Implicit and explicit measures for analyzing the aggression of computer gamers

Matthias Bluemke

University of Heidelberg, Germany

Joerg Zumbach

University of Salzburg, Austria

Keywords: automatic associations, indirect measures, aggression, aggressiveness, self-concept

Matthias Bluemke, Psychological Institute, University of Heidelberg; Jörg Zumbach, Department of Science Education and Teacher Training, University of Salzburg.

We thank Georg Johann for the development of the JAVA applet used for the implicit measurements, and we especially thank Janina Symanzick for her help in collecting students' data.

Correspondence concerning this article should be addressed to Matthias Bluemke, Psychological Institute, University of Heidelberg, Hauptstrasse 47-51, 69117 Heidelberg, Germany. E-mail: Matthias.Bluemke@psychologie.uni-heidelberg.de

1. Introduction

The effects of playing computer games on children has become an important issue in psychological research in the last couple of years. The question of whether playing computer games leads to increased aggression, particularly among those playing violent games excessively, has stimulated numerous studies. Currently, the meta-analytic findings seem to imply that being exposed to violent games increases aggressive behavior, aggressive cognition, aggressive affect, and physiological arousal as well as it decreases helping behavior on average (Anderson, 2004; Anderson & Bushman, 2001; Anderson & Dill, 2000). Nevertheless, from a meta-analytical point of view, each effect size is subject to errors of unknown magnitude, and these errors can only be overcome by aggregation of similar studies, yielding more reliable estimates of effect sizes.

It is not surprising that some researchers question that violent video games have detrimental effects in real life contexts – either on the basis of single-study results or on the grounds of legitimate arguments (Scott, 1995). For example, some studies that found null-results after substantial exposure to violence warn against neglecting the social context in which the playing takes place (Durkin & Barber, 2002; Williams & Skoric, 2005). In this chapter, we emphasize another important issue when encountering weak or null-effects in aggression-related studies: the methods used when assessing aggressiveness and aggressive behaviors. Many null-findings could be rooted in some vulnerability of the measures being applied; thus, the negative effects of playing violent video games might accordingly be underestimated. More precisely, it is a well-known problem that self-reports on socially sensitive topics (such as aggressive thoughts, aggressive feelings, and aggressive behavior) can be biased and, thus, lead to inconsistent results. Although some of the findings that enter aggression-related meta-analyses are obtained by unobtrusive methods such as observation and physiological data, many of the studies are based on self-report measures. This is often the case when affective and cognitive dispositions are analyzed (e.g., trait/state questionnaires). Within this contribution we argue that that these self-reported variables, i.e., *explicit* measures, might meaningfully be complemented by newly developed methods, so-called *implicit* measures, that aim at assessing automatic affect and cognition.

Implicit measures rely on *spontaneous* reactions toward stimuli that elicit *automatic* cognitive, affective, and behavioral tendencies. Typically, one concludes that there exists some kind of cognitive structure or affective correlate by means of associations which themselves are inferred via response latencies in reaction time tasks. The most prominent measures are the affective priming paradigm (Fazio, Jackson, Dunton, & Williams, 1995) and the Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998). Implicit measures like these have been used to explore implicit attitudes toward social categories such as Black and White Americans or East and West Germans (Greenwald et al., 1998; Bluemke & Friese, 2006), automatic affect toward phobia-related and fear-arousing objects (Teachman, Gregg, & Woody, 2001), automatic self-concept (Greenwald & Farnham, 2000), attitudes toward important behavioral concepts such as smoking (Sherman, Rose, Koch, Presson, & Chassin, 2003), as well as spontaneous decision-making processes when subjects are confronted with brands and products (Friese, Wänke, & Plessner, in press).

Although there are still many methodological problems to overcome (Fiedler, Messner, & Bluemke, 2006), implicit measures have already added to our knowledge of pre-activation of emotional and cognitive content in social encounters. In the following, we will (a) highlight advantages of implicit measures, (b) suggest that aggression research might profit from measuring (automatic) affective reactions and predicting (spontaneous) behaviors, (c) describe the general procedure of aggression-related Implicit Association Tests (IATs), (d) and show how these automatic cognitive-affective processes can be integrated into current models of aggressive emotions and aggressive reactions. Finally, we will report our own findings that used implicit measures to explore the consequences of playing violent computer games with regard to the automatic self-concept and attitudes toward aggressive behavior among young adults and school children.

2. Advantages of implicit measures

Social psychology has been concerned with overcoming the limitations of socially desirable responding behavior for many years. In aggression research for instance, a participant might either be unwilling to report on negative emotional consequences of aggressive game playing or she might even lack the capacity for introspection to determine such side-effects or suffer from blind spots. Blind spots are likely to occur if a person follows the purpose of keeping up a positive self-concept that is more in line with social demands. One advantage of implicit measures is their potential to by-pass the adjustment process that accompanies the deliberate answering of questionnaires. In addition, implicit measures have the advantage of relying on spontaneous affective reactions. Many studies have demonstrated that attitudes and other cognitive content can be activated and processed automatically (unintentionally), even unconsciously (Fazio, 2001; Bargh, 2006) and "it appears that nearly everything is preconsciously classified as good or bad" (Bargh, 1994, p.19). There is some support to the notion that implicit measures are capable of tapping into automatic affective reactions triggered within the range of milliseconds. Thus, via implicit measures we can disentangle rather uncontrolled factors that guide behavior from rather controlled processes leading to actions. Current dual-process models in psychology distinguish between these two facets: the reflective-impulsive model (RIM; Strack and Deutsch, 2004; cf. Epstein, 1994) suggests the existence of an impulsive system that functions on an associative basis. Activation is spreading within a semantic network in which cognitive and affective aspects are intertwined via links between conceptual nodes. Moreover, the RIM postulates that people have a reflective system that works in parallel and enables reasoning, decision making, and intentionality. Although the systems partly overlap, people's deliberate beliefs and evaluations of objects, behaviors, and actions can be much more complex and multi-faceted than stored associations such as simple object-valence links. Also, spontaneous and reflective affects toward the same object can either coincide or be obverse (Wilson, Lindsey, & Schooler, 2000). For instance, one could consciously object to discrimination against a member of an out-group, yet at the same time one could nevertheless have negative automatic associations toward the same member. This is just like people reasoning that eating sugar can damage one's health and still feel tempted to consume it and impulsively behave accordingly. Thus, one of the supposed advantages of implicit measures is to assess primary affective and cognitive reactions that occur quite automatically, are difficult to control, and are valuable for predicting impulsive, less-controlled, or automatic behaviors. For example, Asendorpf, Banse, and Mücke (2002) were able to uniquely predict spontaneous shy behavior (facial and body adaptors, tense body posture) in opposite-sex interaction by means of a shyness-self-concept IAT, whereas explicit self-ratings of trait shyness could only predict controlled behaviors (speech duration and illustrators). Also, the extent of control resources available in situations can moderate the predictability of behaviors. Hofmann, Gschwendner, Castelli, and Schmitt (2006) were able to show that an implicit measure of racial attitudes predicted behavior related to prejudice such as visual contact, speech illustrators, and body adaptors in interracial interaction, particularly when participants' control resources were experimentally reduced. Conversely, an explicit measure of racial attitudes predicted body adaptors only when control resources were fully available. In general, it seems possible to predict behavior by assessing automatic cognitive-affective components. In line with the unintentional nature of these automatic components, our actions often precede our understanding of why we behave in particular ways (Bargh & Chartrand, 1999).

3. Linking aggression to automatic affective processes

Applied to the current domain, implicit measures should be particularly useful for (a) avoiding social desirability concerns in self-reports of aggressive traits and states, (b) predicting impulsive aggressive behavior, and (c) predicting aggression that occurs in situations where cognitive control resources are low. Moreover, if implicit measures can be linked to aggressive behavior, it should be possible to (d) demonstrate the detrimental impact of playing violent video games on automatic cognitive-affective tendencies as a precursor to aggressive tendencies if this relationship really exists.

There is initial evidence that these assumptions are correct and that the use of implicit measures spreads in the domain of aggression research. For instance, Uhlmann and Swanson (2004) had an experimental group play a violent computer game. In comparison to a control group that solved a simple puzzle, participants demonstrated a significantly stronger automatic association between themselves and aggression stimuli as evident in the IAT results. In contrast, aggressiveness questionnaires did not reveal any differences between the groups. Explicit measures were thus incapable of demonstrating the effectiveness of the treatment which obviously altered the cognitive system at least in the short-term. Also, both the explicit and the implicit measures explained a unique proportion of variance in the amount of playing outside the lab, thus indicating that the IAT proved sensitive enough to assess long-term changes in the cognitive structure of participants. Furthermore, the IAT captured what participants did not deliberately tell about themselves. Another contribution here comes from Banse and colleagues (Banse, Clarbour, & Fischer, 2005; Banse & Fischer,

2002) who demonstrated that the aggressive behavior of ice-hockey players (as evidenced in peer observation and time-out penalties) could not be predicted by self-reported aggressiveness questionnaires, but by automatic tendencies as assessed by the IAT. In sum, associating oneself more strongly with aggressiveness, as compared to other participants in a reaction-time task, reliably relates to degree of impulsive aggressiveness and correctly mirrors the extent to which one has been exposed to violent computer games.

4. Procedure of Implicit Association Tests

The IAT is a double categorization task that can flexibly be applied to various topics. Quite a number of stimuli are presented in a random sequence on a computer screen and have to be sorted into one of four categories by pressing an appropriate response key on the keyboard. Some of the stimuli refer to aggressive behavior (e.g., attack, threat), some of the stimuli describe peaceful or rather calm behavior (compromise, get along), some stimuli are self-related (I, me), and some stimuli are related to others (you, yours). There are only two response keys, and the participant has to use the same keys for two categories each. Depending on the instructions of the task, the participant either responds to *self* + *peaceful* stimuli with one key (and *other* + *aggressive* with the other key) or encounters identical stimuli and has to press one key for self-relevant + aggressive items (while using the other key for other-relevant + peaceful items). If a participant was faster in the first than in the second task, one would infer that his or her self-concept is linked more strongly to peaceful than to aggressive items. The difference in reaction times between the two tasks indicates the position of the self-concept on an aggressive-peaceful dimension (IAT effect).

The main focus here is not that many other factors could potentially account for the outcome (researchers typically control many of the extraneous variables affecting the latencies; see

Greenwald & Nosek, 2001), but that this so-called IAT effect can potentially be used to differentiate participants' self-concepts in terms of aggressiveness without asking them explicitly (Bosson, Swann, & Pennebaker, 2000; Greenwald & Farnham, 2000). Therefore, one hypothesis could be that playing violent games has short-term consequences by temporarily increasing the cognitive availability of self-related aggression. Repeated playing in turn could chronically activate these self-related aggression associations and eventually alter the self-concept in the long run, thus raising the likelihood of applying aggressive behavioral scripts that are in line with one's altered self-concept.

Interindividual differences between players and non-players of violent computer games could also exist in automatic evaluations of aggressive and peaceful behavior, as the game environment requires from a player to appreciate and use aggressive means to reach the goals of the game. Thus, coupling the two categories (*aggressive* and *peaceful*) with a positive and a negative category (*pleasant* and *unpleasant*) in an IAT should indicate the degree of favorableness of aggressive behavior. Even if all participants are skilled in sorting *aggressive* + *negative* (*peaceful* + *positive*) together and find it rather hard to associate *aggressive* + *positive* (*peaceful* + *negative*), participants could differ in the extent to which they do so. Some might have a strict automatic evaluation of aggression; others might hold lenient evaluations as indicated in smaller IAT effects. A reaction time difference in evaluative IATs would thus provide some evidence for the automatic affect regarding aggressive content. The idea is that automatic evaluations of aggressive behavior might control the selection of a behavioral strategy in a fast and frugal manner. This could be important information when hypothesizing about the primary appraisal of one's own behavioral tendencies: Reinforcing aggressive behavior by playing violent video games strengthens the association of aggressive behavior with positive valence. In turn, the likelihood of displaying aggressive behavior rises. Whether changing the cognitive structures in these respects is a relevant mediator for aggressive tendencies in real life is a question that researchers have only recently begun to address.

5. Models related to aggressive affect, cognition, and behavior

Now that we have discussed advantages of implicit measures and their potential usefulness in aggression research, we will now focus on underlying automatic cognitive-affective processes and implicit measures and how they fit into current models of aggressive reactions. Advantages of assessment related to automatic processes will also be addressed. The discussion about affective aspects does not preclude the role of cognition during the emergence of appraisals, and vice versa. Rather, cognitive and affective aspects interact in a complex manner. This interaction is evident in emotional-affective states which can provide cognitive information as well as they can induce different modes of information processing (Bless & Fiedler, 1995; Clore, Schwarz, & Conway, 1994).

Lazarus' (1991) well-known cognitive-motivational-relational theory, for example, emphasizes the cognitive interpretation of internal or external stimuli (appraisal) before a flexible emotional reaction occurs, which, in turn, enables a flexible adaptation to the situation. Lazarus distinguishes primary and secondary appraisals of complex stimuli and situations. The primary appraisal enables a quick distinction between goal-relevant and irrelevant situations to determine the strength of an emotional response. It checks whether the situation is congruent with an individual's goals, resulting in positive or negative affect, and it determines the kind of identity-relevance in order to subsequently respond with one of various potential emotional reactions. The secondary appraisal addresses causal attributions, an individual's potential to cope with the situation at hand, and future expectations of the development of the situation, all of which can modify and differentiate the initial response. It is noteworthy that the primary appraisal affords a rather undifferentiated view of the situation (pleasant/unpleasant) and elicits a general behavioral tendency (approach/avoidance), before the filtering and narrowing of the emotional response takes place. Comparing the aforementioned aspects of automatic affect and cognition to Lazarus' model, it seems quite evident that the automatic cognitive-affective aspects as assessed by implicit measures lead to similar initial approach/avoidance-tendencies that correspond to the behavior elicited by emotions. Thus, automatic evaluations of a target object and the automatic activation of stereotypes (along with attributions and other inferences) could trigger negative affect, influence the emergence of hostile feelings or anger, and lead to the expression of negative affect in an aggressive way. This effect can be more drastic when cognitive control resources are low, as the adequate secondary appraisal of a situation might fail and a maladjusted emotional reaction might emerge. When cognitive resources are abundant, Hogarth (2002, p. 11) states: "Clearly, we can all become angry for a variety of reasons. But this does not mean that we 'must' act in accordance with the angry thoughts that suddenly appear in our consciousness."

Another model is the General Aggression Model (GAM; Anderson & Bushman, 2002; Anderson & Carnagey, 2004; Lindsay & Anderson, 2000), which describes the route to aggression in a single episode. The GAM assumes a complex interplay of cognition, affect, and arousal which themselves depend on personal and situational variables. Note that the appraisal and decision processes bring about either thoughtful action or impulsive action as outcomes, yet the model does not specify how to predict the outcomes (Figure 1).

*** Insert Figure 1 about here ***

We propose that it is automatic appraisals that determine the way toward impulsive action (rather: impulsive *behavior*), and that it is deliberate and resource-consuming decision making processes that result in controllable thoughtful *action*. Whereas the former route can be predicted by implicit measures, explicit measures should be particularly appropriate for predicting the reflective pathway, but not necessarily vice versa (Fazio, 1986; Wilson et al., 2000). Also, to the degree that cognitive resources are missing in a given situation, people's behaviors will be influenced by automatic cognitive-affective variables to a stronger degree than by variables assessed in a deliberative mode. We do not posit that reflective and impulsive tendencies are mutually exclusive. They rather pose the prototypical ends of a behavioral continuum that spans from automatic behaviors to deliberate actions.

With regard to long-term effects which involve learning processes, the GAM suggests that various behavioral determinants can potentially be affected by repeated violent game playing (Figure 2).

*** Insert Figure 2 about here ***

The first component is a well-established finding stating that attitudes and beliefs are comprised of automatic and reflective components. Therefore, it is likely that attitudes toward aggressive behaviors can also be represented in a reflective and an automatic-associative system as well. Measuring one's attitude toward aggression and aggressive ways of conflict resolution is likely to parallel trait aggressiveness via explicit questionnaires. Yet, at the same time a person could hold a different (e.g., positive) implicit attitude that determines behavior in less controlled moments. The interesting implication of such a dissociation of implicit and explicit attitudes is that researchers should take into account automatic cognitive-affective components as dispositions when making predictions about aggressive behavior and particularly spontaneous behavior. Moreover, we assume that almost all of the factors related to aggressive personality can be subdivided in a similar manner in order to reflect the distinction between an impulsive and a reflective system.

6. Overview of the current study

Following these assumptions, it seems worthwhile to take a closer look at some newly developed implicit measures and apply them to aggression research. In the following study we investigated the relationship between automatic cognitive-affective variables, explicit personality questionnaires, and use of aggressive computer games. First-person shooters (FPS) can be considered a sub-genre of shooter games where the player has full control over a character and interacts directly with the environment from the character's point of view, for instance, by directing weapons at enemies and fighting them. FPS require enormous amounts of violent actions and have raised teachers' and parents' concerns because FPS have been associated with school shootings like in Littleton or Erfurt. As it is difficult to unequivocally establish an influence of first-person-shooting on aggressiveness either on the basis of anecdotal evidence or on the grounds of self-reported personality, it could be that implicit measures are suited to tap into the negative side-effects of the repeated playing of violent video games and that variability in violent game consumption results in systematic differences between groups. With regard to explicit measures, we hypothesized that agreeableness and aggression-related traits should differ depending on the amount of violent game playing. Specifically, FPS players should deviate even more strongly from a computer control group than players of other computer games. The same hypothesis should hold for implicit measures, though implicit measures should show even stronger effect sizes, because of the social desirability concerns that are likely to bias the explicit outcome variables.

7. Method

7.1 Participants and Recruitment

We recruited participants via Internet forums reserved for "communities-of-practice" (FPS: first-person-shooter players) and compared them to other computer game players (PLAY: simulations, racing games, sports games etc.) and personal computer users without extensive game consumption (PC: office applications, World-Wide Web etc.). We carefully concealed aggressiveness as a topic of the study; rather, we described the study as being related to computer use and personality in a general sense. As a means of gratification, we supplied participants with feedback about personality characteristics inferred from response latencies, which should raise curiosity among computer users in general. We did not supply any monetary incentives in order to avoid multiple participation (we also eliminated multiple participation cases by means of a control question). Only during the course of the study could participants have become aware of aggressiveness-related questions, but even this should not have aroused suspicion, because the instructions also allowed for the interpretation that randomly chosen personality characteristics were under investigation.

As personality characteristics are a sensitive topic, we assured participants of anonymity and did not store Internet protocol addresses, however we supplied different hyperlinks to the study hosted at the web lab of the Psychological Institute at Heidelberg University. Thus, we were able to infer the origin of a participant and his or her belonging to one of the three quasi-experimental groups. To ensure the quality of the classification we additionally filtered for the following criteria after study completion: FPS players had to use a personal computer on a regular basis for playing games and they had to have played FPS for at least one hour in the week before. PLAY members had to usually play games different from FPS and they had to have played for at least one hour in the week before. PC users had to report PC usage on a regular basis, but not for playing games. FPS and PLAY did not differ with regard to the amount of playing (*M* = 15.6 vs. 15.0 hrs in the week before, $t < 1$). Deviating from the PLAY group, the FPS group had spent 9.2 hrs. playing FPS.

Whereas 673 participants clicked on the study hyperlinks during one month of recruitment, 238 completed the study. After filtering multiple participation cases, low self-reported quality of data, insufficient language abilities, missing informed consent, and too many errors in the Implicit Association Tests (max. 20% per block, Greenwald et al., 1998), 196 participants were left. Applying the conservative criteria to enter the experimental groups, the final sample consisted of *N* = 37, 49, and 23 participants in the FPS, PLAY, and PC groups, respectively (M_{age} = 28.00 yrs., *SD* = 10.24; 80.7% males; non-students 32.1%).

7.2 Procedure and Material

We used HTML for Web pages and additionally PHP for dynamic parts such as personal feedback. Stimulus presentation and reaction time measurement in the implicit tasks were accomplished by a JAVA applet that renders a platform-independent and operating-system-independent assessment possible. All incoming data were stored in a MySQL database hosted on the Web server and analyzed by using SPSS.

After the initial instructions, participants reported sociodemographic variables, computer usage, and the amount of playing. As a first explicit measure we provided a questionnaire assessing the Big Five personality factors. Then two implicit measures followed, a Single-Target IAT assessing the automatic aggressive self-concept and an IAT assessing the automatic evaluation of aggressive behaviors. Only after participants had completed both implicit measures we administered an explicit aggressiveness questionnaire. After the study participants received full information on the nature and the purpose of the study. The final web page provided individual feedback about the outcomes of the implicit measures.

Explicit Measures: For assessment of the Big Five traits, we used the IPIP40, a German 40-item questionnaire based on the International Personality Item Pool (Buchanan, Johnson, & Goldberg, 2005; Hartig, Jude, & Rauch, 2003). The factor "Agreeableness" was the main dependent variable from this questionnaire. The IPIP40 can be used without copyright restrictions in the Internet (Goldberg, 2001) and has already been validated for Internet applications. As a specific measure of aggressiveness, we chose to apply a wide-spread aggressiveness questionnaire (BPAQ; Buss & Perry, 1992; German version by Amelang & Bartussek, 1997). The BPAQ is a 29-item questionnaire that has been validated for German applications (Herzberg, 2003; von Collani & Werner, 2005). The internal consistencies of the subscales within our sample lay in the range typically reported for these measures (Cronbach's α = .61–.82 and .70–.89 for BPAQ and IPIP40, respectively).

Implicit measures: Implicit associations were measured with the Implicit Association Test (IAT; Greenwald et al., 1998) and its descendant, the Single-Target IAT (ST-IAT; cf. Karpinski & Steinman, 2006; Wigboldus, Holland, & van Knippenberg, 2004). The IAT assessed the automatic evaluation of aggressive vs. peaceful behaviors. The ST-IAT tapped into the automatic self-concept in a non-relative way, that is, we dropped the category "other" which is typically used as a counter-category for the target category "self" in an IAT (Karpinski, 2004), hence the name *Single-Target* IAT.

*** Insert Table 1 about here ***

As described in Table 1, the IAT started with a block of trials that asks test-takers to correctly classify attribute stimuli that appear sequentially on a screen as either negative or positive, for instance PAIN, JOY, by pressing a left or a right response key as indicated by the category on the left or right side of the top of the screen (response-key assignment was counterbalanced across participants). We used the same attribute stimuli that were successfully applied in prior studies (Bluemke & Friese, 2006). In a next step, participants exercised the discrimination of aggressive vs. peaceful stimuli, for example BEAT, RECONCILE, which were adopted from Banse et al. (2005). The third block combined all four categories in a double discrimination task, yet only two response keys could be used, one for categories on the left, another one for categories on the right side. Categories either formed a compatible combination, *aggressive + negative* and *peaceful + positive,* thus enabling quick responses, or they posed an incompatible combination, *aggressive + positive* and *peaceful + negative*, thus inducing slower responses. Afterwards the response-key assignments of the attribute categories were reversed, and participants had to train themselves to use the inverted attribute discrimination. The fifth block combined the attribute and target categories anew, yet the categories were coupled in the alternative way: If participants had encountered the compatible task in the third block first, they solved the incompatible task in the fifth block, and vice versa. The ST-IAT proceeded in a similar, yet simpler way (cf. Table 1). It provided only one block of training trials for the attribute discrimination (aggressive vs. peaceful) and two blocks in which self-related stimuli, for instance ME, MINE, had to be sorted together with aggressive or peaceful stimuli. We counterbalanced the order of the two combined blocks for each implicit measure between participants.

The degree of association between the categories is typically inferred from the difference of the mean response latencies between the two combined blocks (IAT-effect). In the IAT, faster reactions in the *aggressive + negative* and *peaceful + positive* block than in the *aggressive + positive* and *peaceful + negative* indicate a negative automatic evaluation of aggressive behaviors. In the ST-IAT, any stronger association between the self and peaceful association will be evidenced in shorter latencies in the *self + peaceful* block than in the *self + aggressive* block, thus yielding an indicator for the automatic self-concept in terms of aggressiveness. The reaction time analysis requires a specific algorithm. In line with typical recommendations in the IAT literature, only correct trials entered the analyses (wrong key strokes yielded missing data) and response latencies were trimmed to 300 ms at minimum and 3000 ms at maximum. In order to control for method variance due to interindividual differences in means and standard deviations of response latencies, reactions times were *intra*individually standardized (cf. Cai, Sriram, Greenwald, & McFarland, 2004; Greenwald, Nosek, & Banaji, 2003). Although we used these *z*-like scores for the statistical tests, we report the dependent variables in units of milliseconds throughout the text in order to be as clear as possible. Due to the relatively few trials applied per block, the internal consistencies of the implicit measures were modest (r = .53 and .58, split-half reliability according to the odd-even method, Spearman-Brown corrected for scale length).

7.3 Results

Table 2 reports means and standard deviations of all the dependent variables.

*** Insert Table 2 about here ***

IPIP40 – Agreeableness: Testing the hypothesis that self-reported repeated computer playing is associated with lower agreeableness, an ANOVA revealed significant differences among the three groups, $F(2, 106) = 5.98$, $p = .003$, $\eta^2 = .10$. Mean values show that the PLAY group deviated from the PC control group, whereas FPS and PC were comparable.

BPAQ: More differentiated results are obtained by the analysis of aggression-specific traits. Overall, the BPAQ exhibited significant differences of aggressiveness among participants, $F(2, 106) = 6.93$, $p = .001$, $\eta^2 = .12$. On a conventional level of significance, only the BPAQ subscale *anger* failed to demonstrate reliable differences among the groups, $F(2, 106) = 4.66$, $p = .16$, $\eta^2 = .03$. By contrast, all other subscales displayed significantly lower scores for the PC control group: *physical aggression*, $F(2, 106) = 5.73$, $p = .004$, $\eta^2 = .10$, *verbal aggression*, $F(2, 106) = 6.86$, $p = .001$, $\eta^2 = .12$, and *hostility*, $F(2, 106) = 6.92$, $p = .001$, η^2

= .12. Post-hoc analyses confirmed that FPS and PLAY did not differ significantly from each other, although PLAY descriptively received higher scores than FPS. Taken together, both groups of computer players differed from a PC control group.

Aggression Evaluation IAT: Before analyzing the implicit measures, we checked whether the groups differed from each other in terms of overall response speed which could indicate a potential bias due to differential experience with regard to PC use or responding quickly in PC games. This was not the case, M = 987 ms, SD = 186, $F(2, 106) = 1.00$, *ns*. As expected, the IAT effects of all three groups indicated that participants were quick to associate aggressive with negative (and peaceful with positive) but slow to associate the incompatible category arrangement (mean IAT effect = 446 ms). However, the PC control group was 522 ms faster in the compatible than in the incompatible block, whereas FPS and PLAY had smaller latency differences between the critical blocks (436 and 425 ms). Thus, the player groups associated aggressive with negative rather than with positive, too, but the negative association was not as strong as for PC control participants. This finding could be either due to *less negative* aggression-related associations or due to *more positive* aggression-related associations. Given the attenuated reliability of the implicit tasks, the omnibus-*F*-test in a 3 (target group: FPS, PLAY, PC) x 2 (order of blocks: compatible or incompatible block first) ANOVA failed to reliably discriminate between all three groups, $F(2, 103) = 2.20$, $p = .12$, $\eta^2 = .04$, yet contrasting both FPS and PLAY at once against PC confirmed the trend, $t(106) = 2.07$, $p = .04$. Order of blocks did not qualify the results in any way (Fs < 1.40).

Aggressiveness Self-Concept ST-IAT. As expected, overall, participants associated themselves more easily with peaceful than with aggressive stimuli (mean ST-IAT effect = 117 ms). Conducting an analogous ANOVA on ST-IAT effects revealed a significant influence of order of blocks, such that participants had higher scores when starting with the *peaceful + self* block (181 vs. 53 ms). This influence probably reflects a methodological artifact, because the ST-IAT is a relatively simple sorting task with only three categories. However, the relative ease of the task is magnified as soon as one starts with the easier of the two blocks, whereas the relative difficulty increases when participants work through the block that is incompatible with their self-concept as a second step, thus giving rise to augmented ST-IAT effects in the compatible-first condition. This effect does not occur in the incompatible-first condition, when participants heighten their response criterion for correctly classifying stimuli from the very beginning of both blocks.

Comparing all three groups, PC showed the highest ST-IAT effect, that is, the strongest association of self and peaceful (140 ms), whereas PLAY had significantly lower scores (71 ms), $F(2, 103) = 3.18$, $p = .046$, $\eta^2 = .06$. However, FPS did not deviate from the PC control group (139 ms). If we interpret a lower ST-IAT effect as a stronger association of self and aggressive, then players of computer games that did not play FPS regularly tended to have a less peaceful automatic self-concept than FPS players.

Correlations: Across the whole sample, ST-IAT and IAT did not correlate, $r = .09$ ($p = .19$), lending support to the notion that automatic aggressive self-concept and automatic evaluation of aggressiveness are distinct concepts and that shared method variance did not affect the outcomes. Whereas the IAT did not correlate with BPAQ, $r = -.09$ ($p = .20$), the ST-IAT did show a weak negative relationship with self-reported aggressiveness, $r = -.17$ ($p = .021$). Thus, the less peaceful the automatic self-concept (lower ST-IAT effects), the higher trait-aggressiveness.

8. Discussion

In general, the IAT and ST-IAT displayed reaction-time differences between the critical blocks that were in line with the hypothesized direction of automatic evaluation and self-concept. Moreover, they proved sensitive enough to detect differences among different groups of computer users. Nevertheless, we failed to find evidence for the hypothesis that the automatic evaluation of aggression and the automatic self-concept is most strongly affected by playing violent FPS. If we take the explicit measures as a comparison standard, then the implicit measures reflect the same trend that the PC control group was more agreeable and held less aggressive dispositions than the computer game players. Both explicit and implicit measures converge regarding the unexpected finding that players of FPS-shooters were *less* affected than players of other games.

We can only speculate about why we found results that tended to support the opposite of our expectations regarding FPS and PLAY. Maybe the recruiting process suffered from self-selection despite the fact that we tried to conceal the true purpose of the study. There has been some discussion about FPS and their side-effects in the aftermath of school shootings in Germany and other countries worldwide. Perhaps some players of FPS tried to "prove" that they are harmless people, or some participants who observed negative side-effects of playing FPS voluntarily dropped out from the study. Both behaviors could be motivated by the goal not to endanger one's (positive) self-concept or to disconfirm existing (negative) stereotypes about the in-group. Another explanation could be that PLAY indeed was a group with higher aggressiveness, but we are unable to prove so as we did not control for the amount of violence exposure in non-FPS games. We used categories that allowed separation by the type of game, but we had better assessed the amount of playing and the amount of violence entailed in games so as to get an impression of each participant's amount of violence exposure. Note that playing modern racing games can result in violence exposure, too, just like playing modern sports games can require the use of aggressive tactics and performing virtual violence in order to succeed.

We also found no support for the notion that implicit measures are more sensitive than explicit measures in detecting side-effects of computer playing. If this hypothesis was correct, there should be stronger effect sizes of ST-IAT and IAT in comparison to the effect sizes of questionnaires. Obviously, this was not the case. Whether this simply reflects the fact that reliability of implicit measures is not yet optimal or whether the hypothesis really does not hold cannot be judged by the current data. Another idea could be that assessing automatic self-concept works better if relying on a *relative* implicit measure despite our initial reasoning that the "other" category might introduce unwanted error variance (Pinter & Greenwald, 2005). Thus, Uhlmann and Swanson (2004) as well as Banse and colleagues (2005) might have confirmed their hypotheses, because they used an IAT that requested a *necessary* or at least very *helpful* social comparison by making use of the opposite category "other."

Supplementary Data: We sought additional evidence in a more controlled setting, because in Internet studies a researcher simply has to assume that (potentially more) disturbances and (potentially lower) commitment do not affect the outcomes. We furthermore wanted to preclude self-selection and instead recruit a quite homogeneous sample in terms of socio-demographic variables. Although this step decreases external validity and generalizability, it should be potentially useful in reducing error variance, thus raising the power of the statistical analyses. Therefore, we drew a sample of student classes at school (9^{th} grade; age ~ 15 yrs.), as playing PC games has become quite common among students and adolescents and because these groups might contain the most vulnerable subgroup of gamers (Gentile & Anderson, 2003). We also asked for the specific games each individual had played and the amount of playing a week before. We thus estimated an individuals' violence exposure by summing the hours of playing a game weighted by the violence rating of a game (Krahé & Möller, 2004). Finally, we replaced the evaluative IAT by a Self-Other IAT that addressed the self-concept in a relative manner and that had been successfully applied by two groups of researchers in the past. As we wanted to compare the usefulness of ST-IAT and IAT tapping into the aggressive self-concept, we also employed the non-relative ST-IAT. To prevent priming of the "other" category and stimulation of social comparison processes in the ST-IAT, we always administered the ST-IAT ahead of the IAT.

Overall, the procedure and measures of the additional study conceptually mirrored the first one. However, for practical reasons, we administered the questionnaire assessing socio-demographic variables and game consumption as well as the IPIP40 in the classroom in a first wave one week prior to the administration of implicit tasks and the BPAQ, which in turn were administered in small groups of up to four students in a separate room at school (second wave). After having obtained consent from school headmasters, teachers, and parents, 86 participants (M_{age} = 14.79 yrs., *SD* = .95) from two schools (three high school classes and three secondary school classes) completed the study in both phases. Males dominated less (62%) than in the previous study. About a quarter of the students had a non-German ethnic background. After examination of the implicit measures, 16 participants had to be excluded because of more than 20% errors per critical block.

The controlled situation provided the means for answering students' questions and ensuring that the implicit procedures were understood and carried out appropriately. Having solved the self-selection problem of the previous study, we were interested if the more homogeneous sample would reveal that implicit measures are indeed sensitive to the amount of violence exposure in computer games. Therefore, we used a dummy coding for type of school and sex of participant. Violence exposure was a continuous variable. However, violence exposure did not account for variance in any of the explicit and implicit indicators. The only significant relationship existed between type of school and ST-IAT such that participants from secondary school had lower ST-IAT effects (25 ms) than those from high school (114 ms), $\beta = -.272$, $p = .02$. Although this finding could be interpreted in line with stereotypical perceptions of aggression of students from different school types, we do not accept this interpretation because of many other differences that exist between the groups as explained below.

In light of these disappointing findings, one could doubt the use of implicit measures. But instead of abandoning the use of IATs, some problems that have to be overcome have to be addressed. There were some major obstacles in our additional study. Though the 9^{th} grade is the maximum level of Germans' minimal education, many students had difficulties in understanding the meaning of questions in the standard questionnaires IPIP40 and BPAQ. The same problem occurred with the stimuli employed in the (ST-)IATs which were held constant with Study 1. Participants' interruptions and the experimenter's explanations of the semantic meaning of certain stimuli imply that there were many problems with spontaneity during the categorization tasks, rendering the interpretation of the latencies as indexes for spontaneous or automatic associations at least equivocal. Thus, we cannot expect these measures to have acceptable psychometric qualities in terms of reliability (Cronbach's α for ST-IAT and IAT .55, IPIP40 .49 – .78; BPAQ .60 – .68; cf. Study 1) and, more importantly, validity. Similar problems will always occur whenever the participants' language abilities are insufficient to deal with the stimulus materials, thus questioning the application of unaltered implicit measures to students and children in particular. We did not expect such problems with 9^{th} graders, but experience convinced us to do so in future studies. When examining such participant groups, a solution to this problem could be the use of pictures as stimuli, the disposal of age-inappropriate semantic content, and simpler task procedures (Mienert, Scheer, & Frey, 2005).

In conclusion, we suggest that optimizing the stimulus materials and the reliability of the implicit measures seems to be the next major step in aggression research. Following the difficulties in our additional study, this optimization also addresses explicit questionnaires that should be suitable for the examination of juveniles. Unless these methodological changes are made, we cannot expect to find consistent and substantive evidence confirming or disconfirming any relationship between aggressive dispositions and violence exposure in young computer gamers. In the beginning of this chapter, we addressed the topic that explicit measures suffer from specific limitations. We have to admit here that implicit measures also have their weaknesses. Nevertheless, implicit measures provide an interesting methodology that should be used more frequently in aggression research. The mere possibility to predict spontaneous aggressive behaviors by utilizing implicit tools should inspire researchers to examine the relationships between violence exposure, automatic affective processes, and actual aggression by taking a still uncommon, yet promising methodological approach.

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Table 1a: Structure of an Implicit Association Test assessing the automatic evaluation of aggressive behaviors.

Sequence	**Block 1**	**Block 2**	**Block 3**	**Block 4**	**Block 5**
Task	**Attribute Discrimination**	**Target-Concept Discrimination**	**Initial Combined Task (here: compatible)**	**Reversed Attibute Discrimination**	**Reversed Combined Task (here: incompatible)**
Task instructions	**· NEGATIVE** **POSITIVE ·**	**· aggressive** **peaceful ·**	**· NEGATIVE** **· aggressive** **POSITIVE ·** **peaceful ·**	**NEGATIVE ·** **· POSITIVE**	**NEGATIVE ·** **· aggressive** **· POSITIVE** **peaceful ·**
Stimuli	JOY · · STINK NICE · · AVARICIOUS · POISON LAUGHTER · · ILL · PAIN HONEST · · DECEITFUL LOVE · · DISEASE HAPPY · PRESENT · · UNLOYAL · ACCIDENT HOPE · · MEAN HEALTH · GIFTED ·	compromise · · fight agree · · blow (with a fist) reconciliation · give in · · hurt · revenge · hit make peace ·	· PAIN · hit HONEST · · fight reconciliation · LOVE · · hurt · DECEITFUL give in · · DISEASE ...	ACCIDENT · · HOPE MEAN · · HEALTH · GIFTED · LAUGHTER ILL · PAIN · · HONEST DECEITFUL · ...	make peace · · LOVE · blow (with a fist) DISEASE · · fight · HAPPY compromise · · PRESENT · revenge UNLOYAL · ...
Number of trials	10 negative 10 positive	2 x 5 = 10 aggressive 2 x 5 = 10 peaceful	10 negative 10 positive 10 aggressive 10 peaceful	10 negative 10 positive	10 negative 10 positive 10 aggressive 10 peaceful

Note:
Within the task instructions, spatial position of the categories corresponds to the left or right response key.
Target and attribute stimuli alternated in combined blocks (here: depiction of an arbitrary sequence of stimuli).
Attribute stimuli and categories were printed in capital letters in order to avoid confusion with the target dimension (lower case letters).

Table 1b: Structure of the Single-Target IAT assessing the automatic aggressive self-concept.

Sequence	Block 1	Block 2	Block 3
Task	**Attribute Discrimination**	**Compatible Block**	**Incompatible Block**
Task instructions	· **aggressive** **peaceful** ·	· **aggressive** **peaceful** · **SELF** ·	· **aggressive** **peaceful** · · **SELF**
Stimuli	compromise · · fight agree · · blow (with a fist) reconciliation · give in · · hurt · revenge · hit make peace · ...	ME · · hit I · · fight reconciliation · MYSELF · · hurt MINE · give in · ME · ...	make peace · · ME · revenge MINE · · fight · MYSELF agree · · I give in · · ME ...
Number of trials	2 x 5 = 10 aggressive 2 x 5 = 10 peaceful	15 aggressive 10 peaceful 2 x 5 = 10 self-related	10 aggressive 15 peaceful 2 x 5 = 10 self-related

Note:
The uneven category number in the combined blocks can result in two confounds:
If the number of key strokes on the right and left side is kept constant, twice as many stimuli belonging to the uncoupled evaluative category have to be presented.
If on the other hand the number of stimuli per category is kept constant, twice as many key strokes for the coupled categories result.
In order to reduce these inversely related problems, we presented coupled and uncoupled stimuli in a ratio of 4:3, thus reducing the ratio of evaluative stimuli to 3:2.

Table 2: Analyses of Big Five-specific (IPIP40) and aggression-specific (BPAQ) questionnaires plus implicit measures assessing the automatic evaluation of aggressive behaviors (IAT) and the automatic aggressive self-concept (ST-IAT), N = 109, split for players of First-Person-Shooters (FPS), non-violent games (PLAY), and a control group of users of personal computers (PC).

	$\alpha_{N=196}$	$M_{Overall}$ (SD)	M_{FPS} (SD)	M_{PLAY} (SD)	M_{PC} (SD)
IPIP40					
Neuroticism	.89	2.32 (.78)	2.25 (.65)	2.37 (.83)	2.32 (.90)
Extraversion	.84	3.00 (.79)	3.15 (.70)	2.83 (.85)	3.10 (.77)
Openness	.76	3.53 (.63)	3.50 (.72)	3.48 (.57)	3.70 (.62)
Agreeableness	.70	3.54 (.58)	3.69 (.52)	3.33 (.62)	3.72 (.47)
Conscientiousness	.86	3.26 (.75)	3.10 (.77)	3.18 (.74)	3.66 (.63)
BPAQ					
Overall	.88	2.43 (.56)	2.47 (.51)	2.57 (.59)	2.08 (.40)
Physical Aggression	.82	1.87 (.71)	2.05 (.61)	1.93 (.83)	1.46 (.30)
Verbal Aggression	.61	2.99 (.59)	2.94 (.58)	3.18 (.57)	2.66 (.48)
Anger	.79	2.46 (.81)	2.47 (.77)	2.57 (.86)	2.18 (.72)
Hostility	.77	2.62 (.65)	2.58 (.56)	2.83 (.56)	2.26 (.64)
Implicit Measures					
IAT	.53	.99 (.36)	.98 (.37)	.90 (.40)	1.13 (.29)
ST-IAT	.58	.24 (.31)	.30 (.27)	.18 (.33)	.29 (.32)

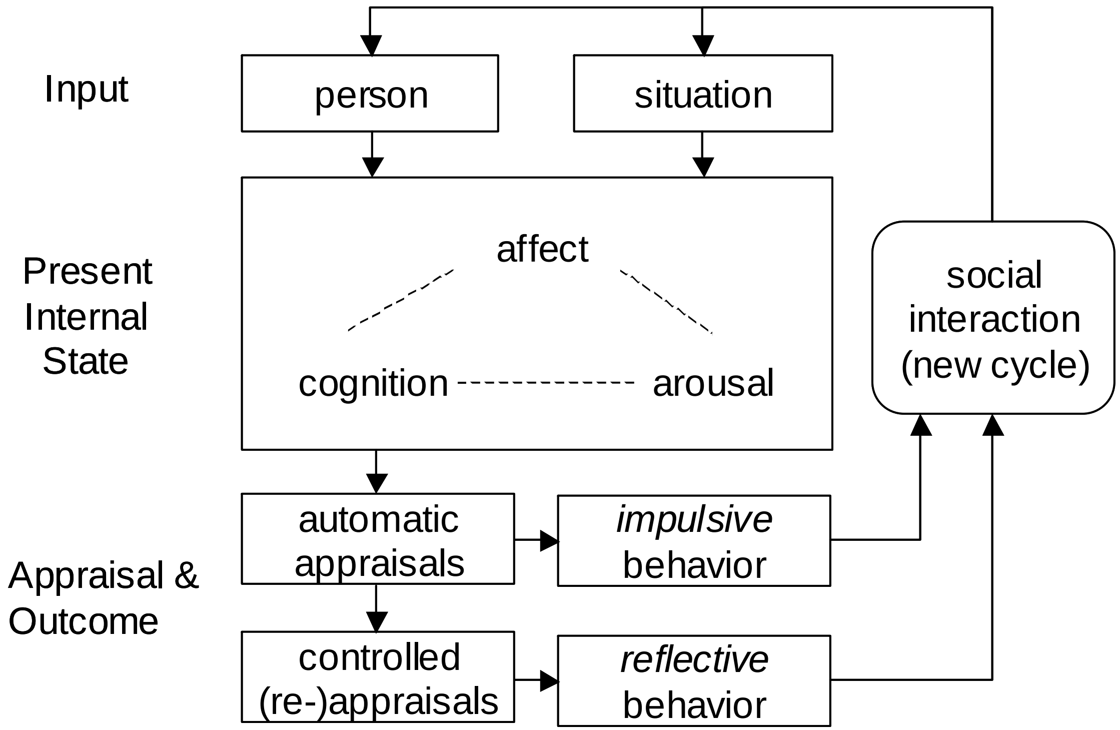

Figure 1: The General Aggression Model of single episodes (figure adopted from Anderson & Dill, 2000).

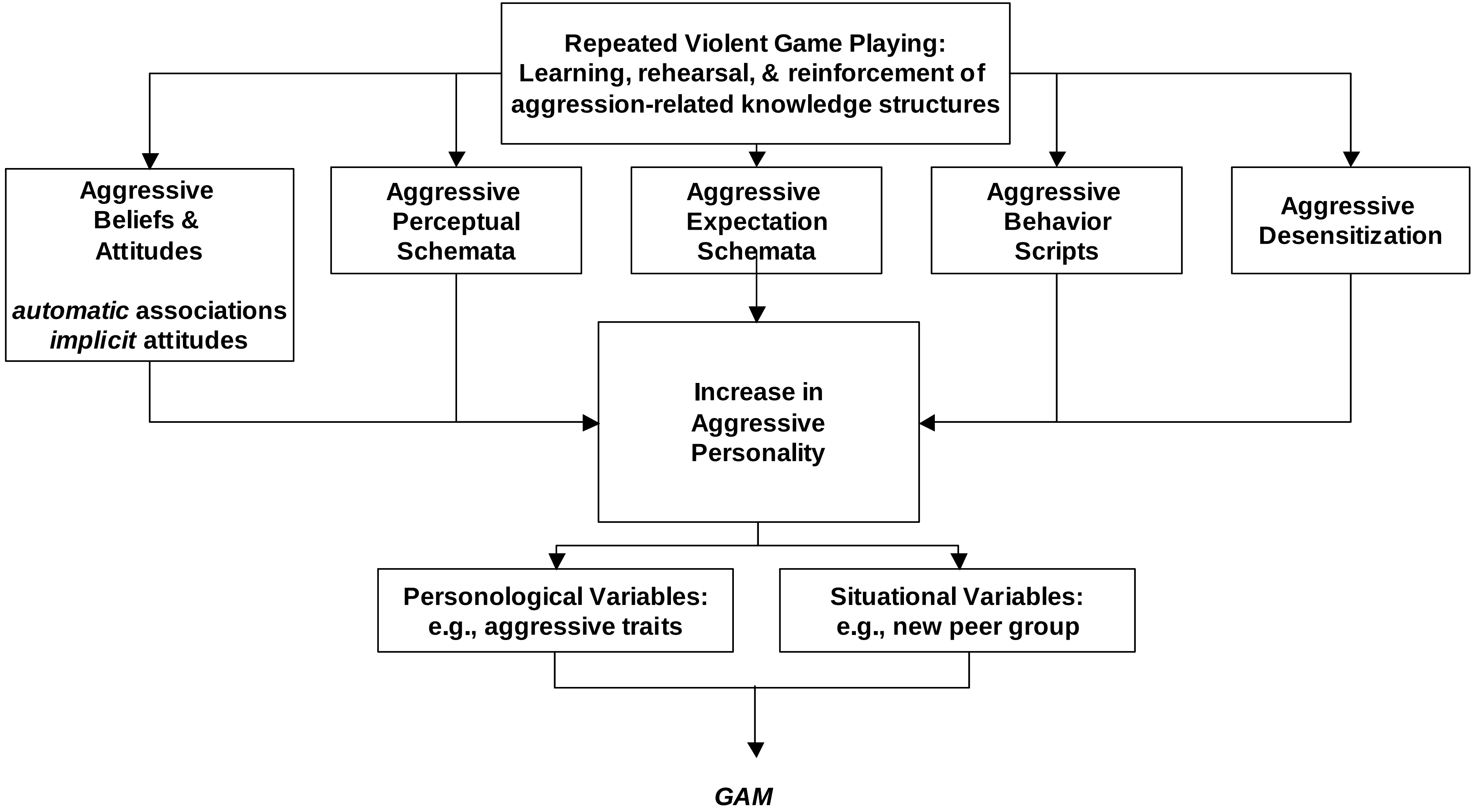

Figure 2: Long-term effects of repeated playing of violent video games as postulated by the GAM (figure adopted from Anderson & Dill, 2000).