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THE EFFECTS OF CONTROLLER TYPE IN A VIOLENT VIDEO GAME:
PRESENCE, AROUSAL, AND STATE HOSTILITY

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THE EFFECTS OF CONTROLLER TYPE IN A VIOLENT VIDEO GAME: PRESENCE, AROUSAL, AND STATE HOSTILITY

By

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ABSTRACT

THE EFFECTS OF CONTROLLER TYPE IN A VIOLENT COMPUTER GAME: PRESENCE, AROUSAL, AND STATE HOSTILITY

By

Gyoung M. Kim

The past decade has witnessed a significant technological advancement of computer game input devices. However, empirical research on the psychological impacts of these input devices on the players is limited. The present investigation employed a within-subjects experiment to examine the advanced input devices of video games in a violent video game by exposing participants (N=24) to a traditional control scheme (keyboard and mouse) and an advanced game controller (touch screen panel) and measuring this factor's impacts on players' sense of presence, physiological arousal, psychological arousal, and state hostility. The results indicated that the advanced game controller increased participants' sense of presence and physiological arousal. However, participants' psychological arousal and state hostility were not increased by the advanced game controller. Implications, limitations, and directions for future research are discussed.

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Introduction

Video games have become one of the fastest growing forms of media. A study by Strategy Analytics (2010) shows that the global game market has grown by over 50% in the period from 2005 to 2009 and it is estimated that the global game market will reach $47.5 billion in 2010. In addition, according to Nielson Media Research (2009), 83% of teens in the United States own at least one game console. Skalski, Lange, Tamborini, and Shelton (2007) suggested that technological advancement could be one reason for the growing video game market. Technical innovation in the video game industry leads to huge improvements not only in graphics, but also in game controllers (Skalski, 2004; Williams, 2002).

Video gaming controllers, input devices for the computing system, have been improved over time with advancing technology. Traditional input devices such as a mouse, keyboard, or joystick had been used as the main gaming controllers for PC games and console games. Recently, more advanced controllers such as a force-feedback controller, gesture recognition camera inputs, and ultrasensitive motion controllers have been developed with new technologies and those provide better gaming conditions to game players.

Playing a video game is making contact with a virtual world. What we see in the virtual world does not actually exist. He and Agah (2001) mentioned "the impossibility of

really touching the entities in the virtual real world, makes the interaction unreal and more difficult." From their statement, we can expect that game players may recognize that the virtual world is not real because they cannot actually touch it. However, what if game players are able to have a simulated feeling of actual touching components in the virtual world through a touch screen?

Many researchers have investigated the relationship between violent video games and players' emotional states. However, existing experimental research has not detailed the role of the touch screen, one of the fastest growing technologies, as the controller for video games and its effects on players. This study attempts to make a contribution to the research on and the effect of technological variables in a violent video game.

Literature Review

Technological advancement in video games

The goal of multimedia applications is providing users a higher resolution of media (Buttolo, Oboe, Hannaford, & McNeely, 1996). In the game industry, video games are getting more realistic and advanced (Ivory & Kalyanaraman, 2007; Barlett, Rodeheffer, Baldassaro, Hinkin, & Harris; 2008) and a number of innovative and user-centered devices have been released to provide more immersive experiences to game players.

Many game development companies release content in HD (High Definition) video resolution. According to Sony's official technical data, the PlayStation 3 is able to play Blu-ray media which displays up to 1080p resolution, the highest definition

commercially available today. Moreover, most game consoles also provide HD sound today (e.g., Dolby Digital 5.1 channel surround and 7.1 channel surround sound).

In the controller field, various input devices can be used to achieve the goal of providing better experiences to players. With advanced technology, input devices have become more interactive and varied. Biocca and Delaney (1995) proposed that a variety of input devices such as voice/audio input, haptic input, body movement and orientation input, facial expressions and eye movements, and psycho-physiological input and brain waves could be used as input channels and could enhance mediated interpersonal communication.

Advanced input devices could play a significant role in making video games more realistic. Many researchers claim that advanced input or output devices of a game console or computer could impact users' psychological state or game skills. He and Agah (2001) found that people perform better when they play the game with advanced input devices (e.g., a force-feedback joystick). They also suggested that higher communication speed between the host and the peripheral leads to higher performance of players in the virtual reality (He & Agah, 2001). Those findings show that the advancement of the input device can have an impact either on media users' physical and psychological states.

Natural mapping

The concept of natural mapping, defined by Steuer (1992) as "the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner" (p. 47), has been proposed as one variable of making game players have the feeling of realism in the virtual world (Tamborini & Skalski, 2006).

Norman (1986, 1988) suggested that natural mapping has the advantage of immediate understanding. For instance, stove controllers set up in a 2 x 2 rectangular form is more convenient to use than stove controllers laid out in a straight line and similarly, the seat controller shaped of the seat itself provides more straightforward controls (Norman, 1998).

Recently, Skalski et al (2007) found that game players who played a racing game with a natural mapped controller such as a steering wheel experienced a higher level of perceived controller naturalness than those who played the game with a keyboard or joystick. Likewise, Bowman and Boyan (2008) also suggest that game players who play a golf game with a motion controller (e.g., swinging the controller like swinging the golf club) could have a greater level of presence than those playing with a traditional controller. They suggest, "Naturally mapped game environments allow the player to access known behaviors and skills and translate that knowledge directly to the game environment" (Bowman & Boyan, 2008, p. 6).

From these examples of and studies of natural mapping, we can infer that it would take less time for game players to understand and operate naturally mapped game controller devices, as those are designed based on human instinct and mental models for behavior. Natural controls in the video game should also cause players to feel more like they are playing in the real world because their body movements playing the game are similar to movements in the real world. Therefore, players may have a higher sense of presence and arousal when they are playing a game naturally with a natural mapped controller. The concepts of presence and arousal are discussed in later sections.

Touch screen

The touch screen is increasingly used as an input device in many industries (e.g., cellular phones, laptops, commercial kiosks, medical devices, etc.). DisplaySearch (2010) estimates that 511 million touch screens will be used for mobile phones in 2010, reaching 50% of all cell phones by 2016. In addition, they also reported that the touch screen market size would be increased from $4.3 billion in 2009 to around $14 billion by 2016.

Touch screens could be used as natural mapped video game controllers. The touch screen can provide more accurate and direct controls, faster navigation speed, and less arm fatigue than using a mouse or joystick to players (Sears, Plaisant, & Shneiderman, 1992). Albinsson and Zhai (2003) stated, "interaction on touch sensitive screens is literally the most 'direct' form of HCI (Human-Computer Interaction)" (p. 105).

The ability to directly touch and manipulate data on the screen without using any intermediary devices has a very strong appeal to users (Benko, Wilson, & Baudisch, 2006). Moreover, people are likely to feel immersed when they natural interaction and control (Witmer & Singer, 1998; Witmer, Jerome, & Singer, 2005).

Forlines, Wigdor, Shen, and Balakrishnan (2007) stated, "Interacting with an application through directly touching graphical elements is a more 'natural' or 'compelling' approach than working indirectly with a mouse or other pointing device."

According to the literature we reviewed, we can expect that a touch screen may reduce the number of gaming controllers in the general gaming setting (i.e., using both a keyboard and mouse at the same time) and provide a more natural way to control objects in the game. The touch screen has a strong potential to create a natural media setting and it also could be a natural mapped controller for video games, particularly for games in

which touch is the natural way of interaction (e.g., punching). More natural settings provided by the touch screen will increase players' states such as presence or arousal like a natural mapped controller allow players to have a higher sense of presence and arousal.

Presence

Presence has been defined as the "perceptual illusion of nonmediation" (Lombard & Ditton, 1997), "a psychological state in which virtual objects are experienced as actual objects in either sensory or nonsensory ways" (Lee, 2004, p. 37) and a "user's feeling that mediated representations are real" (Ivory & Kalyanaraman, 2007, p. 534). These definitions of presence all focus on how much people regard a virtual environment as a real or natural surrounding.

According to the various scholars' definitions of presence, realism and presence are highly correlated. In the virtual reality, the concept of presence can be used to create the realistic environment that is computer generated (Sallnas, Rassmus-grohn, & Sjöström, 2000). Likewise, Calvert and Tan (1994) found that a greater realism in a video game would influence players' emotional state.

The components which can affect the quality of media may influence players' level of psychological or physiological states. One component that can contribute to presence is interactivity (Lombard & Ditton, 1997; Steuer, 1992). Heeter (1992) suggests responsiveness is one dimension of interactivity and that a highly responsive virtual environment could induce a higher sense of presence than less responsive environments. Downs and Oliver (2009) found that a motion-recognizing controller which provides high responsibility and interactivity induces a greater level of presence. Players who played a

golf game with a motion controller on the Wii had a higher level of presence than those who played a golf game without the motion controller (Downs & Oliver, 2009).

Generally, a mouse curser or some other shape must be shown on the screen to represent the direction of the mouse when we use the mouse. On the contrary, the point where the players' fingers make contact with the screen is exactly the same place where players want to control because the touch screen is a both input and output device of the computing system. The touch screen provides direct and natural controls to players, and helps to create realistic gaming settings. When game players touch the screen in order to control objects in the virtual reality, they may feel more natural than playing with the mouse or keyboard, because players actually "touch" the objects on the screen.

For this reason, a touch screen could be related to vividness and realism and could increase the quality of these elements which are variables in inducing the higher state of presence. Therefore we hereby set up the following hypothesis:

H1: Players will experience higher levels of presence when they use a touch screen game controller than when they use a mouse game controller to play the punch game.

Arousal

Arousal is defined as a physiological or psychological state of being excited or activated. Arousal can be measured in two different ways: physiological arousal and psychological arousal. Physiological arousal has been measured by physiological variables such as skin conductance, muscle movement, or heart rate (Stein & Levine, 1987). Ravaja (2004) proposed that heart rate (HR) and skin conductance response (SCR)

are reliable and valid factors for measuring arousal. Psychological arousal can be measured by questionnaires or surveys.

Scholars suggest that technological advancement in video game realism (including graphics, sounds, and controllers) could increase not only players' presence but also their arousal (Lombard et al., 2000; Ivory & Kalyanaraman, 2007). Arousal and presence are closely related (Lombard & Ditton, 1997). In addition, Ivory and Kalyanaraman (2007) also found that newer video games that have more natural game settings with advanced technology evoke higher levels of presence and arousal to game players and violent video games produce higher states of arousal than nonviolent video games.

In addition, as we discussed above, the touch screen provides the natural gaming settings for control. The touch screen device is controlled by actually touching the screen. Therefore, game players may have a more realistic feeling of "touching" objects with their fingers as opposed to holding a mouse or typing on a keyboard. According to findings by researchers, there are strong relationships among realism and arousal (Lombard et al., 2000; Ivory & Kalyanaraman, 2007). Therefore, we can assume that a touch screen, which provides natural controls, may enhance players' psychological or physiological state in violent video games.

Therefore, we hereby set up the following hypotheses:

H2: Players will experience higher levels of physiological arousal when they use a touch screen game controller than when they use a mouse game controller to play the punch game.

H3: Players will experience higher levels of psychological arousal when they use a touch screen game controller than when they use a mouse game controller to play the punch game.

State Hostility

A number of scholars have been investigating the effects of violent video games on human aggression.

Some researchers claim players are able to be aggressive while playing violent video games (e.g., Anderson, 2004; Anderson & Bushman, 2001). Similarly, playing a highly aggressive game would make players more hostile than playing a less aggressive game (Ballard & Lineberger, 1999; Ballard & Weist, 1996).

Williams (2009) also found high state hostility can be generated by violent content in violent video games. He had participants play a violent game and nonviolent game (as a control). Participants who played the violent game demonstrated higher level of state hostility than those who played the nonviolent game. In addition, Barlett et al (2008) found that players who played a higher graphic quality video game had more state hostility than those who played a lower graphic quality video game. Moreover, Barlett et al (2008) found from their experiment that participants who played the violent video game with maximum blood had a higher sense of state hostility than those who played the game with medium blood, low blood, or no blood. They also suggested that the quality of video game graphics is related to the realism (Barlett et al, 2008).

From previous research on arousal, people tend to have a higher state hostility after playing a violent video game with realistic game settings. Therefore, we can predict

that people who play a violent video game in which touch panel provides a more naturally mapped interface will elicit more realistic feeling during game play, and thus lead to higher state hostility than when they play using a less naturally mapped interface. We hypothesize that,

> H4: Players will experience higher levels of state hostility when they use a touch screen game controller than when they use a mouse game controller to play the punch game.

Method

Participants

In total, 24 male college students were recruited from two undergraduate classes at a mid-western university to participate in the experiment for extra credit. Calvert and Tan (2002) found that males behave more aggressively than females and are more interested in violent video games than females (Bartholow & Anderson, 2002). Thus, we included only males in the present study. Potential participants were asked to fill out a short screening questionnaire asking their gender and favorite video game genres and only male participants who play violent video game were recruited for this experiment. All participants signed an informed consent form before participation.

Stimuli

The punch game developed by Vizard (WorldViz LLC, Santa Barbara, CA) was selected for this study. A full high definition resolution (1920x1080) touch screen panel was used for this experiment. In this game, players punched the enemy coming to them

either using a mouse or touching enemies on the screen using their fingers. When the game player hit the enemies, they flew away with screams.

Upon arrival at the laboratory, each qualified participant first took the pre-experiment questionnaire that measured state hostility and psychological arousal. Then three physiological measuring devices were attached to his hands and arm to measure the participant's physiological arousal. Each was given five minutes of relaxation time in order to measure his base line physiological arousal state. After measuring the baseline, participants were randomly assigned to play the video game either with a mouse first or touch screen first.

Participants were given one minute to practice the game play. After the practice, participants played the punch game for six minutes and took the post-experiment questionnaire that measured state hostility, psychological arousal, and presence. Participants were asked to punch at least 100 enemies in a session. They had five minutes of rest time after they finished first session. After that, they played the same game for six minutes with a different type of controller and then took the same post-experiment questionnaire again.

Measurements

Presence. The factor of "Sense of Physical Space," "Engagement," and "Ecological Validity" were selected from ITC-SOPI questionnaires (Lessiter, Freeman, Keogh, & Davidoff, 2000) to measure presence in the present study. Cronbach's alpha of the measures of "Sense of Physical Space," "Engagement," "Ecological Validity" in

playing with a mouse were 0.917, 0.806, and 0.953 and playing with a touch screen were 0.969, 0.789 and 0.951 respectively.

Participants rated their levels of agreement using a nine-point scale, anchored by 1 (strongly disagree) to 9 (strongly agree). Example items include: "I had a sense of being in the scenes displayed," "I felt that the characters and/or objects could almost touch me," and "I felt I was visiting the places in the displayed environment."

Physiological Arousal. Galvanic skin response (GSR) was measured through skin conductance levels (SCLs) by using the Biopac MP150 system (Biopac INC., Goleta, CA). The hardware settings for SCLs were 20μΩ/volt filtering and a 1.0 Hz high-pass filter, and 200 samples per second. SCL baseline was measured for five minutes before beginning the game, and was measured continuously during play. The mean value was calculated from SCL data of each participant's six-minute game play.

Psychological Arousal. Psychological arousal was measured using the Perceived Arousal Scale (Anderson et al., 1995) which contains 24 items. Cronbach's alpha of the measure of psychological arousal in pretest, playing with a mouse, and playing with a touch screen were 0.761, 0.816, and 0.842 respectively. Participants rated their levels of agreement using a nine-point scale, anchored by 1 (strongly disagree) to 9 (strongly agree). Example items included: "Active," "Energetic," "Exhausted," and "Inactive."

State Hostility. State hostility was measured using the State Hostility Scale (Anderson et al., 1995) which contains 32 items. Cronbach's alpha of the measure of state hostility in pretest, playing with a mouse, and playing with a touch screen were 0.812, 0.796, and 0.852 respectively. Participants rated their levels of agreement using a

nine-point scale, anchored by 1 (strongly disagree) to 9 (strongly agree). Example items included: "I feel furious," "I feel frustrated," "I feel good-natured."

Result

Repeated ANOVAs were used to test the hypotheses in the present study.

Hypothesis 1 was supported, stating that video game players playing with a touch screen will have higher level of presence than player who played with a mouse. Repeated ANOVA analysis showed the significant main effect of game controllers on players' sense of presence, $F(1, 23) = 16.34, p < .01, \eta^2 = 0.42$. Participants reported significantly higher levels of presence ($M = 4.2, SD = 1.81$) when they played with a touch screen than when they played with a mouse ($M = 2.97, SD = 1.75$).

Repeated ANOVA analysis showed the significant main effect of game controllers in the "Sense of Physical Space" part, $F(1,23) = 8.536, p < 0.01, \eta^2 = 0.271$. Participants reported significantly higher levels of "Physical Space" ($M = 4.06, SD = 2.38$) when they played with a touch screen than when they played with a mouse ($M = 3.06, SD = 2.10$).

In the "Engagement" part, repeated ANOVA analysis showed the significant main effect of game controllers, $F(1,23) = 15.092, p < 0.01, \eta^2 = 0.396$. Participants reported significantly higher levels of "Engagement" ($M = 4.94, SD = 1.68$) when they played with a touch screen than when they played with a mouse ($M = 3.58, SD = 1.67$).

Lastly, the touch screen was significant for "Ecological Validity," $F(1,23) = 15.844, p < 0.01, \eta^2 = 0.408$. Participants reported significantly higher levels of

"Ecological Validity" ($M = 3.90$, $SD = 1.89$) when they played with a touch screen than when they played with a mouse ($M = 2.61$, $SD = 1.79$).

Hypothesis 2 was supported. Repeated ANOVA analysis showed the significant main effect of game controllers on players' physiological arousal, $F(1, 23) = 8.578$, $p < .05$, $\eta^2 = 0.27$. Participants demonstrated a greater increase of physiological arousal ($M = 7.8$, $SD = 7.3$) when they played with a touch screen than when they played with a mouse ($M = 6.3$, $SD = 6.17$).

Hypothesis 3 was not supported. Repeated ANOVA analysis showed that there was no significant effect of game controllers on psychological arousal, $F(1, 23) = 2.913$, $p = .10$, $\eta^2 = 0.11$. There was no significant difference of psychological arousal when they played with the touch screen ($M = 3.66$, $SD = 0.87$) and when they played with a mouse ($M = 4.1$, $SD = 0.95$).

Hypothesis 4 was not supported. Repeated ANOVA analysis showed that there was no significant effect of game controllers on state hostility, $F(1, 23) = 0.069$, $p > .8$, $\eta^2 = 0.003$. There was no significant difference of state hostility between playing with a touch screen ($M = 3.1$, $SD = 0.66$) and playing with a mouse ($M = 3.14$, $SD = 0.55$).

Discussion

The main purpose of the present research was to analyze the effect of different types of controllers on psychological states such as presence, psychological arousal and state hostility, and physiological state of arousal. The within-subjects experiment found that the touch screen induces a higher sense of presence and physiological arousal in the

violent video game. However, the touch screen did not increase players' level of self-reported psychological arousal or their state hostility.

Many researchers agree that recent video games offer increasingly realistic play (Carnagey & Anderson, 2004; Gentile & Anderson, 2003) mostly due to advanced graphics or sounds. Touch screen interfaces could provide a different way of increasing video game realism.

Biocca (1997) suggests that media exposure outcome is strongly impacted by close mapping of a human's body movements. Skalski et al. (2007) also mentioned, "advanced control devices allow players to perform a range of actions conducive to the experience of presence." The result from the present experiment showed that the touch screen as a controller, in the punching game for this study, was experienced as a more natural interface than the mouse. In addition, we also found that this realistic game, human-centered touch screen controller influenced players' sense of presence and arousal.

The touch screen has not been used widely in the violent video game industry yet. This study demonstrates experiential benefits of using the touch screen as the game controller in the game industry and enabling more natural gaming settings.

Limitations and Future Research

Although the present research found some effects of the advanced game controller on players' states, several questions remain unanswered.

First, we found that the result of physiological data measured by a computer and psychological data measured by the paper-based questionnaire were different. The

number of items for measuring arousal was 24. On the other hand, Biopac measured 200 samples of participants' physiological data per second. We can assume that the discrepancy in the psychological arousal may be resulting from the lack of reflection on their psychological state on the paper-based questionnaire at this time.

Secondly, enjoyment was not measured in this study. Enjoyment is one of most important variables of video game playing because people play games for fun. If we put enjoyment as a dependant variable, we could find whether advancement of the input device and enjoyment were related or not.

Third, players' gaming performance was not measured. However, we have anecdotal evidence that participants tend to play this video game more naturally with a touch screen. Players punched enemies more like really punching someone when they used a touch screen than when they used a mouse. They also tended to use their hands and arms together while playing with a touch screen. On the contrary, players used only their hands while they were playing with a mouse. Future research will include game performance as a dependent variable.

Fourth, it is possible that not all game players want naturally mapped controllers while playing a game. The naturally mapped controller may appeal to casual gamers more than to hardcore gamers (e.g., "Playing a different game," 2006).

Finally, based on the present study, touch screen game controllers impacted game player's perceived presence and physiological arousal. However, the touch screen may not play a significant role in generating a natural game environment in some other cases. For instance, for games that require player's control of avatars' legs or multi parts, a

touch screen may not provide as a natural way of controlling as it provides in this punch game.

FIGURES

Figure 1.

Screen shot of the game play

Figure 2.

The game play with a touch screen

APPENDIX

1. Pretest Questionnaire

ID : _____

1. Instruction: Please indicate the extent to which you agree or disagree with each of the following mood statements. Use the following 9-point scale. 1 means "strongly disagree" and 9 means "strongly agree".

I feel furious.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like I'm about to explode.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel friendly.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel aggravated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel understanding.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel amiable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel stormy.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel mad.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel polite.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel mean.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel discontented.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel bitter.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like banging on a table.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel burned up.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel irritated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like yelling at somebody.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel frustrated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel cooperative.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel kindly.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like swearing.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel unsociable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel cruel.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel outraged.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel good-natured.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel agreeable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel disagreeable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel angry.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel enraged.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel offended.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel sympathetic.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel disgusted.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

I feel tame.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

2.

Instruction: Different people react very differently to the same situations. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following 9-point rating scale. 1 means "very slightly or not at all" and 9 means "extremely".

Active	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Alert	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Aroused	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Depressed	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Drowsy	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Dull	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Energetic	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Excited	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Exhausted	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Fatigued	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Forceful	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Inactive	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Lively	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Powerful	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Quiet	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Sharp	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Sleepy	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Slow	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Sluggish	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Tired	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Vigorous	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Weak	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Weary	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Worn-out	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely

2. Posttest Questionnaire

ID : _____

1.

Instruction: Please indicate the extent to which you agree or disagree with each of the following mood statements. Use the following 9-point scale. 1 means "strongly disagree" and 9 means "strongly agree".

I feel furious.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

I feel like I'm about to explode.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel friendly.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel aggravated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel understanding.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel amiable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel stormy.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel mad.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel polite.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel mean.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel discontented.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel bitter.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like banging on a table.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel burned up.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel irritated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like yelling at somebody.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel frustrated.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel cooperative.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel kindly.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel like swearing.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel unsociable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel cruel.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel outraged.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel good-natured.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel agreeable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel disagreeable.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel angry.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel enraged.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel offended.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel sympathetic.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel disgusted.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I feel tame.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

2.

Instruction: Please indicate the extent to which you agree or disagree with each of the following mood statements. Use the following 9 point scale. 1 means "strongly disagree" and 9 means "strongly agree".

I had a sense of being in the scenes displayed	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I felt I was visiting the places in the displayed environment	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I felt that the characters	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

and/or objects could almost touch me	
I felt involved (in the displayed environment)	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I enjoyed myself	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
My experience was intense	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
The content seemed believable to me	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
The displayed environment seemed natural	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I had a strong sense that the characters and objects were solid	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
While playing the game, I felt like I was really 'there' in the game environment.	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I had the sensation that I moved in response to parts of the displayed environment	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree
I felt surrounded by the displayed environment	Strongly Disagree 1 2 3 4 5 6 7 8 9 Strongly Agree

3.

Instruction: Different people react very differently to the same situations. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following 9-point rating scale. 1 means "very slightly or not at all" and 9 means "extremely".

Active	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Alert	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Aroused	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Depressed	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Drowsy	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Dull	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Energetic	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Excited	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Exhausted	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Fatigued	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Forceful	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Inactive	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Lively	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Powerful	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Quiet	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Sharp	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely
Sleepy	very slightly or not at all 1 2 3 4 5 6 7 8 9 extremely

Slow	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Sluggish	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Tired	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Vigorous	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Weak	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Weary	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely
Worn-out	very slightly or not at all 1	2	3	4	5	6	7	8	9 extremely

4. Open-ended question about their guess of the hypothesis

Instruction: Please write down your thoughts about the experiment. It could be your guess about the purpose of this study or your feedback about this game and this questionnaire. Thank you!

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