in Psychology, 14*. https://doi.org/10.3389/fpsyg.2023.1155807

Orth, U., Meier, L. L., Bühler, J. L., Dapp, L. C., Krauss, S., Messerli, D., & Robins, R. W. (2022). Effect size guidelines for cross-lagged effects. *Psychological Methods*. https://doi.org/10.1037/met0000499. Advance online publication.

Pallavicini, F., Pepe, A., & Mantovani, F. (2022). The effects of playing video games on stress, anxiety, depression, loneliness, and gaming disorder during the early stages of the COVID-19 pandemic: PRISMA systematic review. *Cyberpsychology, Behavior, and Social Networking, 25*(6), 334–354. https://doi.org/10.1089/cyber.2021.0252

Prescott, A. T., Sargent, J. D., & Hull, J. G. (2018). Metaanalysis of the relationship between violent video game play and physical aggression over time. *Proceedings of the National Academy of Sciences of the United States of America, 115*(40), 9882–9888. https://doi.org/10.1073/pnas.1611617114

Przybylski, A. K., & Weinstein, N. (2019). Violent video game engagement is not associated with adolescents' aggressive behaviour: Evidence from a registered report. *Royal Society Open Science, 6*(2), Article 171474. https://doi.org/10.1098/rsos.171474

R Core Team. (2023). *R: A language and environment for statistica foundation for statistical computing*. https://www.R-project.org/.

Ramirez, M. J. (1993). Acceptability of aggression in four Spanish regions and a comparison with other European countries. *Aggressive Behavior, 19*(3), 185–197.

Rhemtulla, M., Brosseau-Liard, P.É., & Savalei, V. (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. *Psychological Methods, 17*(3), 354–373. https://doi.org/10.1037/a0029315

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Shamay-Tsoory, S. G., Aharon-Peretz, J., & Perry, D. (2009). Two systems for empathy: A double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. *Brain: A Journal of Neurology, 132*(Pt 3), 617–627. https://doi.org/10.1093/brain/awn279

Sherry, J. L. (2007). Violent video games and aggression: Why can't we find effects? In R. W. Preiss, B. M. Gayle, N. Burrell, M. Allen, & J. Bryant (Eds.), *Mass media effects research: Advances through meta-analysis* (pp. 245–262). Lawrence Erlbaum Associates Publishers.

Shin, D.-H., & Ahn, D. (2013). Associations between game use and cognitive empathy: A cross-generational study. *Cyberpsychology, Behavior, and Social Networking, 16*(8), 599–603. https://doi.org/10.1089/cyber.2012.0639

Silke, C., Brady, B., Boylan, C., & Dolan, P. (2018). Factors influencing the development of empathy and pro-social behaviour among adolescents: A systematic review. *Children and Youth Services Review, 94*, 421–436. https://doi.org/10.1016/j.childyouth.2018.07.027

Singer, T., & Lamm, C. (2009). The social neuroscience of empathy. *Annals of the New York Academy of Sciences, 1156*(1), 81–96. https://doi.org/10.1111/j.1749-6632.2009.04418.x

Smahel, D., Machackova, H., Mascheroni, G., Dedkova, L., Staksrud, E., Ólafsson, K., Livingstone, S., & Hasebrink, U. (2020). EU kids online 2020: Survey results from 19 countries. *EU Kids Online*. https://doi.org/10.21953/lse.47fdeqj01ofo

Statista. (2023). Number of video game users worldwide from 2019 to 2029. Retrieved from https://www.statista.com/statistics/748044/number-video-gamers-world/.

Szycik, G. R., Mohammadi, B., Hake, M., Kneer, J., Samii, A., Münte, T. F., & te Wildt, B. T. (2017). Excessive users of violent video games do not show emotional desensitization: An fMRI study. *Brain Imaging and Behavior, 11*(3), 736–743. https://doi.org/10.1007/s11682-016-9549-y

Szycik, G. R., Mohammadi, B., Münte, T. F., & te Wildt, B. T. (2017). Lack of evidence that neural empathic responses are blunted in excessive users of violent video games: An fMRI study. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.00174

Teng, Z., Nie, Q., Guo, C., Zhang, Q., Liu, Y., & Bushman, B. J. (2019). A longitudinal study of link between exposure to violent video games and aggression in Chinese adolescents: The mediating role of moral disengagement. *Developmental Psychology, 55*(1), 184–195. https://doi.org/10.1037/dev0000624

Teng, Z., Yang, C., Stomski, M., Nie, Q., & Guo, C. (2022). Violent video game exposure and bullying in early adolescence: A longitudinal study examining moderation of trait aggressiveness and moral identity. *Psychology of Violence, 12*(3), 149–159. https://doi.org/10.1037/vio0000424

Tremblay, R. E., Vitaro, F., & Côté, S. M. (2018). Developmental origins of chronic physical aggression: A bio-psycho-social model for the next generation of preventive interventions. *Annual Review of Psychology, 69*(1), 383–407. https://doi.org/10.1146/annurev-psych-010416-044030

Usami, S., Murayama, K., & Hamaker, E. L. (2019). A unified framework of longitudinal models to examine reciprocal relations. *Psychological Methods, 24*(5), 637–657. https://doi.org/10.1037/met0000210

Vachon, D. D., Lynam, D. R., & Johnson, J. A. (2014). The (non)relation between empathy and aggression: Surprising results from a meta-analysis. *Psychological Bulletin, 140*(3), 751–773. https://doi.org/10.1037/a0035236

von Salisch, M., Vogelgesang, J., Kristen, A., & Oppl, C. (2011). Preference for violent electronic games and aggressive behavior among children: The beginning of the downward spiral? *Media Psychology, 14*(3), 233–258. https://doi.org/10.1080/15213269.2011.596468

Vossen, H. G. M., & Fikkers, K. M. (2021). The mediating role of sympathy in the relationship between media violence and Dutch adolescents' social behaviors. *Journal of Children and Media, 15*(3), 389–409. https://doi.org/10.1080/17482798.2020.1828118

Vossen, H. G. M., Piotrowski, J. T., & Valkenburg, P. M. (2015). Development of the adolescent measure of empathy and sympathy (AMES). *Personality and Individual Differences, 74*, 66–71. https://doi.org/10.1016/j.paid.2014.09.040

Vossen, H. G. M., Piotrowski, J. T., & Valkenburg, P. M. (2017). The longitudinal relationship between media violence and empathy: Was it sympathy all along? *Media Psychology, 20*(2), 175–193. https://doi.org/10.1080/15213269.2015.1121825

Vuorre, M., Johannes, N., Magnusson, K., & Przybylski, A. K. (2022). Time spent playing video games is unlikely to impact well-being. *Royal Society Open Science, 9*(7). https://doi.org/10.1098/rsos.220411

Wallace, J., Boers, E., Ouellet, J., & Conrod, P. (2023). A population-based analysis of the temporal association of screen time and aggressive behaviors in adolescents. *JAACAP Open*. https://doi.org/10.1016/j.jaacop.2023.08.002

Wildy, H., & Clarke, S. (2009). Using cognitive interviews to pilot an international survey of principal preparation: A western Australian perspective. *Educational Assessment, Evaluation and Accountability, 21*(2), 105–117. https://doi.org/10.1007/s11092-009-9073-3

Willoughby, T., Adachi, P. J. C., & Good, M. (2012). A longitudinal study of the association between violent video game play and aggression among adolescents. *Developmental Psychology, 48*(4), 1044–1057. https://doi.org/10.1037/a0026046

Yao, M., Zhou, Y., Li, J., & Gao, X. (2019). Violent video games exposure and aggression: The role of moral disengagement, anger, hostility, and disinhibition. *Aggressive Behavior, 45*(6), 662–670. https://doi.org/10.1002/ab.21860