Computers in Human Behavior 56 (2016) 142–146

Contents lists available at ScienceDirect

Computers in Human Behavior

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

Full length article

The differential effects of agency on fear induction using a horror-themed video game

Kyle E. Madsen

Brigham Young University–Hawaii, 55-220 Kulanui St., Laie, HI 96762, USA

ARTICLE INFO

Article history:
Received 10 October 2015
Received in revised form
10 November 2015
Accepted 20 November 2015
Available online 1 December 2015

Keywords:
Agency
Mediated enactive experience
Fear
Physiology
Horror-themed video game

ABSTRACT

Fear research faces a dilemma as typical methods of induction elicit passive or indirect fear, rather than authentic or direct fear. The present study investigated and compared the effects of interactivity, or agency, on the physiological responses of participants as measures of direct fear as they either played or watched a horror-themed video game. Assuming agency allows for greater immersion, the former group would exhibit greater physiological responses, possibly indicating greater fear reaction. Change scores were calculated from subtracting baseline mean values from exposure mean values for every participant in measures of electrodermal activity (EDA), respiratory rate (RR), and heart rate (HR). Self-reported fear data was also gathered for every participant. Players had a significantly greater increase than watchers in EDA, RR, and HR change scores. Players and watchers did not differ significantly in self-reported fear. Change score *t* tests for specific events that occur in the video game are also reported. These results suggest that the variable of agency may have had the effect of inducing a greater fear response and that it provides utility for researchers seeking to ethically induce direct fear.

1. Introduction

1.1. Direct and indirect fear

An obstacle for fear researchers to overcome is the elicitation of a direct fear response in subjects. Researchers sometimes rely on stimuli that induce shared fear. Empathic fear is either a fear for others, or a shared, social fear experience as explained by the work of Sanders, Mayford, & Jeste, 2013, who found that a shared experience compounds fear in mice. Shared fear is also known to exist by research showing that fear related facial expressions can serve as unconditioned stimulus (Esteves, Parra, Dimberg, & Öhman, 1994). The fear-learning through these types of observation is referred to as an indirect form of induction, contrasted with direct. Additionally, Olsson, Nearing, and Phelps (2007) reported evidence that empathy plays a role in fear-learning by observation. They found neural activation patterns in observational fear-learning. They found that the same areas in the brain that activate in reaction to direct fear stimuli also activate during indirect stimuli. However, they neither analyzed nor reported any differences in activation quality or intensity between the two conditions. Olsson and Phelps (2007) elaborate by explaining that although direct and indirect fear may be activated by similar patterns, the indirect seem to involve a more distributed network of regions within the brain that are involved in social perception and evaluation. Finding a reliable method to induce direct fear would be beneficial in laboratory research. Doing so would allow more genuine responses in any given subject, while also upholding ethical guidelines.

1.2. Entertainment media as tools for fear induction

A contemporary and effective tool to induce fear is the use of entertainment media, namely film, video games, and virtual reality (VR). These media forms provide visual and auditory stimuli in high fidelity. That is, they can both mimic real life events and present unnaturally occurring ones that appear life-like. Horror-themed films are often used to induce fear, both in the laboratory and in mainstream entertainment (Vorderer, Wulff, & Friedrichsen, 2001). In horror-films, the audience views stimuli, mostly from a limited, third-person, omniscient point of view, and is prompted to experience fear for main and side characters alike. As for the use of horror-themed films in the laboratory, there are some interesting effects. Kreibig, Wilhelm, Roth, and Gross (2007) differentially compared fear- and sadness-inducing films along with neutral

E-mail address: Madsen89@go.byuh.edu.

http://dx.doi.org/10.1016/j.chb.2015.11.041
0747-5632/

emotion films. They were able to detect differences in all three by analyzing cardiovascular, electrodermal, and respiratory response patterns, which were bolstered by additional self-report data that also showed differences.

Still, the empathic fear that viewers of horror-films experience is passive and disconnected, thus resulting in an indirect fear response. A problem therefore exists for researchers who wish to observe fear responses. This is because the act of inducing direct fear response activates a specific reaction system shown to be not entirely similar to indirect fear responses. Two tools used by a wide range of emotion researchers and therapists that have the ability to elicit direct fear responses are VR and video games.

Used both in the lab, and in therapy, VR has become useful in detecting certain emotional responses including anxiety and fear. So quick has the use of VR become that O'Connor et al. (2014) write that they hope to bring about a revolution in 3D media and VR for interpersonal communication and interaction. Some examples of the use of VR in research are, first, Geslin, Bouchard, and Richir (2011), who compared gamers' to non-gamers' fear response using VR. Participants, whose past experiences with video games were assessed, were placed in a VR situation in which aversive visual and auditory stimuli were presented. Afterward, they completed an emotional response questionnaire Geslin et al. (2011). They found that subjects who considered themselves to be regular first-person-shooter gamers reported that they experienced less fear and surprise than those that considered themselves to be non-video gamers. In addition, the therapeutic use of VR has entered the area of exposure therapy and is found to be useful in desensitization procedures in which patients are exposed to life-like aversive stimuli (Malbos, Rapee, & Kavakli, 2013).

Video games may be the next best option for researchers if VR is unavailable for use. Both media forms can present stimuli in high fidelity, but they are different in two ways. First, VR's graphical presentation surrounds the field of vision, while in playing video games, the field of vision varies depending on the size of, and the participant's proximity to, a television set. The other is in how they are controlled. For example, standard in VR, gyroscopes incorporated into the machine allow the field of perception to change depending on the head's orientation, while video games have fallen on a standard controller set where two analog sticks, or a mouse and keyboard arrows are used to control movement. But one might ask what aspect is exactly the variable that induces fear using horror-themed VR and video games. Also, is the induced fear direct or indirect? In other words, are they different from watching a film?

1.3. Agency

One variable that is implicated in creating a heightened sense of fear in VR and video games is actually what makes the two similar. Either using a game controller or a gyroscopic headset, subjects have control of their virtual behavior. They have a means by which they can either manipulate the environment, or explore within it. Bordegoni's (2011) explanation of the action-perception model in Human–Computer Interfaces (HCI) is informative in this area. HCIs first begin with functional mathematical codes that lead to electronically produced acoustic, geometric, and sometimes haptic models. Movies contain sounds and shapes, but are without the ability to provide haptic models the way VR and video games can. Examples of haptic models include force feedback, and controller vibration. The subject can then react with their own haptic interface channel—the controller with its multiple buttons—affecting the functional mathematical code again, which continues the process of action and reaction between computer and person.

This principle of control is referred to in recent literature as agency. Agency is a sense of interactivity, autonomy, and presence that a player is said to feel as they make choices within a game's virtual world. Rigby and Ryan (2011) explain that agency allows players to be engaged and make stories their own. Perron (2009) theorizes that agency refers to a perceived causality between one's actions and the events in virtual environment. When it comes to horror-themed video games, players receive a sense of ownership over the actions carried out in the events of the game's narrative. Often found in video games are additional entities or figures that are also given signs of their own agency. In horror-themed games, these non-playable characters—perhaps once inanimate objects like lifeless bodies, dolls, or puppets, now displaying properties of life—are designed with artificial intelligence to appear to possess their own agency independent of the player's. Then, they will regularly act on, and threaten, the player's agency. This is thought to induce fear (Kirkland, 2009; Perron, 2009). Habel and Kooyman (2014) suggest to game designers that more research be done on video game interactivity and to utilize agency mechanics for future possibilities in horror-themed games as an effective feature for inducing fear.

In keeping with the more popular topic of video game research, Lin (2013) examined interactivity (agency) and its effect on players' aggression, rather than fear response. The design of her experiment was to manipulate agency and control for identification, which was surmised to be a mediating variable between agency and aggressive outcomes. She compared three groups: 1) those that played an aggressive character in a video game, 2) those who only watched the same character through screen-captured recording of the same game, and 3) those who watched a film that the video game was based on. The film and video game in question were X-Men Origins: Wolverine (both have the same title with the video game being the "uncaged edition"). When looking at the physiological responses of the participants, Lin found that blood pressure increased in those that played versus both the recording and film watchers. Heart rate was not found to increase, but Lin suggests it is because they only analyzed physiological states before and after playing, recording-watching, and film-watching, not during stimulation. In addition, the players experienced greater aggressive affect and cognition than the other two groups. Identification, where the player/watcher connects emotionally with the main character, was not seen to be a mediating variable in this scenario.

However, identification has been examined in tandem with agency in earlier studies. First, Peng (2008) refers to Social Cognitive Theory's (SCT) enactive and observational experience in his study on self-efficacy in learning, which may help describe possible effects of agency. SCT states that an individual learns both through interaction or passive observation (PO) within a real environment, and that the latter is more effective than the former. One key difference between the two is that observational experience may occur through mediated or non-mediated means (i.e., real or virtual environmental stimuli), while enactive experience may only be possible in the real world because that is where individual action can take place. Peng, however, theorizes that giving an individual control in virtual space, like a video game, should provide a *mediated* enactive experience (MEE). Through which, the user might perceive similar effects as a typical enactive experience, thereby providing greater potential for learning than PO. He writes that MEE will blur the line between the self and the manipulated virtual character, allowing for identification. Peng's experiment found MEE to be more effective in influencing self-efficacy than PO.

Second, Havranek, Langer, Cheetham, and Jäncke (2012) analyzed the sense of presence players felt by manipulating perspective and interactivity as measured by three standard questionnaires, electroencephalography, and standard low-resolution brain electromagnetic tomography. In their 2 (first-person perspective and third-person perspective) by 2 (agency and

non-agency) design, they found the first-person perspective and agency groups to have the larger sense of presence according to all five measures. Lin (2013) did not discount identification to be a possible factor, but rather discussed that identification might have appeared as a significant mediating variable had the game and film she used been in the first person perspective, thereby eliciting the sense that the player or watcher is more connected with main characters and the fictional world. Using similar agency and presence methodology as the aforementioned, this study's objective is to assess the effect of agency on fear induction using a first person perspective, horror-themed video game.

1.3.1. Hypothesis

Subjects who play a horror-themed, first-person perspective video game will experience a greater fear response than those who merely watch a screen-captured recording of the same video game being played.

2. Method

2.1. Participants

Fifty-three male participants from a pool of undergraduate college students participated in this study. Their ages ranged from 19 to 40. Two subjects dropped out early from the project, and one respondent's data file became corrupted and unusable. As a Two-group, between-subjects design, participants were randomly assigned into one of two groups: play or watch. The total number of respondents in the play group was 26, and the total in the watch group was 24.

2.2. Materials and measures

2.2.1. Physiological equipment and measures

Biopac (version 4.0) student hardware and software was used to record and acquire physiological reactions in participants. Three leads connected each participant to the Biopac console; one for EDA, one for RR, and one for HR. The EDA lead connected two transducers to two toes on the same foot. The transducers were placed on the toes because of the presence of a video game controller in the subjects' hands, where EDA sensors would normally be placed, which would potentially disrupt data acquisition during play (Picard & Healey, 1997). For RR, the respiratory strap and transducer was placed around subjects' chests, just below the arm-pits. And for HR, Electrocardiograph transducers were placed on the right wrist and the inside of both upper ankles. The placements were the same across both groups.

2.2.2. Entertainment media materials

2.2.2.1. Platforms. A PlayStation 4 video game console was used to play the horror-themed game, with one controller and one television monitor. Three laptops were used for the experiment, two for physiological data acquisition, and the other for displaying captured footage of the game for the watch group.

2.2.2.2. Horror video game used. Konami's, *P.T.* ("Playable Teaser"), was chosen for stimulation. It was chosen because of its linear style and first-person perspective, as well as being part of the horror genre. The video captured footage of *P.T.* is one without any added player commentary, and is captured from an individual playing the game for the first time. Both game-playing and game-watching ran at an approximately equal time, and both present the same visual and auditory stimuli in the same order.

2.2.3. Self-reported emotions

Five emotion Likert scale items were given to participants after completing the play and watch experiences. The five emotion items are frightened, anxious, happy, amused, and entertained. Though this study is only interested in fear, the other four emotion items were asked to control for demand characteristics.

2.3. Procedure

Subjects sat directly in front of one of the two sources of visual stimuli, depending on which group they were assigned to. The play-group subjects sat in front of the television set which displayed real time game-play, while the watch-group subjects sat in front of the laptop monitor which displayed screen captured footage. Audio stimuli came through head-phones that were placed on each participant in both groups.

Data acquisition consisted of two main sequences. First, 3 min of baseline data for each physiological measure was recorded on each subject. After which, the stimuli immediately began. For both groups, the experience stopped approximately 30 s after a specific event that marks the end of a segment within the game. During data acquisition, event markers were placed at specific events that occur in the video game that use various types of scare tactics.

Upon completion of the experience, participants were asked to answer a short demographics questionnaire that included the following: how often you play video games (The answer choices available were on a five point Likert scale ranging from "very frequently" to "almost never"). The emotion scale items were completed afterword.

3. Results

3.1. Average physiological change scores comparisons

The hypothesis predicted that players would display a greater fear response than watchers, therefore physiological measures would indicate a greater increase than watchers. Average change scores for EDA, RR, and HR were each analyzed with a one-tailed independent-groups t test. Change scores were calculated by subtracting the average resting baseline values for each physiological measure from the average values of the same three measures of the entire exposure experience for every participant (i.e., EDA experience mean − EDA baseline mean, RR experience mean − RR baseline mean, and HR experience mean − HR baseline mean).

The play group ($M = 1.61$, $SD = 1.02$) had a significantly higher change in average EDA than the watch group ($M = 1.004$, $SD = 1.28$), $t(48) = 1.87$, $p = .04$, $d = .52$. The play group ($M = 7.29$, $SD = 4.36$) had a significantly higher change in average RR than the watch group ($M = 3.9$, $SD = 4.21$), $t(48) = 2.79$, $p = .004$, $d = .79$. After the removal of two outliers—one from the play group and one from the watch—the play group ($M = 8.23$, $SD = 9.83$) had a significantly higher change in average HR than the watch group ($M = 2.64$, $SD = 4.61$), $t(45) = 2.47$, $p = .01$, $d = .73$. Because of the significance found in all three measure comparisons, the hypothesis was supported.

3.2. Self-reported emotions analysis

According to the hypothesis, players would also indicate a greater self-reported fear score than watchers. A one-tailed independent-groups t test for self-reported fear between the two groups was also implemented. The play group ($M = 3.25$, $SD = .89$) and the watch group ($M = 3.17$, $SD = 1.13$) did not differ significantly on self-reported fear, $t(48) = .29$, $p = .39$.

One-tailed independent-groups t tests were also calculated for

each other emotion score. Taken individually, only one of the five self-reported emotion score *t* tests revealed significance between the two groups. The play group scored higher on self-reported entertainment than the watch group, $t(48) = 1.78$, $p = .04$, $d = .5$. In order to assess possible effects of all emotional measures together, a summative emotion score was calculated for every individual in both groups. When the scores were subjected to a one-tailed independent-groups *t* test, the play group scored significantly higher than the watch group, $t(48) = 1.9$, $p = .03$, $d = .54$. See Table 1 for a detailed comparison of the individual *t* tests for the five self-report emotion scores and the total score.

4. Specific event physiological analyses

Change scores and one-tailed independent-groups *t* tests for the three physiological measures during three separate events that occurred during the exposure period were calculated to account for possible change over time. The three events were chosen for a variety of reasons. First, they are all in the same order and each participant experienced them, lending to comparability between groups. Second, the subjective intensity level of the stimuli increases with each one. Event one is a loud, unexpected rattling knock behind a bathroom door that occurs as the video game character passes by it. Event two takes place when the character looks into the crack of a slightly open door and a ghostly figure suddenly appears inside and closes it quickly. Event three occurs when the character becomes trapped in a bathroom for an extended period of time, during which, visual and auditory cues are presented with the aim of inducing fear reactions in the player. During data acquisition, I placed markers at the exact moment that an event occurred. I later calculated scores from these events by highlighting a section of time directly after the marker and then recording the average values for the three physiological measures during that period. I highlighted approximately 30 s after the first two events, and 1 min after the third event. I subtracted the EDA baseline state values from the EDA values of the three events time periods for every participant (e.g., EDA loud rattle − EDA baseline; EDA door peak − EDA baseline; and EDA trapped − EDA baseline). I performed the same steps to calculate change scores for RR and HR.

Beginning with the EDA score *t* tests, only during event three did the play group ($M = 1.86$, $SD = 1.26$) score higher than the watch group ($M = 1.004$, $SD = 1.54$), $t(48) = 2.17$, $p = .02$, $d = .61$. The RR *t* tests yielded significant results as well. The play group scored higher in RR change scores than the watch group during event one, $t(48) = 2.81$, $p = .004$, $d = .8$, event two, $t(48) = 1.97$, $p = .03$, $d = .56$, and event three, $t(48) = 1.64$, $p = .05$, $d = .46$. And last, the HR *t* tests also yielded significant results. The play group scored higher in HR change scores than the watch group during event one, $t(48) = 1.91$, $p = .03$, $d = .55$, event two, $t(48) = 2.49$, $p = .01$, $d = .72$, and event three, $t(48) = 1.73$, $p = .05$, $d = .5$. Table 2 represents the *t* test results for the three events in each physiological measure.

Table 1
Mean self reports (and standard deviations) of emotionality as a function of agency.

Emotion measure	Agency variable		*t*(48)	*p*	Cohen's *d*
	Play	Watch			
Afraid	3.25 (.89)	3.17 (1.13)	.29	.39	–
Anxious	3.81 (.94)	3.63 (.94)	.66	.26	–
Happy	2.38 (1.2)	1.96 (1)	1.36	.09	–
Amused	3.19 (1.17)	2.63 (1.38)	1.58	.06	–
Entertained	3.54 (1.24)	2.88 (1.39)	1.78	.04	.5
Total	16.17 (3.53)	14.25 (3.63)	1.9	.03	.54

Note. *P* values are for contrast between play and watch groups. Emotion was measured on 5-point self-report scales. Mean values range from 1 to 5. Range for the summative emotion measure was 5–25.

Table 2
Mean physiological change scores (and standard deviations) of three in-game events as a function of agency.

Event #	Agency variable		*t*(48)	*p*	Cohen's *d*
	Play	Watch			
EDA					
Event 1	1.27 (1.23)	1.03 (1.45)	.65	.26	–
Event 2	1.96 (1.26)	1.46 (1.66)	1.2	.12	–
Event 3	1.86 (1.26)	1.004 (1.54)	2.17	.02	.61
RR					
Event 1	7.19 (3.89)	3.76 (4.71)	2.81	.004	.8
Event 2	7.37 (4.92)	4.65 (4.87)	1.97	.03	.56
Event 3	7.43 (4.72)	5.12 (5.26)	1.64	.05	.46
HR					
Event 1	8.74 (14.01)	2.32 (8.77)	1.91	.03	.55
Event 2	11.84 (14.06)	3.39 (8.99)	2.49	.01	.72
Event 3	12.15 (17.2)	4.98 (10.89)	1.73	.05	.5

Note. Events 1 & 2 were approximately 30 s sections highlighted directly at the start of the events, and event 3 was approximately a 60 s section.

5. Discussion

5.1. Physiological and self-report summary and limitations

These results support the hypothesis that the variable of agency would have greater effects on participant's physiological responses during a horror-themed video game experience than the effects of merely watching a screen captured recording. Specifically, when testing change scores derived from subtracting average resting state values from the average values for the entire exposure experience in each physiological measure, the play group's change scores were found to be significantly higher than the watch group. Additionally, when analyzing change scores of three specific events during the exposure period, the play group showed significantly higher changes in respiratory rate and heart rate during each event than did the watch group. Only during event three did the play group show a significantly higher change in EDA than the watch group, though there was a trend for the play group to score higher during events one and two.

The play group did not score higher than the watch group in self-reported fear. They did, however, score significantly higher than the watch group in self-reported entertainment. Also, when calculating a summative score for all emotional measures for each participant, the play group scored significantly higher than the watch group.

This may be a result of limitations in the study. It may reveal that the physiological responses may not be a result of fear response, but mere entertainment. However, though participants self-reported fear didn't differ significantly, they did still report a certain level of fear, indicating that the construct did operate to a degree during the experience for participants. This may confirm previous findings of self-report methods and their known validity problems. Participants could be recognizing that they are having a physiological response, but translating that into abstract language may be a difficult process, during which, misinterpretation or miscommunication might occur. Another limitation in these self-report measures could be that the range chosen was too small, and thus resulted in showing small differences between groups.

5.2. Methodological limitations

The methodology had some limitations as well. The video game used, P.T.—though classified as horror-themed—may be limited in its capacity to induce fear, as the fear stimuli is subjective. What might be considered frightening by one may not be frightening to another. Again, having a more diverse sample population might show differences in participants' fear response in this area to

possibly confirm that *P.T.* is sufficiently frightening across cultures. Conversely, *P.T.* might also have too much variety when it comes to scare tactics. It might not be seen as one singular stimulus, but a collection of stimuli. Certain events may induce different types of aversive stimuli such as surprising loud noises, grotesque imagery, darkness, and spatial confinement to name a few. A variety of reactions therefore might confound results.

Another issue comes from the differences in the amount of time participants in the play group had to spend with the game. Though the experience is linear—in that the order of events that take place are exactly the same each time it is played—the amount of time it takes to trigger such events does vary as they rely in part upon participants' capacity to solve a small number of simple but ambiguous puzzles. The play group therefore varied in how long it took them to complete the set sequence. The watch group on the other hand, though they experienced the exact same order of events, did experience them all at approximately the same time. As a result, time interval analyses could not be conducted to more accurately compare groups. Only specific events, which varied in when they occurred, were used to show a possible change over time. Ideally, a matched-pairs design would allow for such comparisons.

Frustration became an issue for a small number of participants. For some in the play group, this occurred when a puzzle proved too difficult to solve, and for the watch group, not having control over proceeding events also produced some frustration in a small number of subjects. Frustration could have been confounding in such a way as to replace fear response with annoyance or anger instead. Using a horror-themed game with puzzles to solve that are not so abstract may help control for frustration.

And finally, in relation to frustration, attention level or flow could also be a factor to consider in replication. Flow, or the state of optimal experience and stimulation, as theorized by Csikszentmihalyi (1990), largely depends upon the individual. Flow manifests from a proper combination of challenge and skill. Should an activity prove too easy, a subject may become bored and decline in their attention. Conversely, if an activity's challenge level lies beyond a person's skill set, they may choose to avoid anxiety and frustration by shifting attention away from that activity. When selecting a video game, it may be best to match the age group of the participants with the Entertainment Software Ratings Board's recommended age. Similarly, the generation should also be considered, as technology or computer self-efficacy may mediate between skill set and anxiety or frustration, as some generations have not as readily adopted technology as others and therefore might not be suited for a chosen game's challenge level (Czaja et al., 2006).

5.3. Suggestions for future research

Future research may look into performing a similar study, but with the use of VR technology. As mentioned previously, VR would be the ideal scenario as it more fully immerses the user by taking up more range in their field of vision. *P.T.* might be used in such a situation, but other horror-themed games should be considered in further fear induction research. Additionally, future research should examine effects of player agency on different emotional constructs, such as happiness or sadness. As interactive media has become more sophisticated in story telling techniques and in photorealistic graphics, more emotional responses may become available to elicit. Again, comparisons of gender might be considered for future research in this and other fear-induction methods.

5.4. Conclusion

These results suggest that the variable of agency may have had the effect of inducing greater physiological fear response. It may also further support the theorized effects of agency, namely, that it gives a player a mediated enactive experience through which to identify within a virtual world, and then experience such senses as presence and autonomy, thus inducing greater emotional response. The results may also indicate that the variable of agency provides utility for researchers seeking to induce direct and authentic fear safely and ethically for the purposes of emotion research.

Acknowledgments

The author gratefully acknowledges Dr. W. Jeffrey Burroughs and Dr. Boyd H. Timothy for their helpful instructions, comments, and support. The author would also like to thank Tedd Scheall Johnson for his help in gathering data.

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