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Enter the Matrix: Does Self-Activation Really Matter for Aggressiveness After Violence Exposure?

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Media comparisons are only valid within "zones of comparability." Either the level of participants' interactivity (i.e., the "syntactics" of what they do) has to be constant, while the content might vary, or the content of specific media (i.e., the "semantics" of what they encounter) has to be kept constant, while the level of interactivity with the content might vary. The present experiment varied the level of interactivity: Participants watched a violent scene from the movie The Matrix or reenacted the same scene in a Matrix-inspired first-person shooter game. Using the same violent content (shooting at Matrix guards), our results suggest that the higher the level of self-activation while being exposed to violent media content, the stronger the changes in aggressive dispositions as assessed with an aggressive self-concept Implicit Association Test. Ruling out confounders from previous research, unspecific arousal was not responsible for the obtained short-term increases in aggressive dispositions.

Public Policy Relevance Statement

This research reveals that playing actively violent computer games increases aggressive dispositions even after playing for a very short time (3 min). Although this might not predict long-time effects of being exposed to violent media, this short-time effect is directly related to exposure to violent scenes. The finding highlights the importance of the age restriction of violent computer games.

Keywords: aggression, aggressive self-concept, Implicit Association Test, self-activation

Measurement confounds often undermine the conclusiveness of research by allowing alternative interpretations. Research on the relationship between violent media and human aggression can serve as a prime example. The existence of confounders in aggression research effectively nourishes criticism, leads to tensions between scientific camps in the violent-media–aggression debate, and ultimately prevents scientific progress and societal action. For instance, in a U.S. Supreme Court ruling from June 2011, the majority of the court was not convinced that a link between exposure to violent video games and harmful effects on minors existed.[1] In the debate on media violence exposure effects, scientists themselves have repeatedly called for more conclusive evidence, before strong conclusions are warranted (Anderson et al., 2010; Ferguson & Kilburn, 2010). Our research deals with a framework that can guide researchers to avoid or rule out the presence of confounders when different media are compared, the media comparison paradigm. Using prominent previous research as a starting point, we critically examine alternative explanations for the claimed causality of the role of self-activation during video game players' active engagement with violent media (Gentile, 2015).

Problems of Media Research

There has been a heated debate about the psychological effects due to violence exposure and media consumption. As of now, there is still controversy among researchers whether media-driven ef-

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[1] In delivering the opinion of the Supreme Court on the case of Brown (formerly Schwarzenegger) vs. Entertainment Merchants Association, Justice Scalia said, "These studies have been rejected by every court to consider them, and with good reason: They do not prove that violent videogames cause minors to act aggressively" (http://www.supremecourt.gov/opinions/10pdf/08-1448.pdf).

fects are “real,” that is, whether causality has been sufficiently demonstrated, or what the size of any effect might be (for a cordial introduction into the debate, see Ferguson & Konijn, 2015). Furthermore, the meta-analytic techniques for estimating effect sizes and the relevance of any established effect obtained from controlled lab studies for real-world problems are under debate (Anderson et al., 2010; Ferguson & Kilburn, 2010). Confounders may exist in experimental settings as well as in natural environments and psychological measures (Elson, Breuer, Van Looy, Kneer, & Quandt, 2015).

Confounders in Media Violence Research

Adachi and Willoughby (2011) recently criticized the use of dependent variables that assess competitiveness rather than aggression (e.g., the so-called “noise-blast paradigm,” sometimes also called the “competitive reaction time task” [CRTT] or “Taylor aggression paradigm”; Elson, Mohseni, Breuer, Scharkow, & Quandt, 2014; Epstein & Taylor, 1967). Their first criticism calls the validity of the interpretation of such test scores as measures of aggression into question, due to potential confounders in the dependent variables. Furthermore, according to their literature overview, “no study has equated the violent and non-violent video games on competitiveness, difficulty, and pace of action [. . .] Consequently, it is unclear whether the violent content alone is responsible for elevated levels of aggression” (p. 61), rendering many studies on video game effects ambiguous. This second criticism pertains to the internal validity of experimental designs per se.[2]

Elson et al. (2014) also criticized the use of behavioral aggression measures used in media research, raising specific doubts about the CRTT. They found large differences in significance levels and effect sizes between different CRTT procedures and analyses. These differences, based on unstandardized use and analysis, invoke procedural confounders that fluctuate with each application. They impact the results and impede sound interpretations. According to Elson and colleagues, the current practices diminish the credibility and significance of laboratory research on aggression (see also Elson et al., 2015). Standardizing the CRTT setup and trial analysis may improve its future utility (Brugman et al., 2015).

DeCamp (2015) discussed real-life confounders pertaining to measures of aggression in violent media research. Her analysis of the impact of violent media use on aggressive behavior, especially when combined with other causal factors (e.g., observing violence at home, sensation seeking, ethnicity, etc.), revealed that the status of playing violent video games had only little or no predictive value in real life (but see Gentile & Bushman, 2012, for a combined risk factor analysis). Unfortunately, among the dependent measures that DeCamp investigated were “weapon carrying,” “gun carrying,” and “hitting.” These indicators fall at the more extreme end of everyday behavior, resulting in low base rates for being observed, and they do not inform us about psychological variables or aggressive dispositions, the lurking readiness to act aggressively in any form at some point. Nevertheless, her research has shown that many factors impact violent behavior, and research has to be scrutinized to avoid confounders before solid conclusions can be drawn (see also Elson et al., 2015). When analyzing violent video games and violence trends over an extended period of time on the general population, Markey, Markey, and French (2015) did not find evidence for real-world homicides and aggravated assaults being positively linked to violent game consumption.

To work toward a resolution of the confounder dilemma in experimental research, Bluemke, Friedrich, and Zumbach (2010) had empirically controlled confounding variables in (non)violent media comparisons. In a replication attempt of Uhlmann and Swanson’s (2004) study, they kept the competitiveness, the difficulty, and the pace of action at the same level. They showed that violent and peaceful video games can indeed be held responsible for upward and downward changes in aggressive dispositions even when confounders are eliminated or controlled. In their study, an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) on the automatic aggressive self-concept reflected aggressiveness changes after exposure to computer games. So-called implicit measures allow ruling out effects of self-presentation and the response bias, namely, by using objective response latencies within the range of a few hundreds of milliseconds, obtained from simple computer-based, cognitive sorting tasks. When the aggressive self-concept is at the focus, the researcher assesses the speed with which a respondent can couple self-related stimuli with aggressive words, alternatively with peaceful words (Banse, Messer, & Fischer, 2015). From a dual-process perspective, this Aggressiveness-IAT (or Agg-IAT) is a measure that can predict the impulsive pathway to aggression rather than the deliberate route, especially when self-control is generally low or temporally exhausted (Bluemke et al., 2010; Bluemke & Teige-Mocigemba, 2015; Bluemke & Zumbach, 2012; Denson, Capper, Oaten, Friese, & Schofield, 2011; Richetin & Richardson, 2008; Richetin, Rich-

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[2] Previous efforts on matching media content should be acknowledged and scrutinized. Anderson and Dill (2000) compared a violent condition with a nonviolent condition on the basis of completely different game types (Wolfenstein 3D shooter vs. Myst adventure). Supposedly, the two games were matched on enjoyment, game difficulty, frustration, and action speed according to a limited pretest ($N = 32$). As the authors acknowledged, the games were not matched on excitement (and we add here: competitiveness, atmosphere, etc.). Furthermore, controlling a mere subset of potential confounders—in their case, subjective ratings taken after the treatment— by analysis of covariance (ANCOVA) biases the focal treatment effect of violence exposure. The upward- or downward bias can emerge whenever treatment groups differ on the covariates as a result of the treatment itself, which they did (Adachi & Willoughby, 2011; Miller & Chapman, 2001). As Cochran (1957) explained, “it is important to verify that the treatments have had no effect” on the covariate, as “a covariance adjustment . . . may remove most of the real treatment effect” (p. 264). This is because of the following:

> [w]hen the treatments do affect the [covariates] to some extent, the covariance adjustments take on a different meaning. They no longer merely remove a component of experimental error. In addition, they distort the nature of the treatment effect that is being measured. (p. 264)

A more positive example is the comparison of the same computer game varying only in (first/third person) perspective, yet this study by Krcmar and Farrar (2009) did not match confounders across violent and nonviolent conditions (the latter actually was a no-game condition that allows the interpretation of any effects as being due to gaming per se). Adachi and Willoughby’s (2011) Table 1 alone lists 18 articles that did not match violent and nonviolent conditions, mostly with competitiveness being the culprit.

ardson, & Mason, 2010; Teubel, Banse, Asendorpf, & Schnabel, 2011; Zumbach, Seitz, & Bluemke, 2015).

The fact that a mere 5 minutes of violent gameplay altered the aggressive self-concept—at least temporarily—is compatible with the notion that self-activation potentially plays a major role in shaping automatic precursors of aggressiveness during gameplay (Bluemke & Zumbach, 2012). However, this study did not investigate the involvement of the self as a concept (Markus & Kunda, 1986), which acts as the central memory structure in IATs on the aggressive self-concept. Depending on the situation, various self-related aspects can become activated in memory, say, aggressive behavioral scripts, which subsequently govern people's behavior (Kawakami et al., 2012). We will scrutinize whether an alternative interpretation for the supposed role of self-activation in violent media effects exists that was left uncontrolled in previous research: unspecific arousal. It may act as a confounder of activity and agency differences across media conditions, and we show how to rule out its impact along the lines of the media comparison paradigm.

Confounders in Research on Self-Activation Through Video Games

Fischer, Kastenmüller, and Greitemeyer (2010) addressed the question whether the impact of violence exposure on aggressiveness depends on self-activation. They showed that the effect of violence exposure on aggression was markedly strengthened if participants strongly identified with their video game character. Generally, participants administered more hurtful hot sauce to a fellow participant after an aggressive game (boxing) than after a nonaggressive game (bowling). Furthermore, in each condition, half of the participants used personalized virtual players that mirrored participants' gender and physical appearance. In line with a self-activation account, participants playing with self-created avatars applied more hot sauce than those who had used nonpersonalized characters, despite both groups playing the same game. Once the amplified similarity in appearance allowed a participant to identify more strongly with the virtual character, or *alter ego*, then the violent game had the profoundest effect on players' aggression. When running a mediation analysis to add to the picture, retrospectively reported self-activation during gameplay purportedly mediated the relationship between personalized versus nonpersonalized violent games and aggression (Fischer et al., 2010). Al-though the use of hot sauce as a behavioral measure, as recommended by Adachi and Willoughby (2011), is potentially better than the use of the criticized CRTT, several questions remain.

A Useful Framework for Media Comparisons

According to the media comparison paradigm (Figure 1; see also Bluemke et al., 2010), media comparisons are notoriously difficult, but only valid within "zones of comparability." The causal influence of a single factor has to be clearly established, and potentially detrimental confounders have to be ruled out. Types of media differ in many regards, such as media content, or how consumers can interact with media. For conclusions to be stringently drawn, the window of opportunity for theoretically relevant alternative explanations to emerge needs to be small. We borrow the long-known and most fundamental distinction between "syntax" and "semantics" in linguistics and between syntactic and semantic approaches in media studies (Altman, 1984; Jameson, 1975; Rauh, 2016; Todorov, 1970). When engaging with different media conditions, either the level of interactivity (i.e., the "syntactics" of what participants do) has to be constant while different content is being compared; alternatively, the content of specific media (i.e., the "semantics") has to be constant while the level of interactivity with media content varies (see also Elson et al., 2015). The comparison of *types* of media stimuli (say, movie vs. video-game sequences) requires at least *approximately* equivalent conditions in these two fundamental dimensions, which will eradicate the most important confounders; not all potentially relevant features will always be controlled by this heuristic (such as whether "screams" occur rather by movie actors or game players). Yet, valid comparisons require ruling out blatant confounders, so as to establish zones of comparability.

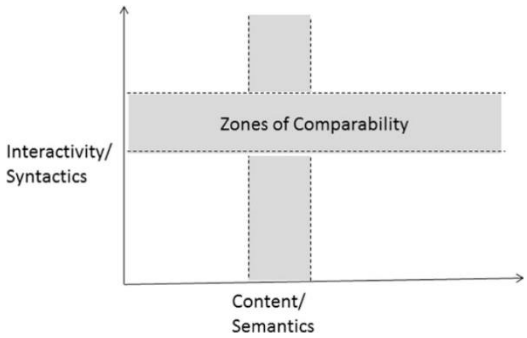

Figure 1. Illustration of the media comparison paradigm.

By not keeping either syntactics or semantics constant, but rather altering the two strands simultaneously, the ostensibly replicated violence-exposure effect in Fischer et al.'s (2010) study may have stemmed from crucial differences between peaceful and violent games other than violent content: Within the same type of media under investigation (video games), participants were exposed to different types of games so that the activity of the games differed as did the pace of actions (Adachi & Willoughby, 2011; Bluemke et al., 2010; Elson et al., 2015). If mere physiological arousal drove the main outcomes (e.g., due to competitiveness or action differences), then personalized characters may have temporally intensified arousal (e.g., due to the novelty of personalized characters), rather than increased self-activation that would supposedly lead to changes in aggressive dispositions. The findings are ambiguous, because the general aggression model (Anderson & Dill, 2000) acknowledges arousal as a transient but sufficient causal factor leading to aggression in social situations (Zillmann, 1978). As unspecific arousal was not controlled, there is a high likelihood that it contributed to the observed effects.

The authors of the said study reported a mediational analysis to support the underlying cognitive process. Self-activation was measured "by asking participants how awake, strong, attentive, active, upset, and motivated they felt" (Fischer et al., 2010, p. 193). Such an instrument is actually less reminiscent of a scale for assessing self-activation in the sense of involvement of the self in a situation than it is of a scale for *activity* and *potency* in general—the two dimensions that, apart from valence, underlie the semantics of adjectives (Osgood, Suci, & Tannenbaum, 1957). As the scale focused on active/passive and strong/weak connotations, responses on the purported measure of self-activation, once again, may have reflected *unspecific (physiological) arousal* rather than the involvement of the self as a memory structure (Russell, 1978, 1980). Such an alternative interpretation might account for the mediational link established between the experimental manipulation and the subsequently observed aggression; it thus puts a question mark on the self-activation account in the sense of cognitive processes related to the learning of behavioral scripts and aggressive schemas.

Overview and Hypotheses

To clarify the role of self-activation in video game effects, which our previous study had not investigated (Bluemke et al., 2010), and to overcome the ambiguities surrounding the intricate relationship of arousal with self-activation in Fischer et al.'s (2010) outcomes and pertinent conclusions, we ran a new experiment. By manipulating the interactivity of media to be dealt with, but keeping the media content comparable, our experiment took place in a zone of comparability. One experimental group watched violent content taken from the movie *Matrix* passively, whereas others engaged actively with the same content by playing a shooter game that reenacted the *Matrix* plot.

The two conditions reflected the same content (protagonist, scene taken from story board, use of weaponry, and type of armed violence), but only one condition required participants' active participation. A third group simply read an article with neutral content. Self-activation should become evident on an implicit measure specifically capturing the association between self and aggressive behaviors, the Agg-IAT (Banse et al., 2015). Thus, we hypothesized implicit aggressiveness increases when participants were passively exposed to media violence, because aggressive scripts and schemas form through observation of such behavior (cf. Ferguson & Dyck, 2012), but even more so when participants actively engage in aggressive acts while immersed in a virtual world (Anderson et al., 2003; Bluemke et al., 2010; Coyne, 2016; Gentile, Coyne, & Walsh, 2011).

To elaborate, people's involvement has repeatedly been shown to heighten their self-activation (for a review, see Fischer et al., 2010). And the more people's selves are supraliminally or subliminally primed (say, because players become immersed into gameplay and identify strongly with their game character and its actions), the higher the impact on psychological variables (McGloin, Farrar, & Krcmar, 2013; Smeets, Jansen, Vossen, Ruf, & Roefs, 2010; van den Bos, Miedema, Vermunt, & Zwenk, 2011). For instance, Lull and Bushman (2016) studied the impact of violent and nonviolent gameplay within the same game. The degree of simulated reality was additionally modified by comparing three-dimensional versus two-dimensional gameplay. The three-dimensional condition increased anger in the violent gameplay condition. In line with this reasoning, by definition, playing a violent character *oneself* will involve the self more strongly and lead to a higher degree of self-activation in comparison with just observing violent scenes carried out by movie protagonists. This difference will manifest in stronger Agg-IAT changes when one's *alter ego* engages in violent acts than when primed with aggressive concepts by watching third-person violence.

Hypothesis 1: Agg-IAT scores should increase across experimental conditions from reading to watching to playing.

Much like Fischer and colleagues (2010), we concur that *self-activation* is an underlying mechanism that alters the psychological relevance of the violent content, resulting in changes of aggressive dispositions at least in the short term (and potentially the increased likelihood of aggressing). If self-activation is indeed responsible for the strength of the violence exposure–aggression link, as suggested by Fischer and others (2010), then playing violent games is likely to alter the aggressive self-concept more than passively watching the violent movie does, and definitely more so than simply reading a magazine. In other words, the different involvement of the self in any exposure to violence should be reflected in different adjustments of the aggressive self-concept after active, passive, or no violence exposure. However, for this hypothesis to be acceptable, mere physiological arousal differences as an outflow of different levels of interactivity must not account for any experimental effects attributed to self-activation. In other words, a zone of comparability must be established that rules out a blatant arousal explanation of the said effects.

Hypothesis 2: Arousal differences do not mediate the violence-exposure effect on Agg-IAT scores across experimental conditions from reading to watching to playing.

Simultaneous support for both hypotheses allows to conclude stringently on the relevance of self-activation. This claim will also be bolstered if the main dependent variable directly involves the self-concept as a memory structure, rather than a mediator variable that is itself ambiguous.

Method

Participants and Design

Ninety students of the Austrian or German (thus mostly Caucasian) background at the University of Salzburg (62.2% females; $M_{\text{age}} = 24.66$ years, $SD = 6.13$) participated in exchange for course credit. They were randomly allocated to an experimental condition, either the article-reading control group, the *Matrix*-movie group, or the *Matrix*-game group. Implicit and explicit measures of aggressiveness were taken before and after the treatment. Data on skin conductance were sampled before, during, and after the treatment.

Experimental Procedure and Materials

After obtaining informed consent, the experimenter attached electrodes to participants' middle and ring fingers of the left hand to collect electrodermal activity parameters as they completed the explicit aggressiveness questionnaire (as a paper-and-pencil test). Next, participants worked on an implicit aggressiveness measure assessed by the IAT-software (see the following text). Then, for all groups, a 3-min treatment took place, in which control participants read an article on autism, and one experimental group watched a violent scene from the movie *Matrix*, whereas the other group played a first-person shooter game with the same scene. The scenario was modeled after the entry hall from the movie *Matrix*.

It was edited such that guards, who randomly appeared near the square pillars, had to be eliminated. First-person shooting through a crosshair, to be pointed at the guards by the participant, was realized by using the computer mouse input. The game allowed success to both experienced and unexperienced players (which were randomly allotted to the conditions so that having had prior experiences with the movie, or with computer gaming, was balanced out across conditions). To add to a comparable atmosphere, the same background music was present in the game as in the movie. Finally, immediately after the treatment, explicit and implicit aggressiveness were measured a second time. The procedure took about 30 min, including debriefing.

Explicit aggressiveness. Buss and Perry's (1992) Aggression Questionnaire (BPAQ) with 29 items and a 5-point rating scale format (ranging from *I fully agree* to *I do not agree at all*) assessed facets ranging from physical and verbal aggression to anger and hostility (German 27-item version; von Collani & Werner, 2005). BPAQ sum scores at pretest and posttest reflected reliable interindividual differences in our sample, Cronbach's α_1 = .86, 90% confidence interval (CI) [.82, .89], and α_2 = .87, 90% CI [.83, .90]. Like many self-report measures of personality traits, BPAQ scores are also context dependent (Butcher & Spielberger, 1983). They reflect cross-situationally stable trait components as well as situationally dependent fluctuations of aggressiveness. Though state measures may be created so as to be more responsive to situational differences than the trait BPAQ (Farrar & Krcmar, 2006), even such measures do not overcome self-presentational issues and deliberate response biases. Hence, the IAT served as the main measure of interest, which is also directly related to the self as a semantic memory structure.

Implicit aggressiveness. The aggressive self-concept IAT assessed the sorting speed of stimulus words in a double-barreled sorting task. We used a five-block IAT structure and the stimuli reported by Bluemke and colleagues (2010). First, the discrimination of aggressive and peaceful attribute words (20 trials) and the discrimination of self and other target words (20 trials) were practiced. Then, critical blocks combined attribute and target words (80 trials), with self + peaceful (other + aggressive) first, and self + aggressive (other + peaceful) second. Between the two critical blocks, participants practiced the inverted target category positions (40 trials). IAT effects were computed as so-called D_5-difference scores that subtract the mean latency in the critical self + peaceful (other + aggressive) block from the mean latency in the critical self + aggressive (other + peaceful) block (Greenwald, Nosek, & Banaji, 2003). Lower IAT scores imply comparatively quicker associations between self + aggressive; hence, they reflect more aggressive self-concepts. If one accepts zero IAT effects as indicating equally strong associations between self + aggressive and self + peaceful, then— on average—peaceful self-concepts resulted. As previous findings suggest, the IAT is among the most reliable implicit measurement procedures (LeBel & Paunonen, 2011), and in our sample, reliable interindividual differences in IAT effects were obtained: Spearman-Brown corrected odd-even reliability r_1 = .73, 90% CI [.61, .81], and r_2 = .71, 90% CI [.59, .80].

Physiological measure. Skin conductance (CASSY Lab) was assessed before and after treatment when participants filled in the BPAQ, and also during the treatment phase. Five seconds at the beginning and the end of each period were discarded. The average skin conductance level in each phase served as a proxy for arousal (in μS). Data from three participants were lost during gameplay. They were excluded from further analyses. Skin conductance levels allow a glance at excitement during treatment and arousal differences at posttest that might undermine the conclusiveness of response-latency-based measures.

Results

Pretest Aggressiveness

Running a 3 (experimental condition: control, movie, game) × 2 (gender: male, female) analysis of variance showed that participants in the experimental conditions tended to differ in explicit aggressiveness even before any treatment, *M* = 2.38, *SD* = 0.42, range = 2.29–2.53 (see Table 1 for inferential tests according to omnibus analysis of variance models). Consequently, pretest BPAQ scores qualified as a covariate for the analysis of posttest aggressiveness. With regard to a gender effect, men and women did not differ, *M*s = 2.40 versus 2.37, *SD*s = 0.34 versus 0.46. Also, the Condition × Gender interaction was far from significance.

With regard to pretest IAT scores, no stringent differences were found between the experimental groups, *M* = 0.50 [0.46 –0.52], *SD* = 0.36. However, men had significantly lower IAT scores, speaking to a less peaceful (more aggressive) self-concept, *M*s = 0.38 versus 0.57, *SD*s = 0.37 versus 0.34. Again, the Condition × Gender interaction was not significant. Individuals reporting higher explicit aggressiveness also had a more aggressive implicit self-concept, reflected in a negative relationship between the BPAQ and IAT scores, $r = -.32, p = .002$.

Posttest Aggressiveness

Implicit aggressiveness was analyzed by an ANCOVA of pretest-posttest IAT change scores (ΔD_5), which take preexisting group differences into account (Bluemke et al., 2010; Bluemke & Zumbach, 2012). Apart from the experimental condition and par-

Table 1
Explicit and Implicit Aggressiveness: AN(C)OVA Models

Variable	*F* test	*P* value (*p*)	Effect size (η_p^2)
BPAQ at pretest			
Experimental condition	*F*(2, 84) = 2.54	.09	.06
Gender	*F* < 1		
Interaction	*F*(2, 84) = 1.09	.34	.03
Agg-IAT at pretest			
Experimental condition	*F*(2, 84) = 1.17	.32	.03
Gender	*F*(1, 84) = 6.55	.01	.07
Interaction	*F*(2, 84) = 1.36	.26	.03
Agg-IAT-change at posttest			
Experimental condition	*F*(2, 83) = 3.08	.051	.07
Gender	*F* < 1		
Interaction	*F* < 1		
BPAQ-pretest (covariate)	*F*(1, 83) = 2.80	.10	.03

Note. ANOVA = analysis of variance; ANCOVA = analysis of covariance; BPAQ = Buss and Perry's Aggression Questionnaire; Agg-IAT = Aggressiveness-Implicit Association Test.

ticipant gender as between-subjects factors, we controlled for the unexpected preexperimental differences in explicit aggressiveness by including BPAQ as a covariate (see Table 1 for inferential tests). Confirming Hypothesis 1, implicit aggressiveness varied as a function of treatment condition. Active players showed the strongest increase in implicit aggressiveness—almost by a quarter standard deviation, $\Delta D_5 = .24$ (Figure 2). A planned contrast across the three conditions reflected the expected linear trend, $t(87) = 1.85$, $p = .03$ (one-tailed), $r_{\text{effect-size}} = .19$, with contrast weights λ = (+1, 0, -1) for the game, movie, and control groups, respectively. Neither gender nor its interaction with treatment impacted IAT change scores (all $\eta_p^2 < .01$). Aside from this, the BPAQ covariate tended to relate weakly to IAT change scores.

No comparable impact of treatment condition was observed when we analyzed BPAQ change scores, $F < 1$. A comparison of the test-retest reliabilities confirmed that aggressiveness shifts were specific for the implicit measure, changing the participants' rank order of IAT scores, $r_{\text{tt}} = .54$, 90% CI [.40, .65], but not of BPAQ scores, $r_{\text{tt}} = .95$, 90% CI [.93, .97], all $ps < .001$. IAT scores showed less stability than BPAQ scores, even when correcting for attenuation (unreliability) simultaneously at pretest and posttest, $r_{\text{adj}} = .75$, 90% CI [.66, .82].

Physiological Arousal

As expected, actively playing a violent game increased arousal (Bluemke et al., 2010). During treatment, skin conductance was higher for active players than for passive viewers and control participants, $t(84) = 2.06$, $p = .02$ (one-tailed), with contrast weights λ = (+1, 0, -1), $r_{\text{effect-size}} = .22$ (Figure 3).

No such differences existed at pretest and posttest, $ts < 1.45$, $ps > .15$. Though high skin conductance is compatible with the strong self-involvement of active players during treatment, it might simply reflect stronger psychomotor activity. So first of all, the physiological measure supports the idea of an effective gaming manipulation. At the same time, the scores do suggest that arousal differences—which could have interfered with the measurement of implicit aggressiveness via response latencies— had leveled off at posttest. Hence, the IAT scores were assessed free from any arousal confound.

Crucially, arousal changes from pretest to posttest were unrelated to IAT change scores, all $|r|s < .11$, $ps > .32$. Therefore, the mediation analysis stops, as one crucial link between the dependent variable and a potentially confounding mediator is absent (Baron & Kenny, 1986). Confirming Hypothesis 2, arousal cannot be held responsible for mediating the changes in implicit aggressiveness.

Discussion and Conclusions

Playing the *Matrix* scene involved participants more strongly than merely *watching* it. Both conditions led to increasingly aggressive self-concepts, yet more so for the active player group. Blatant content differences, however, cannot account for this finding. Likewise, arousal can be ruled out to have hampered the cognitive capacity or psychomotor processes required for solving the IAT response-compatibility task. Our data support the conclusion that self-activation is a moderator of the harmful effects of violence exposure: Due to stronger self-activation, game playing participants associated themselves faster with aggressive (relative to peaceful) stimuli than any other group. Unlike Fischer and colleagues (2010), we can rule out that arousal during treatment, or enduring pretest-posttest arousal differences, mediated the changes in implicit aggressiveness.

In terms of mechanisms, our findings support the idea that being actively engaged with violent behavior, rather than passively

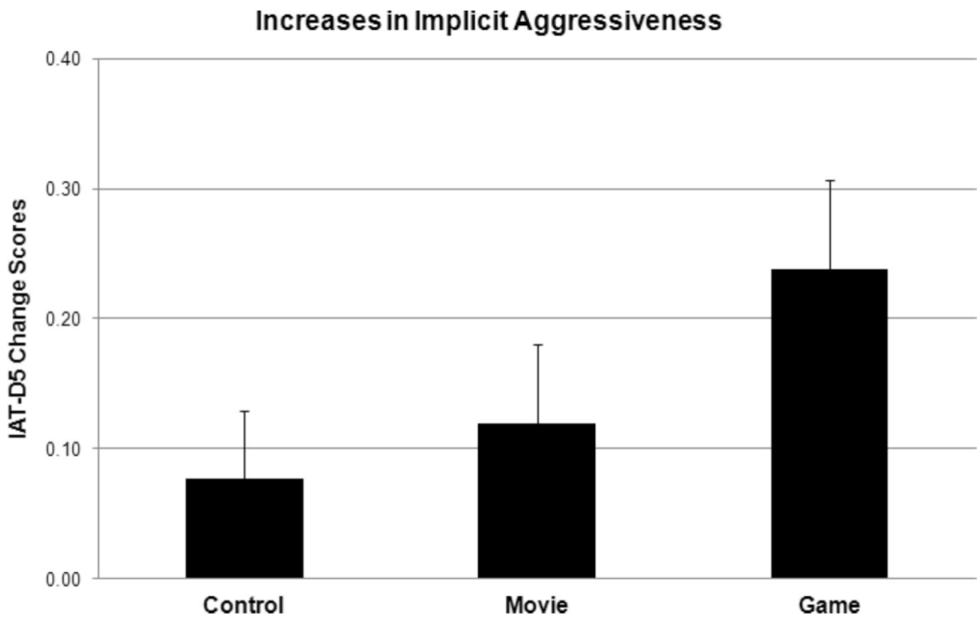

Figure 2. Pretest-posttest changes in implicit aggressiveness in a reading control group, a movie-watching group, and a game-playing group. Higher scores represent increases in implicit aggressiveness (i.e., lower Agg-IAT D_5-scores). Agg-IAT Aggressiveness-Implicit Association Test.

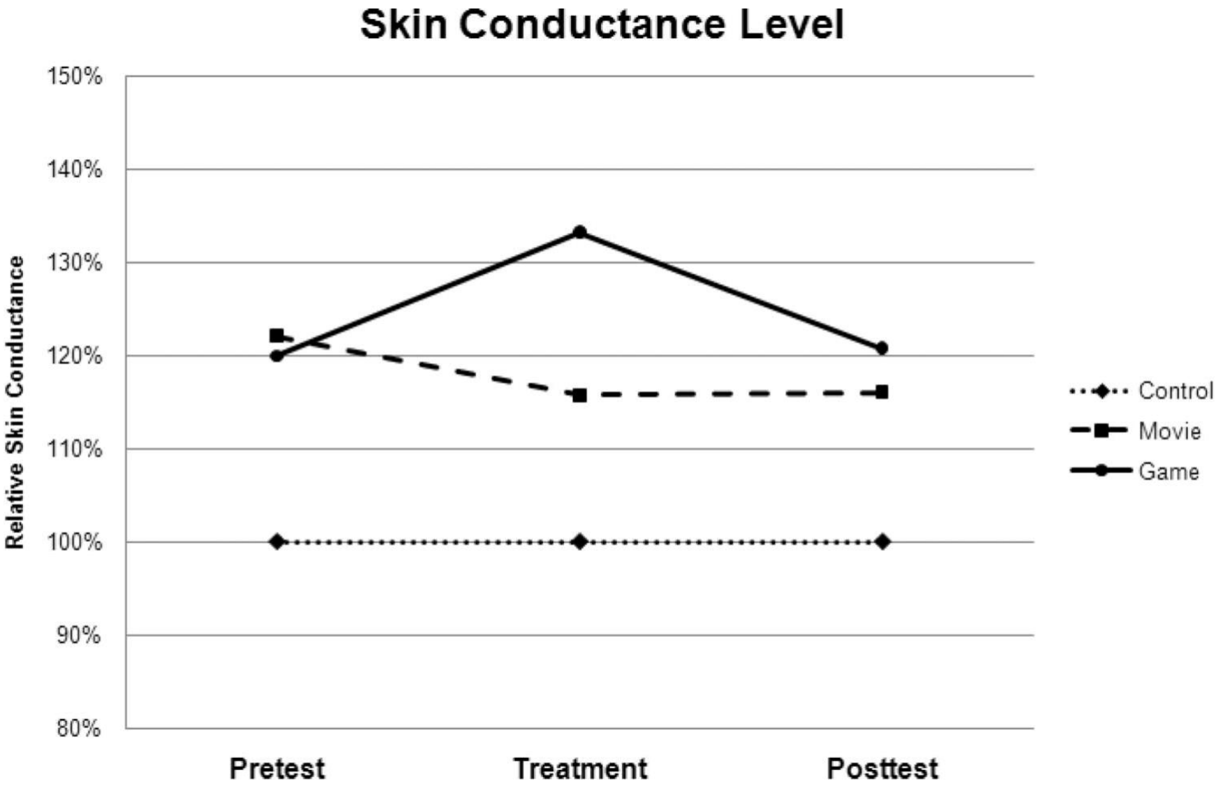

Figure 3. Changes in physiological arousal (skin conductance) in three groups across the experimental procedure, calibrated at the level of the control group (100%).

watching others' violent actions, changes the self-related associations known as dispositions of aggressive impulses. Temporarily, physiological arousal was higher in the game condition than that in the video condition. We assume that, indeed, immersion into the combat scene was actively driven by the player becoming part of the game itself (Lull & Bushman, 2016). This might be the key factor for a higher degree of self-activation in active gaming conditions, leading to a stronger memory link between the action-related scripts and self-related knowledge structures. Thus, the stronger the self was actively involved during violence exposure, the stronger were the changes of the aggressive self-concept due to violence exposure. Consequently, implicit aggressiveness as measured with the IAT was highest in the active game condition, yet also higher in the passive video condition than in the control group. We note here that any such differences were not reflected in typical measures such as the BPAQ. Explicit questionnaires are known for displaying high trait stability (Farrar & Krcmar, 2006), whereas about half of the Agg-IAT variance is known to reflect situational (state) variance amenable to treatment effects (Lemmer, Gollwitzer, & Banse, 2015). Explicit measures are likely to detect differences in long-term effects of exposure to violent media once they have sunk into the accessible part of the self-concept. The IAT, by comparison, is more sensitive already to short-time effects. The link between short- and long-term effects is an issue still open on the research agenda, especially with regard to frequent playing. The forming and strengthening of stable self-aggressive schemas in memory will likely be based on repeated encounters of single violent episodes (as suggested by Anderson & Bushman [2002]).

We followed the media comparison paradigm, which provides a heuristic for reflecting on valid methodology and suitable research paradigms in media violence and aggression. Criticism on research regarding the violent media-aggression link that focuses on a lack of comparability of different media can be debilitated by keeping media content and media interactivity under *experimental* control. The studies by Krcmar, Farrar, and McGloin (2011) as well as Krcmar and Farrar (2009) can serve as prime examples for implicitly adopting the media comparison paradigm to match experimental conditions on confounders. For instance, when investigating the effect of game realism, comparing Doom 3 to its predecessor Doom 1 justified analyzing the effects of game realism in a zone of comparability (identical elements are first-person shooter, tasks and goals, narrative, locations, gameplay mechanics, etc.). However, using a no-game condition, the same study did not establish zones of comparability for comparing *violent to nonviolent media*, creating interpretational ambiguity in this specific regard. The psychological complexity of experimental stimuli of different kinds often means that comparability can only be approximated (hence *zones* of comparability). Although strict control may come at the cost of reduced external validity, we agree with Elson et al. (2015) who postulated that confounding variables have to be controlled more often, and more strictly, especially if we are to test the causality of mechanisms hypothesized to underlie changes in aggressive dispositions.

We stress here that controlling confounders statistically *ex post facto* is insufficient (Anderson & Dill, 2000) and that experimental conditions need to be established *ex ante* to be compared legitimately. ANCOVA can help account for variance due to *pretreatment* differences between groups, but it "is inappropriate if the covariate is not independent of the treatment" (Elashoff, 1969, p. 389). Obviously, the problem gets worse the more additional concomitant variables are included in (M)ANCOVA (see, for instance, Krcmar et al., 2011). The goal of our current design was to control by *experimental design* for blatant arousal differences due to different pace while keeping the content (or semantics) constant. Control variables like the physiological data provided a manipulation check and, at the same time, ruled out an alternative explanation in terms of mere physiological arousal hampering IAT sorting performance, without arousal indicators serving as covariates in the statistical analysis. Future research will profit from stringent comparisons when examining long-term effects of media reception on implicit and explicit measures of aggressiveness and behavioral measures of aggression.

Limitations

The media comparison paradigm does not allow to rule out all potential confounders, but it encourages to establish a zone of comparability that does allow ruling out *specific* alternative explanations that may occur in typical media comparisons (for the sake of cumulative science). In the present case, we can rule out that unspecific arousal was responsible for the observed difference between watching and playing highly similar violent media content, whereas it may have been a contributing factor in previous media comparison studies. We cannot preclude that third variables existed that also contributed to, or mediated, the observed violence exposure effect. Among the most often discussed psychological factors that instigate aggression subsequent to active media consumption rather than passive media consumption are immersion, frustration, and identification with a protagonist. All these factors might either be direct causes for aggressive outcomes or function as indirect mediators of psychological differences between experimental media conditions. Our current study setup is silent on these additional research questions, which are certainly worthwhile to pursue in the future. Our design allows the conclusion, though, that being actively engaged with media portrayals of violence fosters aggressiveness in comparison with passive exposure to the same media violence. A future cross-check of this hypothesis might involve two participants: one playing the game and the other observing the same screen. As a general rule, whatever the media content compared, we recommend that researchers always check whether their message is in line with the conclusiveness of their experiment.

Taken together, the present findings are in line with recent research on media violence concluding that violent media use may indeed foster aggressive dispositions (Bushman, Gollwitzer, & Cruz, 2015; Hoffman, 2014). We do not deny that factors other than self-activation, such as reward structures due to narrative elements in the game context, may be causally involved in media effects (Sauer, Drummond, & Nova, 2015). As the mechanisms underlying changes in the aggressive self-concept (e.g., due to self-activation during violence exposure) become clearer and more refined, it will still be necessary to identify conditions that affect some consumers of violent content more than others (Ferguson, Bowman, & Kowert, 2017). It will become more and more crucial to understand which personological rather than media variables consolidate, or impede, the transition from any short-term associations to long-term effects of exposure to violent media.

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