Sensory realism and mediated aggression in video games

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A B S T R A C T

This study investigated whether sensory realism cues in violent games – blood color (red vs. blue), screams of pain (on vs. off), and player perspective (first-person vs. third-person) – affect players’ physiological arousal (i.e., skin conductance levels), spatial presence (i.e., sense of being physically “there”), and state aggression in a popular violent game (Half-Life 2), controlling for users’ prior game experiences. A path model (N = 160) was examined to see the mediation effects of arousal and presence between realism cues and state aggression. In line with the general aggression model, results showed that realistic blood color and screams increased arousal, but no effect was found for first-person perspective. Presence significantly affected users’ state aggression. However, contrary to our expectation based on the excitation transfer theory, arousal did not show any significant effect on aggression. In addition, presence mediated the influence of realistic blood color on state aggression. In the effects of graphic realism of violence on user aggression, presence did a crucial role. Implications and future studies were discussed.

1. Introduction

Media displays and interaction techniques are often designed to maximize perceptual realism and user engagement with media content (Biocca, 1997). A prominent example is the portrayal of media violence. About 60% of TV programs contain violence portrayals (Seawell, 1998), and violent games account for about 80% of video game market revenues (Anderson & Bushman, 2001). With the evolution of media from books to virtual environments, such portrayals have become both graphically realistic and interactive (Smith, Moyer-Guse, & Donnerstein, 2004). The arrival of interactive and immersive 3D games increasingly supports active behavioral engagement of the user in more perceptually realistic portrayals of violence (Bensley & van Eenwyk, 2001).

In media-violence studies, a long standing concern has been how the realistic portrayal of virtual violence affects users’ perceptions and behaviors in the real world (Anderson & Dill, 2000; Huesmann, 1988; Jo & Berkowitz, 1994; Smith et al., 2004). Recent changes in the realism of media violence raise important questions about its effects. Do changes in formal realism of media violence alter: (1) user’s arousal and emotional experience; (2) make them feel more present in the violent environment, and in turn; (3) increase aggressive feelings and hostility? In the context of other content and media genres, technological advances of realistic graphics and sound have been reported to induce increases in arousal and sense of presence in the virtual world (Lombard & Ditton, 1997).

According to the General Aggression Model (GAM), violent media increase user aggression by increasing arousal, or by enhancing aggressive cognition, or by heightening affective feelings (Anderson et al., 2004). With respect to arousal, Excitation Transfer Theory (ETT, Zillmann, 1996) explains that increased arousal in violent games could increase user aggression through arousal (excitation) transfer. When media users are exposed to violent content, thus, they feel higher arousal from the violent experiences, and feelings of aggression could be enhanced with the increased arousal. With the increase of arousal-evoking environments with realistic graphics and increasingly natural interactivity, the effects of violent games on arousal could be greater than in the past (Ivory & Kalyanaraman, 2007).

Considering that games take place in a variant of virtual reality (VR) space, we wish to investigate the effects of realistic cues on spatial presence (or presence) – the sense of “being physically there” in a virtual environment (Biocca, 1997). Many aspects of media form related to “sensory realism” including number of sensory modalities such as sound and visual cues, color, and user perspective have been reported to affect presence (see Lombard & Ditton, 1997). However, in violent-game studies, demonstrations of the effects of sensory realism on arousal and presence have been relatively rare considering the technological advances in violent games. Moreover, even though presence was also reported to enhance user aggression (Nowak, Krcmar, & Farrar, 2008) in virtual...
environments, there is little research on how the sense of presence affects aggression in violent games.

A motivation to manipulate blood color for a realism cue is that the description of realistic blood is one of the most important criteria to rate games as adult games in many countries (e.g., “Game Ratings and Descriptor Guide” in the Electronic Software Rating Board in USA, Computer Entertainment Rating Organization in Japan, Game Rating Board in Korea). They differentiate adult games from youth games based on the description of graphically violent cues including realistic blood description. Recently in Korea, a popular online game (Starcraft2) was rated as “adult games (18+)” mainly due to the description of realistic blood color (red) in the game (Priest, 2010). Such is the rationale to make the violence “less realistic” by changing the realistic red blood into the less realistic blood (e.g., blue or black blood color, or elimination of blood) of the creatures in the games. However, there are few scientific tests about the effect of realistic blood color on user aggression. In addition, we suspect that sound effect (screams of pain) and user perspective (first-person) would directly and interactively with the realistic blood color influence both user arousal and aggression. We finally investigate mediation roles of physiological arousal and presence between realism cues and user aggression in order to see a mechanism of the effects of realism cues on aggression.

In the current study, therefore (1) based on GAM, we examined whether the increased realism of violence – specifically blood color, screams of pain, and user perspective – affects users’ physiological arousal and aggression, and (2) based on ETT, we investigated whether increased arousal affects users’ feelings of aggression. In addition, based on presence studies, we tested (3) the effects of sensory realism on presence and (4) whether presence increases user aggression. Finally, we analyzed (5) the mediation effects of arousal and presence between sensory realism cues and users’ feelings of aggression.

2. Literature review

2.1. Mediated aggression through arousal: GAM and ETT

Many studies of media violence show that violent games affect users’ feelings of aggression such as thoughts and attitudes. Violent video game exposure was reported to be positively related to users’ aggressive thoughts and attitudes (Anderson & Bushman, 2001; Sherry, 2001). For example, game users who have experienced violent games showed higher hostility than non-violent gamers among college students (Ballard & Weist, 1996) and adolescents (Gentile, Lynch, Linder, & Walsh, 2004).

Regarding violent media effects, the General Aggression Model (GAM) provides a useful framework for understanding how exposure to violent media influences user aggression (Anderson & Bushman, 2001). The GAM postulates both short-term and long-term effects: Short-term effects are about how a single exposure (single-episode) to violent media affects user aggression while long-term effects deal with the effects of multiple (or repetitive) exposures on building the user’s aggressive personality.

The GAM explains that violent media increase user aggression through their impact on the person’s present internal states such as arousal, cognitive, or affective variables. In other words, violent media may influence users’ aggressive behaviors by increasing their arousal, by priming aggressive cognitions (including previously learned aggressive scripts or schemata), or by creating an aggressive affective state (Anderson & Bushman, 2001, 2002). This process of increasing user aggression could occur by influencing one, two, or all three aspects of the present internal state (Anderson et al., 2004). Thus, when it comes to specifying the effects of arousal on aggression, the GAM shows that violent games could affect users’ aggressive cognitions or affect through increased arousal.

There are two influential factors on aggression in this process – situational and personal inputs. Situational inputs (or cues) are features of the present situation that increase user aggressive states such as presence of a weapon, an insult, or an uncomfortable environment. Personal inputs include whatever the person brings to the current situation such as aggressive personality, attitudes, and beliefs (Anderson et al., 2004). Situational inputs, thus, include all kinds of stimulating violence cues in media content that can affect user aggression by influencing user arousal or cognition; personal inputs can include aggressive personality, tendencies, or prior experience.

Focusing on the effects of arousal on aggression, Excitation Transfer Theory (ETT) explains the effects of exposure to excitement-evoking media on viewer aggression through arousal transfer (Zillmann, Katcher, & Milavsky, 1972). The excitations (or arousal) refer to the excitation of sympathetic nervous system, such that arousal includes physiological components such as heart rate, skin conductance, blood pressure, and perspiration (Baron & Richardson, 1994). According to the ETT, physiological arousal evoked by early events transfers to later events and it may add to the arousal from the later events: Since arousal may not dissipate for a long time, the early excitations intensify subsequent arousal from the later events because of the residual arousal retained from the earlier arousing experience (Zillmann, 1990, 2006). The degree of intensification depends on the size of the residual arousal caused by the earlier events, and the later events do not have to be related to the early events (Zillmann, 2006).

In violent media, arousal influences user aggression due to the residual arousal from early violent events. In addition, if later events caused aggressive feelings, the residual arousal from violent events could much strengthen user aggression due to the intensified arousal from later aggressive events. Considering that violent media are generally arousing as to evoke aggressive feelings (e.g., anger, hostility), such arousal could persist over a longer time than the game experience, which potentially induces user aggression because heightened arousal from the experience of violent media could strengthen the degree of arousal with aggressive feelings such as anger or hostility at later events. If arousal evoked by early events is labeled as anger, the residual of the arousal influences later arousal by labeling the later one as anger (Anderson & Bushman, 2002).

2.2. Effects of sensory realism on arousal and presence in virtual violence

The construct of realism has a long history in the area of violence research (Barlett, Rodeheffer, Baldassaro, Hinkin, & Harris, 2008; Diener & Woody, 1981; Potter et al., 1995). Sensory realism refers to formal features of a representation that progressively simulates the same experience in the natural environment, for example a highly realistic representation of a gun (visual realism) or an addition of realistic sound (auditory realism). In interactive media, increased sensory realism results from a wide range of innovations in technological interfaces and interface techniques. In this study we chose to manipulate formal features that increase sensory realism of a violent act: (1) visual cues associated with blood, (2) auditory cues related to sounds of violence and pain, and (3) the user’s viewpoint relative to violent acts.

2.2.1. Visual cues of violence realism: blood color

In virtual space, violent acts are reported to affect the arousal and aggressive thoughts of young adults (Calvert & Tan, 1994). Specifically, graphical realism of violence in virtual space causes a strong effect on users’ arousal (Jeong & Biocca, 2012) and...
perceived violence (Potter, Pashupati, Pekurny, Hoffman, & Davis, 2002). Among graphical depictions, realistic blood increases users' perception of gore and aggressive thoughts while playing violent games (Farrar, Krkmar, & Nowak, 2006).

In a study examining blood effects in a first-person shooter game (Mortal Kombat), users playing with depictions of blood showed higher arousal than those without blood (Ballard & Weist, 1996). Furthermore, Barlett and his colleagues (2008) reported that the amount of blood in violent video games increased arousal. In their experiment, those in the maximum blood and medium blood conditions showed a significant increase in both physiological arousal and hostility, while those in the low blood and no blood conditions did not show any significant increase. Therefore, violent games, especially graphically violent games with realistic blood depiction, might cause higher arousal and thus enhance the probability of aggressive thoughts and behaviors.

Considered broadly, colors have been shown to affect arousal or emotional states (Bornstein, 1978; Mikellides, 1990). Among the colors, red is associated with excitation and stimulation, while blue is seen as secure and soothing (Jacobs & Hustmyer, 1974; Wilson, 1966). Red stimuli have been shown to be more strongly linked to arousal than blue stimuli (Guilford & Smith, 1959; Jacobs & Suess, 1975; Wilson, 1966).

With respect to game studies, there is relatively little research into the effect of color. Wolfson and Case (2000) found that game scores were higher when backgrounds were red rather than blue. Stark and his colleagues (1982) examined the effects of red and blue colors on the gaming behaviors of gamblers, and reported that people exposed to red lighting took more risks and staked more money. Even though these studies focused on the effects of screen color or background lighting, they are consistent with the notion that red evokes more arousal than blue. Therefore, we tested the following hypothesis:

**H1.** (a): More realistic sensory representations of violence, specifically red blood, will lead to increased arousal compared to blue blood.

2.2.2. Auditory cues of violence: pain cues

Like the visual realism cues, auditory realism (i.e., screams of pain) could affect user aggression in the violent media as a primary factor of sensory realism. For game players, sound effects, such as intermittent sirens or bells, have been shown to increase game players' arousal (Hess & Diller, 1969). Other than the sound of weaponry, realism of violence may be represented by realistic audio pain cues such as screaming and moaning. When people experience emotionally arousing sounds, their physiological responses vary significantly with reports of arousal (Bradley & Lang, 2000). Some researchers argue that audio noise or pain cues increase users' arousal (Cassidy & MacDonald, 2007). In this study we examined the effects of audio pain cues – specifically screams of pain – on player arousal. The following hypothesis was tested:

**H1.** (b): More realistic sensory representations of violence, specifically screams of pain, will lead to increased arousal compared to the absence of screams.

2.3. Effects of sensory realism on presence

The sense of presence (or simply “presence”) has been defined as the sense of “being there” in a virtual environment (Biocca, 1997), or “a psychological state in which virtual objects are experienced as actual objects” (Lee, 2004). The construct addresses the degree to which a user's sense of body location and experiential consciousness is focused on experience and action in the virtual space of the media representation rather than the physical world that the user inhabits (Biocca, 1997; Biocca, Harms, & Burgoon, 2003; Lee, 2004; Steuer, 1995). Focusing on the virtual space, the sense of presence is called “spatial (or physical) presence” (Biocca, 1997; Lee, 2004). In the approaches driven by technological perspective to the sense of presence, thus, spatial presence (i.e., a sense of spatial placement in a virtual environment) was a primary factor in the measurement of presence (Wirth et al., 2007).

Previous research on presence has focused on two sets of causal variables: media form and individual difference variables (Lombard & Ditton, 1997). Many aspects of media form that increase “sensory realism” have been shown to affect the user's sense of presence, including number of sensory modalities such as sound and visual cues (Kim & Biocca, 1997; Steuer, 1995), color (Lombard & Ditton, 1997), and user perspective (Schneider, Lang, Shin, & Bradley, 2004; Tamborini et al., 2004). With respect to individual difference variables, individuals vary in their ability or proclivity to feel as if they are “present” in virtual environments. Reports of individual differences in ability to experience presence include prior experience of media (Lombard & Ditton, 1997) and personality type (Heeter, 1992).

From the literature on causal variables of presence, sensory realism cues such as color and sound are argued to be media variables that affect presence (Lombard & Ditton, 1997). Thus, we can assume that red blood within a game might increase the feeling of being present in the game world. Adding pain cues such as screaming adds further sensory information to the virtual environment (Kim & Biocca, 1997; Lombard & Ditton, 1997; Steuer, 1995) as opposed to environments that lack this cue, and should augment the sense of presence. Thus, the following hypotheses are proposed:

**H2.** (a/b): More realistic sensory representations of violence, specifically (a) red blood and (b) screams of pain, will lead to increased spatial presence compared to blue blood and no screams.

2.4. Effects of user perspective on mediated experience of violence

Another dimension of sensory realism of the violent act deals with the actor's or perpetrator's body, which is the point of view on the violence. In actual violence, the violent act is experienced from the first-person perspective – that is from the point of view of the actor. In games it is not uncommon to represent the user with a full body avatar that is experienced from the point of view of another, positioned as an observer in space typically behind or near the avatar. Although the first-person perspective may have limitations in its level of representational realism, given that the user's body movement is not well captured and represented, looking at another body engaged in violence – the essence of a third-person perspective – is less realistic representation.

Previous literature about violent games says that first-person video game playing might strongly heighten aggression through identification with the virtual characters (Anderson & Bushman, 2001; Tamborini et al., 2004). Likewise, viewer perspective has been shown to influence the sense of presence in games (e.g., Eastin, 2006; Schneider et al., 2004). Specifically, first-person perspective games have been thought to enhance the sense of presence through the identification process (Schneider et al., 2004). As a test, we propose following hypotheses:

**H3.** (a/b): More realistic sensory representations of violence, specifically first-person perspective will lead to increased (a) arousal and (b) spatial presence compared to third-person perspective.
2.5. Effects of arousal and presence on aggressive feelings

According to the ETT, arousal evoked by earlier events in violent media lingers and strengthens aggressive feelings such as anger or hostility from later events (see Zillmann, 1996). Thus, increased arousal in violent games could heighten user aggressive feelings through the mechanism of excitation transfer. Likewise, GAM explains that violent media affect user aggression by increasing arousal (Anderson & Bushman, 2001, 2002).

In gaming studies, however, there are just a few studies focusing on the relation between arousal and aggressive feelings. Ballard and Weist (1996) found a positive correlation between arousal and hostility in their violent-game experiment. Likewise, Arriaga and his colleagues (2006) reported the association between arousal and hostility. Thus, this study will test whether increased arousal in violent games leads to an increase in aggressive feelings. Based on ETT, we hypothesize that arousal heightened by sensory realism cues will increase users’ state aggression (i.e., hostility, anger, physical aggression, and verbal aggression, see (Farrar & Krcmar, 2006)).

Furthermore, we will examine whether there is a significant effect of presence on the feelings of aggression such as hostility and anger. There are some recent studies about the relation between presence and aggression. Persky and Blascovich (2008) showed that presence enhanced users’ aggressive feelings in violent games. Nowak and her colleagues (2008) also reported that violent-game players who felt more presence showed more hostility than those who felt lower levels of presence. Thus, we explored the following hypotheses.

H4. Individuals with higher levels of arousal will show higher levels of aggressive feelings such as (H4a) hostility, (H4b) anger (H4c) physical aggression, and (H4d) verbal aggression than those with lower levels after the game.

H5. Individuals with higher levels of presence will show higher levels of aggressive feelings such as (H5a) hostility, (H5b) anger (H5c) physical aggression, and (H5d) verbal aggression than those with lower levels after the game.

Finally, we will examine the potential mediating effects of presence and arousal between realism cues and state aggression in a path model. Presence has been reported to be affected by both technological and individual cues. In addition, it is reported that presence influences user responses to media cues as well. Presence plays a pivotal role in mediating between media cues and users’ cognitive and affective states (Lee, Jeong, Park, & Ryu, 2011). Previous studies in human–computer and virtual environment literatures showed this mediating effect of presence (Lee & Nass, 2004; Lee et al., 2011). Regarding aggression, some recent studies report that presence mediates between violent game playing in virtual reality and aggression (Nowak et al., 2008; Persky & Blascovich, 2008). However, little is known about the mediator effect of spatial presence on state aggression in violent games. In addition, even though GAM and ETT imply the mediation role of arousal between violence cues and user aggression, there are few studies about the mediation effect of arousal. Based on previous studies of realism cues, arousal, and aggression, we will examine the mediating role of arousal in path models. Fig. 1 depicts a hypothesized path model that reflects our theoretically-motivated hypotheses.

RQ: Will arousal and spatial presence mediate realism cues on aggression?

3. Method

3.1. Design

We conducted a $2 \times 2 \times 2$ between-subjects experiment that manipulated the following three factors: (1) visual realism of the blood with two levels, blood color was red or blue, (2) auditory realism (pain sounds) with two levels, sound present or absent, (3) user’s perspective, first or third-person. We controlled prior game experience as a covariate in the analysis.

3.2. Participants

A total of 160 participants (128 male, 32 female) were recruited from a major mid-western university in the United States and randomly assigned to one of the eight experimental conditions. In terms of sex, considering different gaming patterns between males and females, we used a stratified randomization. Each group was composed of 4 females and 16 male students. Participants’ mean age was 20.6 years ($SD = 1.47$). Volunteers received course credit for their involvement in the experiment. All participants were above the age of 17, making them eligible to play games rated “M” for Mature.

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Fig. 1. Hypothesized path model. Note: GAM (General Aggression Model) is applied at the left circle part about the effects of realistic cues and prior experience on user arousal; ETT (Excitation Transfer Theory) is employed at the right circle area about the effect of arousal on aggression, which is part of GAM; and presence theory is used in the middle-bottom circle region including both the effects of sensory realism cues on presence and presence effects on aggression.
3.3. Stimulus materials

The experiment used the game Half-Life 2, which is rated “M” (Mature) by the Entertainment Software Rating Board (ESRB) because of violence, blood and gore. Since player-perspective, blood color, and sound effects are not directly changeable in the stock version of the game, these were altered using a game modification tool called Garry’s Mod (www.garrysmod.com).

During the session, the player’s task was to walk through several locations in the game terrain—a maze of rooms and corridors while fighting opponents along the way. The maze used locations from the game, but many paths were blocked off using in-game objects to create barriers that kept all players on the same path. There were 20 opponents encountered during the experiment at 10 different sites (e.g., rooms or hallways) in the game.

The color of blood directly-emitted from the bodies of wounded enemies was either red or blue, depending on experimental condition. However, red blood was splattered on the background of each location in the game (e.g., on the walls) since this was not a modifiable feature although it was constant in the game. The sounds of pain were heard whenever an enemy was killed, but only for participants in this experimental condition. All other sound effects (e.g., footsteps, shooting, water droplets, etc.) could be heard by all participants. During play, participants wore head-phones to maximize the clarity of auditory cues and block external noise.

3.4. Measures

3.4.1. Presence

Presence was measured using the scale of “spatial (or physical) presence,” a psychological state in which virtual physical objects are experienced as actual physical objects (Lee, 2004), in the revised ITC–SOPI (Independent Television Commission–Sense of Presence Inventory) presence scale (Lessiter, Freeman, Keogh, & Davidoff, 2001). The spatial presence (or presence) questionnaire in this study contains 20 items about the feelings of “physically being there in the virtual environment” (e.g., “I felt as though I was in the same space as the characters and/or objects,” “I had a sense of being in the scenes displayed,” $x = .92$).

3.4.2. Physiological arousal

In order to measure participants’ physiological arousal while playing the game, Galvanic Skin Response (GSR) was measured through skin conductance levels (SCLs) using a Biopac MP150 system (Biopac Inc., Goleta, CA). The following hardware settings were used: 20 µS/V filtering and a 1 Hz high-pass filter, with a sampling rate of 200 cycles per second. Before participants started playing the game, baseline SCL was measured for 5 min. SCL was measured during the entire game-play session, but not during the assessment phases that followed. Across conditions, we compared average deviation from baseline for the SCL measure.

3.4.3. Aggressive feelings

Aggressive feelings (or aggression) were measured using a modified version of Buss–Perry’s aggression questionnaire (see Buss & Perry, 1992; Farrar & Krcmar, 2006). This questionnaire was developed to measure “state aggression” for a short-term study such as an experiment with an immediate posttest, which is as reliable as the original version and has adequate construct validity. For example, “I tell my friends openly when I disagree with them” changed into “I would tell this person openly that I disagree with him or her.” (Farrar & Krcmar, 2006). The scale measured four different feelings of aggression: hostility, anger, physical aggression, and verbal aggression.

In order to verify the factor structure and determined reliabilities of the measure, we ran a factor analysis on this scale. From the original Buss–Perry scale, two items (item 8 and 27) were dropped out because of poor reliability, and two items were loaded on different dimensions from the original scale (item 10 on physical aggression from anger; item 19 on anger from verbal aggression). Following the results, each dimension showed good reliability (hostility, 8 items, $x = .80$; anger, 6 items, $x = .76$; physical aggression, 9 items, $x = .81$; verbal aggression, 4 items, $x = .71$). The overall analysis showed adequate model fit ($\chi^2 = 59.38$, $p < .05$; RMSEA = .069; CFI = .920).

3.4.4. Previous game experience

As a control variable, previous game experience was assessed with questions about participants’ habits playing shooter games (within the past 6 months), such as “How many hours a day do you play shooter games?” Participants rated their previous experience on an 8-point scale: 1 (none), 2 (less than 30 min), 3 (more than 30 min–1 h), 4 (more than 1–2 h), 5 (more than 2–3 h), 6 (more than 3–4 h), 7 (more than 4–5 h), 8 (more than 5 h) ($M = 3.19$, $SD = 1.15$).

3.5. Procedure

Participants were asked to complete the game experience and demographic questionnaire prior to arriving for the experiment after filling a consent form. Just prior to starting an experimental session, each participant practiced moving their character and using weapons. For this practice, a printed page of instructions was provided, and a trained experimenter read these instructions aloud and aided in their practice. The practice phase did not exceed 10 min, and there was no opponent at this level. The player’s perspective (first- or third-person) for this practice session corresponded to their ensuing experimental condition.

Participants were fitted with physiological recording equipment after completing the practice session. Before the experimental game-play session began, participants completed a brief baseline recording session during which they sat quietly and relaxed. Skin-conductance level was recorded throughout the game-play session that followed. Participants played the game until they reached the end of the maze and could go no further. After the experiment, the questionnaires were administered to assess participants’ presence experienced during the game and feelings of aggression.

4. Results

Before testing the hypothetical model, we examined the effects of sensory realism cues (e.g., red blood, screams of pain, and first-person perspective) on physiological arousal, spatial presence, and feelings of aggression. The average game-playing time for each participant was about 12 min ($M = 12.21$, $SD = .25$), with the entire experimental session (including all surveys and the recognition test) lasting less than an hour. Table 1 shows the mean values and standard deviations of the key variables.

4.1. Effects of sensory realism on arousal, presence, and state aggression

To test the effects of sensory realism cues on physiological arousal using skin conductance levels (SCLs; deviation from baseline values), we used one-way analysis of covariance (ANCOVA) with prior game experience as a covariate. Red blood ($M = .45$, $SD = .14$) led to significantly higher SCLs than did blue blood ($M = .33$, $SD = .15$), $F (1,151) = 25.51$, $p < .01$, $\eta^2 = .16$. Screams of pain ($M = .42$, $SD = .16$) had a significant effect compared to the absence of screams ($M = .35$, $SD = .15$), $F (1,151) = 8.15$, $p < .01$, $\eta^2 = .05$.
There was an interaction effect between perspective (first-person) and blood (red) on rated arousal, $F(1,151) = 4.22, p < .05$. $\eta^2 = .05$. The physiological arousal was measured by SCLs (skin conductance levels).

$\eta^2 = .05$. There was an interaction effect between perspective (first-person) and blood (red) on rated arousal, $F(1,151) = 4.22, p < .05$. $\eta^2 = .05$. In the first-person perspective condition, there was a bigger gap between red blood ($M = .45, SD = .15$) and blue blood ($M = .28, SD = .11$) than in the third-person perspective (red, $M = .44, SD = .14$; blue, $M = .37, SD = .17$). However, we could not find any significant effect of perspective on physiological arousal, $F(1,151) = 2.84, p = .12$, and other interaction effects.

With respect to spatial presence, participants in the red blood conditions tended to show higher ratings of presence ($M = 3.13, SD = .48$) than those in the blue blood conditions ($M = 2.93, SD = .44$). The difference between red- and blue-blood ratings was significant for presence, $F(1,151) = 6.54, p < .05$, $\eta^2 = .04$. Game experience showed a significant effect, $F(1,151) = 4.21, p < .05$, $\eta^2 = .03$. However, there was no significant effect of pain sounds or player perspective on presence. Likewise, we could not find any interaction effect on spatial presence.

To assess the effects of sensory realism cues on feelings of aggression, we conducted separate ANCOVAs with each of the four state aggression scale factors as dependent variables (and again, with prior experience as a covariate). Scores on the hostility and physical aggression (see Fig. 2). These results indicate that participants who feel higher spatial presence in the game show a higher degree of hostility, anger, and physical aggression than those who feel lower spatial presence. Thus, H5 was supported.

4.2. Testing hypothesized model

Our hypothesized path model specifies the effects of blood color, screams of pain, first-person perspective, and game experience on physiological arousal and presence. In addition, the model examined the relationships among arousal, presence, and feelings of aggression. The path model shows a good fit: RMSEA = .067; CFI = .920; IFI = .948 (see Fig. 2). Table 1 shows centralities and correlations between the variables in this study.

4.2.1. Effects of sensory realism on arousal and presence

In line with the results of ANCOVA tests, the effects of blood color (red) and sound (screams of pain) showed significant effects on physiological arousal (see Fig. 2), and there was no significant effect of the player’s perspective on arousal. Likewise, the effect of red blood had a significant effect on spatial presence. There was a significant effect of prior game experience on perceived arousal ($\beta = .14, p < .05$): participants who had more experience in shooter games showed higher presence than those with less experience. Thus, H1a, H2a, H1b were supported; but H2b, H3a and H3b were not.

4.2.2. Effects of arousal and presence on state aggression

With each of the four feelings of state aggression, the effects of arousal and presence on aggression were tested. In the model, there were significant effects of spatial presence on hostility, anger, and physical aggression (see Fig. 2). These results indicate that participants who feel higher spatial presence in the game show a higher degree of hostility, anger, and physical aggression than those who feel lower spatial presence. Thus, H5 was supported.

Table 1
Correlations between variables.

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<th>4</th>
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<td>.28***</td>
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<td>.38***</td>
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<td>.22**</td>
<td>.39**</td>
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<td>Verbal aggression</td>
<td>2.49 (.70)</td>
<td>-.04</td>
<td>.07</td>
<td>.07</td>
<td>.02</td>
<td>.03</td>
</tr>
</tbody>
</table>

Note: Physiological arousal was measured by SCLs (skin conductance levels).

$p < .05$.

$** p < .01$.

$*** p < .001$.

Fig. 2. Path model analysis. Note: Model fit: $\chi^2 = 44.55, df = 23, p < .05$; RMSEA = .067; CFI = .920; IFI = .948.
except for verbal aggression. However, there was no significant effect of arousal on aggression. With presence, physiological arousal had no effect on hostility, anger, physical aggression, and verbal aggression. Thus, H4 was not supported.

4.2.3. Mediation effects of arousal and presence

As we found at the path model results, there could be mediation roles of spatial presence between realistic blood and state aggression (hostility, anger, and physical aggression). We did not consider the mediation role of arousal since there was no significant effect of arousal on state aggression. Following the results of ANCOVA tests, there were two direct effects between sensory realism cues and state aggression: red blood on hostility and red blood on anger. Thus, spatial presence could mediate the effects of red blood on hostility and anger.

Based on the SEM approach to testing mediation effects (see Holmbeck, 1997), we checked significance of $\chi^2$ change between the hypothesized model and the other model that includes two direct paths (i.e., from realistic blood to hostility and to anger). The result showed that the model containing the two paths did not lead to a significant model fit change, $\chi^2 (df = 2, N = 160) = 2.86, p = .45$, which meant that spatial presence mediates between realistic blood and hostility; and between realistic blood and anger.

5. Discussion

A key motivation for this study was sensory realism and its effect on the psychological experience of game violence: Do these differences in sensory realism change significantly how violence is experienced? The study investigated whether realistic violence cues, specifically the use of realistic blood color, screams of pain, and first-person perspective affect players’ level of physiological arousal and spatial presence in the violent game. And finally this study explored whether arousal and presence mediated the effects of realism cues on later aggressive feelings.

Looking at specific sensory cues of violence, we found that realistic blood color (red) increased users’ physiological arousal in violent games. Specifically, the realism of the realistic blood cues appears to make the players feel as if they are in the game. These findings support the proposition that graphic realism in violence increases user arousal and presence. This extends the findings in violent game studies that the mere presence of blood increases users’ arousal compared to the absence of blood (Ballard & Weist, 1996; Barlett et al., 2008; Jeong, Bohil, & Biocca, 2011).

The realism of the violence is also cued by auditory modality. Specifically, screams of pain were as influential as blood color on the player level of arousal within the game environment. This finding is also consistent with previous studies about the general relationships between unpleasant sounds and arousal (see Bradley & Lang, 2000; Cassidy & MacDonald, 2007; Frankenheuser & Lundberg, 1977; Loeb, Holding, & Baker, 1982), which is also broadly in line with the GAM that predicts the effects of situational cues on arousal.

The user’s perspective on the violence, be it in first-person or third-person perspective, did not differ in effect on the users’ level of arousal or presence. This suggests that viewing of the user’s avatar body did not significantly alter their experience during game play. These findings, however, differ from previous studies reporting that playing games in first-person perspective might enhance presence or aggressive affect (Anderson & Bushman, 2001; Schneidner et al., 2004; Tamborini et al., 2004). It is believed that because the real world is experienced from a “first-person perspective” that players of games in first-person perspective may more easily identify themselves with the characters in a virtual 3D world of games.

It may be that the effect of identification can be applied to third-person perspective since the opposite result also has been reported. Farrar et al. (2006), for example, found that presence increased in the third-person perspective. In virtual environments where visual cues dominate and where the avatar is not controlled by body movement (i.e., VR body tracking), an avatar that represents the user may be a required factor for the user’s sense of presence (Benford, Bowers, Fahlen, Greenhalgh, & Snowdon, 1995), such that mere presence of the virtual body (avatar) can increase the user’s sense of presence (Slater & Usoh, 1994). Thus, regardless of the identical perspective in first-person perspective between character and user, third-person perspective could enhance the sense of presence with much higher identification because playing in the third-person environment provides actual presence of virtual body with users (Farrar et al., 2006).

Regarding the effect of spatial presence on state aggression, the results show that feeling as if one is present in the game increases aggressive feelings such as hostility and anger after the game is over. This result also matches with those of recent studies about the association between presence and aggression which reported that the sense of presence augments aggressive feelings (Persky & Blascovich, 2008) or hostility (Nowak et al., 2008).

Contrary to our expectation, however, arousal did not increase state aggression, when controlling for presence, even though there were significant correlations between arousal and state aggression (hostility, $r = .19, p < .01$; anger, $r = .16, p < .05$). Likewise, arousal did not mediate the influence of sensory realism on state aggression. In violent-game studies, these results are in line with those of Arriaga et al.’s study (Arriaga et al., 2006). They reported that arousal (heart rate) did not significantly increase aggression (state hostility) when controlling for game content (violent games), despite a significant correlation between arousal and aggression. In addition, there was no mediation effect of arousal between violent game playing and state hostility.

It seems that physiological arousal does not play a crucial role in predicting users’ state aggression in virtual violence. The significant relationship between arousal and aggression could be spurious considering both the strong association between presence and aggression and that between arousal and presence. From the viewpoint of GAM, the effect of violent media on aggression occurs by increasing arousal, or by increasing aggressive cognition, or by increasing aggressive affect. Thus, the result of the current study indicates that aggression could be affected not by arousal but primarily by cognitive or affective variables, or through interaction effects between the variables. Future studies could investigate how such variables influence user aggression controlling for presence.

Another explanation for this result could be that it is due to the interactive environment. Zillmann’s experiments (e.g., Bryant & Zillmann, 1979; Zillmann, 1990, 1996; Zillmann et al., 1972) reported that increased arousal did induce increased aggression. However, considering that the ETT well explains displaced aggression—vented feelings of aggression from an earlier event towards an unrelated situation or person—that occurs typically by a source against which retaliation is impossible (Anderson, 2007), two important points draw our attention in the experiments. One is that excitation transfer occurred if there had been a provocation at an earlier event. Second is that subjects who were aroused by a provocation were not able to retaliate at the earlier event in the experiments. It seems that the provocation was just provided at a non-interactive environment point where subjects could not actively respond (shoot or kill) to the stimulating agents (e.g., opponents, monsters, etc.). Actually, most ETT experiments were conducted in less-interactive environments (e.g., watching TV, movie, or animation) rather than in highly interactive ones (e.g., playing games). Players in violent games can or should retaliate...
on the instigating agents by shooting or hitting them. Such interactive environments could result in different user responses (e.g., less hostile to others) after playing the games. For further explanation, future studies need to investigate the arousal effect on aggression in different levels of interactivity.

Finally, the effect of realistic blood on user aggression supports a public policy about graphic realism in game rating systems. A general motivation for some attempts to control the depictions of violence is the belief that there is a relationship between the way violence is portrayed and the effects on the user's experience of violence. Such is the rationale behind the seemingly arbitrary requirement in some countries to make the violence "less realistic" by substituting the red blood of the real world with the less realistic blood (e.g., blue or black blood color, or elimination of blood) of the creatures that inhabit the virtual world of gaming. Consistent with the intuition that sensory realism affects the experience of violence, this study shows that realistic blood color affects the feelings of aggression (i.e., hostility and anger) through the sense of presence (i.e., spatial presence).

These results partially support the public policy assumption that more realistic blood depiction is associated with higher levels of aggressive feelings. Specifically, the results show that among the sensory realism elements, realistic graphical violence could be the most influential factor affecting feelings of aggression through presence. Therefore, we might say that the decision by game rating boards in many countries (e.g., "Game Ratings and Descriptor Guide" in the Electronic Software Rating Board in USA, Computer Entertainment Rating Organization in Japan, Game Rating Board in Korea) that differentiate games targeted to adults and youths based on the description of graphically violent cues out of a concern regarding the arousal and aggressive feelings of young users may find support in the results of this study.

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References


