

Examining immersion in a game-based experiment to study extreme behavior

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Abstract

This paper investigates whether immersion in a game-based experiment can be used to observe authentic behavior, for example in the case of studying extreme behaviors under unfamiliar circumstances. A graphic adventure game (Opponent Immersion Game) was developed, in which participants could experience and act on various known risk factors and triggers for violent extremism. We investigated the following topics: 1) The relation between the perceived level of immersion and authentic in-game reactions, 2) the impact of the level of authenticity on the use of (in-game) violent extremist behavior, and 3) the impact of the presence or absence of visuals in the game on resulting game experiences. Results from an experiment with 188 participants show that authentic reactions are positively correlated with the flow experience, a subcategory of immersion. More authentic behavior is related to less violent behavior. Contrary to expectations, there was no effect of the exclusion of visuals on the level of immersion. Response coding shows the majority of participants had positive sentiments towards the game. This study shows that game based experimentation for studying human behavior in extreme and unfamiliar circumstances is a promising approach.

Keywords: Serious Gaming, Immersion, Game-Based Experimentation;

1 Introduction

Disruptions of today's society, such as violent extremism, require a better understanding of how individuals come to engage in violence. However, studying the development of violent extremism is hindered by the difficulty in reaching out to these individuals [1] [2]. This has become known as the primary data problem: Available data predominantly come from difficult to compare case studies and are skewed toward deradicalized individuals [3]. It is vital to gain more understanding about how individuals justify violence as an appropriate means toward a goal and to investigate whether existing violent extremism theories can be confirmed using experimental data. Using surveys targeting the general population for research purposes should increase insight into which factors motivate individuals to use violence. This strategy has resulted in interesting findings on the antecedents of violent extremist tendencies, but at the same time demonstrated the difficulty for the general public to take on the perspective of violent extremists [4]. The present study investigates the possibility of using Serious Gaming as a means to increase immersion in fictional and unfamiliar situations in order to observe authentic behavior. If this premise is confirmed, Serious Gaming may be used to gather empirical data on extreme behaviors, such as violent extremists.



Serious gaming is increasingly used in innovative research studies in various domains, such as mental health [5], education and training [6], and physical exercise and lifestyle change [7]. One reason why serious gaming is gaining popularity for research purposes is because of its ability to capture authentic reactions from individuals in unfamiliar and extreme circumstances that are difficult to (re)create in real life, and because it allows for a controllable environment. For example, Rovira i Pérez [8] used a virtual reality environment to capture behavioral responses to emergency situations. The controlled environment allowed researchers to increase the quality and reliability of behavioral assessments.

Authenticity was found in a study examining fear responses in horror games. In this study, participants responded with authentic fear despite their implicit understanding that the game environment was not real [9]. Using the immersive properties of virtual environments, authentic reactions to presented stimuli can be elicited from players during game-play [10]. Frequently, traditional experiments instruct participants to imagine situations based on written descriptions [4]. Traditional experimenting could benefit from using (video) games to elicit and investigate authentic behavior.

While the use of virtual environments to capture authentic behavioral responses is not new [11, 12], this study is among the first to set up a game-based research platform to allow collecting empirical data about the path toward violent extremism. This game-based research platform is named The Opponent Immersion Game (OIG). The OIG is a graphic adventure game in which online participants experience a scenario with known risk factors of radicalization. A graphic adventure game is a type of game that uses static character and object images in order to guide players through a storyline. Players take on a character who interacts with the storyline; players experience agency when choosing how to respond to different scenarios, since their choices in the game can alter the storyline of the game .

This platform has been built with the aim to test potential interventions to mitigate violent extremist tendencies. However, a first step is to investigate the ability of an immersive game to elicit authentic reactions. Immersion in relation to video games is generally understood as a person's "suspension of disbelief": the belief that they are really part of the fictitious game world and of the storyline that unfolds in the game. Basically, when a player is immersed, the game claims the attention of multiple senses [13] [14] [15]. This immersion can stem from various aspects of a game; for example, augmented reality games often utilize methods in which different senses of the player are involved (e.g., visual, auditive and tactile). For graphic-and-text gaming, eliciting immersion relies heavily on the game's narrative and the opportunity to interact and steer the storyline. This is done through manipulating different aspects of the scenario, the plot, and the characters [16].

Immersion can be divided in three levels that lead to people feeling as if they are in the fictitious world [17]. The first level of immersion is engagement, which drives the player's invested time, effort, and attention to the activity. Engagement must be present in order for players to experience other levels of immersion. Once players are engaged, they might be engrossed if they are emotionally attached to and focused on the game. Total immersion is the final level of experiencing immersion, where players experience presence and flow. Presence is the feeling of being inside the game world, where players feel surrounded by the stimuli presented to them in the game. Flow is a state in which players are so involved in an activity that nothing else matters to them.

Nilsson, Nordahl, and Serafin [18] outline three different drivers of immersion, including 1) the system technology and the perceptual response to that system, 2) the narrative contents of the game, and 3) the challenges faced in the virtual world. Immersion as a result of properties of a system could include immersion resulting from different senses being stimulated (e.g., sound, touch, sight or how people react to different graphics used in a game (e.g., resolution, lighting). Narrative responses refer to (the engagement of) a story's plotline and characters. Finally, immersion and motivation as the result of challenges in the game that require interaction of the player with the game world in order to further game progress.

With regard to the relation between perceptual response and immersion; it is important for game designers to understand the role of graphics while deciding how to create character and background images. Literature that demonstrates how graphics in the game affect player's interactions with an adventure game is lacking. It has generally been assumed that game graphics are important to player enjoyment and immersion in a game. For example, Ciesla [19] stresses the importance of investing in character and background images; he mentions that they are highly important in visual novels but that "it's better to have no visuals than amateurish or stock library graphics" (p. 35). There is evidence that realism in a game contributes to immersion in first-person shooter games [20]. Additionally, realistic expressions of pain on character avatars are important for eliciting and training real empathy responses [21]. A better understanding of the effects of graphics on participants' immersive experience in a graphic adventure game is needed, just as how a participant's immersive experience affects their interactions and behaviors in this graphic adventure game.

2 Use case: Violent extremism

Violent extremists, rooted in either religious, ideological or political beliefs, are concerning disruptions in today's society. Understanding the motivations and development of organized violent extremist groups has proved to be of vital importance in recent, tumultuous times. Such examples of religious, ideological and political violence have in common that ordinary individuals become entangled in a path towards violence. Unfortunately this path is poorly empirically investigated since data on this process is difficult to collect. Theories on violent extremism and case studies have sought to understand the motivations, triggers, and behaviors of people and groups who engage in extremist behavior, such as violence, in order to achieve certain personal and societal goals. It is generally understood that the violent extremist process occurs over several stages, likely triggered by series of events and trigger factors [22]. However, these groups of radicalized people are difficult to isolate; therefore, their motives, and other characteristics remain predominantly retrospectively studied. A better understanding of how an individual is compelled to resort to violent extremism is needed, which triggered the selection of the present use case for the OIG [23].

An overview of the story line is detailed later in the description of the game scenario. The development of the story relied on previous research and theorizing on variables related to violent extremist behavior. Included were risk factors such as perceived social exclusion [24], (need for) significance [25] [26] and (need for) social justice [22], uncertainty [27], unfair treatment of people around them [28], connectedness with an in-group [29], and (lack of) identification with an out-group [30]. Recently, these psychological factors were incorporated in a process model describing the initial stages toward violent extremism [2]. This General Needs and Affect (GNA) process model on the path toward violent extremism formed the basis of our story line.

3 Game-based experimentation

Overview

Given the state of the art of game-based designs in creating immersive experiences, games are believed to be a valuable addition to traditional experimental methods, especially when studying behavior. Compared to more traditional methods and survey research, they may allow to capture authentic behavior more than introspective evaluations might do. The potential benefits of using a game-based platform for experimental studies might include



that: 1) an immersive environment has the potential to capture the attention of participants for extended periods of time, 2) an immersive game environment potentially captures more authentic reactions and behavior than with the use of traditional surveys, and 3) the data would be able to be used for modelling extreme behavior [23].

Research questions

This paper concerns three research questions in regard to game-based experimentation. The first is focused on how immersion (driven by the perceptual, narrative and challenge-based experience) affects the authenticity of in-game reactions.

RQ1: Does immersion contribute to more authentic in-game reactions and behavior?

We hypothesize that more immersion will lead to more authentic participant behavior. The second is focused on the authenticity of reactions. In a game environment, a frequent question concerns whether behavior coming from participants answering as themselves (authentic) is similar to behavior coming from participants answering as they think their characters would (non-authentic).

RQ2: Do authentic reactions result in less non-normative in-game behavior than non-authentic reactions?

We hypothesize that participants who respond as themselves instead of how they think their characters would respond, will show less non-normative behavior. Therefore, we expect that participants who respond as themselves are less likely to resort to violent extremism in the OIG.

The third research question concerns how the addition of detailed game visuals affects immersion:

RQ3: Does the presence or absence of visuals in a game affect the participants' immersion levels?

Based on the theory of sensory immersion [31], we hypothesize that more detailed graphics in a game will lead to higher levels of immersion for participants.

As an exploratory research question, we are also interested in how participants experience the game:

RQ4: What are the sentiments of participants towards the game experience?

4 Design of the Opponent Immersion Game

To investigate the research questions described above, a game environment was developed (the OIG). The game environment describes an unstable environment in which participants receive cues for acting out. In the interactive game scenario the participant is able to respond in different ways. In later stages of the game scenario, participants are able to perform extreme violent behavior. These differing responses of participants are our assessments.

Design of game-based experimentation

The participants (*players*) of the OIG react to *events* which present *circumstances* and *triggers* for extreme behavior (see Figure 1). For example, an event was implemented where a police officer trashes the participants' car since conflicts with authority are a known trigger factor for radicalization [35].

To capture the behavioral responses of participants, the *actions* and *interactions* of the *player* are recorded. The recorded in-game responses represent experimental *measures* of interest such as beliefs, attitudes and non-normative behavior. Figure 4 below illustrates the relationship between game elements and experimental cues and measures. These measures of interest were included using the GNA model [2] as a guideline. For example, participants are able to choose their response (*action*) to a discriminating hotel manager (*event* with *trigger*) by deciding to display normative or non-normative in game behavior. Simply leaving the hotel is a *measure* of normative behavior in this part of the scenario. Opting to break a vase is a *measure* of *non-normative behavior*. In a subsequent scenario event, the participant has an *interaction* dialogue with their neighbor, responding to questions about their *beliefs*, whether they feel being discriminated against and whether they feel a *need* for justice.

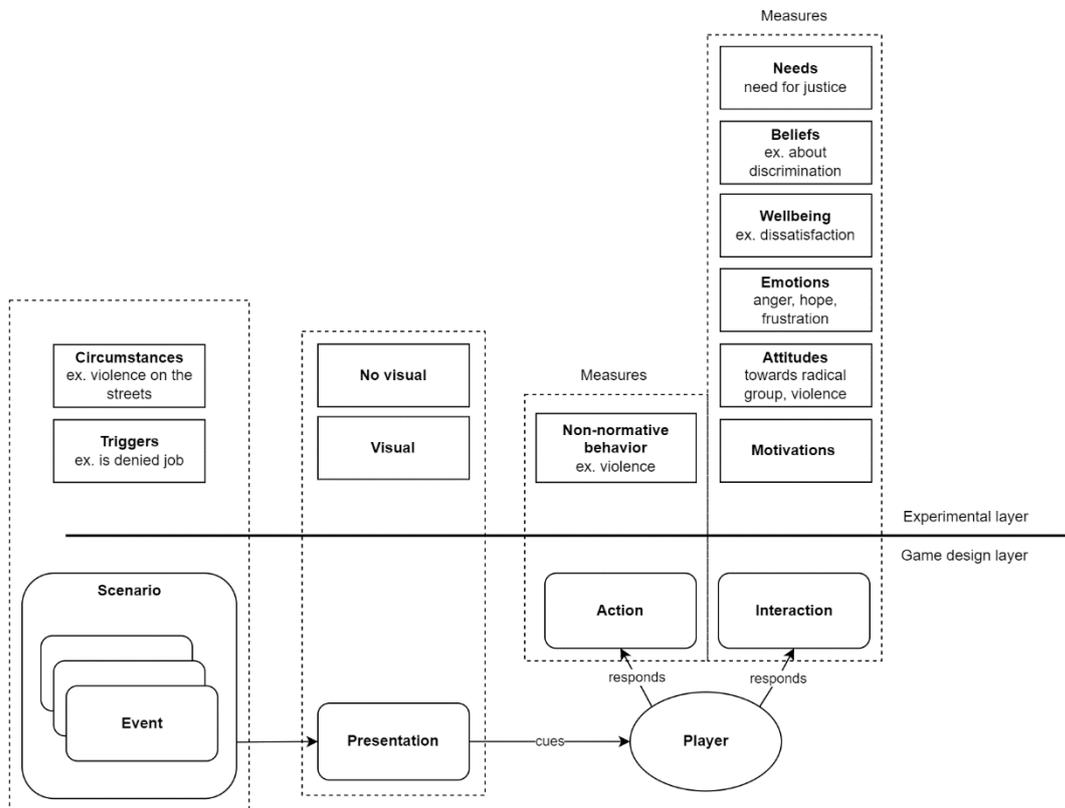


Figure 1: Design of OIG game-based experimentation (references in italics).

Game scenario

The game scenario was developed using the game-based experimentation design as strict guideline. In a scenario blueprint, all scenario *events* were coded as a instantiation of a *circumstance* or *trigger*. Possible responses were coded as (*non*)*normative actions* or *interaction* responses representing the communication of a certain *need*, *belief*, *wellbeing*, *emotion*, *attitude* or *motivation*.

Participants are taken on a journey in the fictional capital of Bazonala, a politically unstable country (political *circumstance*) with two distinct ethnic groups (demographic *circumstance*), where the main character (who is nameless and genderless in order to encourage participants to project their own identity onto the main character) has moved in

order to make ends meet for his/her family (social-economic *circumstance*). Participants are part of a minority group in the country, the Bani-Tayla, who are easy to tell apart from the majority group, the Akisho, based on prominent physical and facial features. When entering the city, participants encounter a police officer who seems to take pleasure in putting participants' belongings through a "random search" (unfair treatment *trigger*). Once through, participants settle into a slum and attempt to go grocery shopping, where they find that food is scarce and expensive (basic living conditions *circumstance*), especially for the Bani-Tayla. Repeatedly, the main character comes into situations where unfair treatment (*trigger*), either openly or latently is the order of the day. For example, when looking for work, participants are denied an interview for a position; meanwhile, they witness an Akisho interviewee being welcomed into the manager's office, and when the main character comes down with a cold and looks for medicine, participants are denied it at the pharmacist. From here, the scenario gradually escalates with the player being mentored by a neighbor to engage in (peaceful) protesting (affiliation *trigger*). The neighbor subsequently introduces participants to violent protesters by attending a fraction protest group that engages in violent extremism. Experiences such as deteriorating living conditions, a blackout, and being subjected to violence from a government official (experience with violence *trigger*) serve as triggers to engage in (co)-organizing violent actions and ultimately the possibility of storming the government palace (extreme non-normative *action*).

Game type

A relatively low-fidelity technology for immersion was chosen for the OIG, namely a 2D browser-based game. This enables easy online experimentation and accessibility. The graphic adventure game genre was chosen in order to balance the ability of the player to influence the game outcome with the need for experimental control.

Game mechanics

Participants (*players*) recruited from the online research platform Prolific Academic are immersed in a virtual narrative (game *scenario*, see Figure 2), in circumstances that may trigger violent actions (*events*).

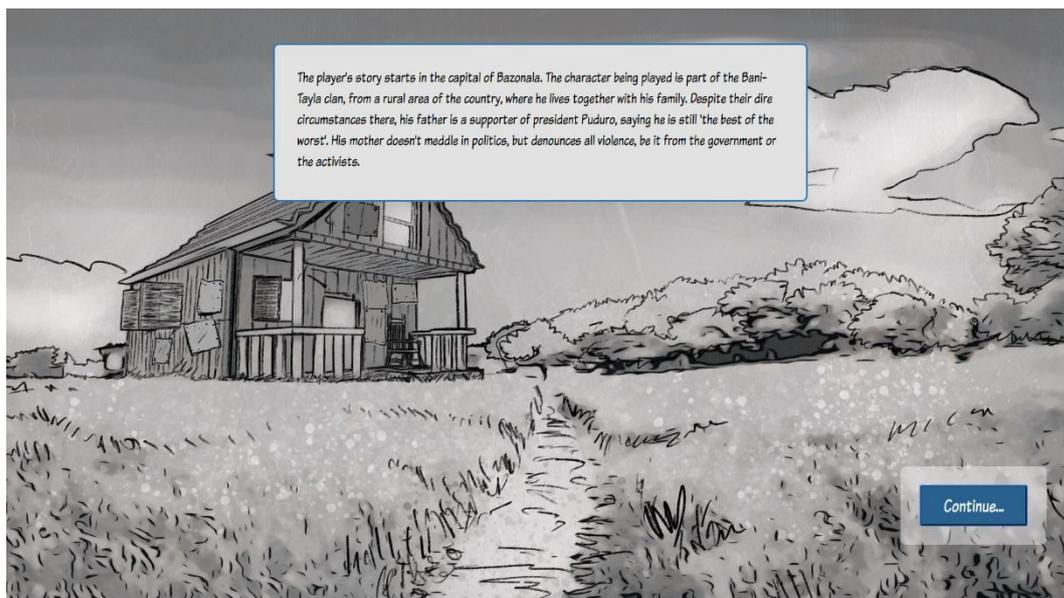


Figure 2: Scenario introduction

The player is confronted with several choices in the form of *actions* in the virtual game world (see Figure 3). In this example, near the end of the scenario, the first response option represents the measure of *normative behavior*, the second response option *non-normative behavior*.



Figure 3: Event and action responses

The player also has *interactions* with non-player characters (NPC) (see Figure 4). In this example, the player responds to a manager telling them they cannot apply for a job. In this case, the second response option represents the *belief of injustice*, the third response option represents the *belief of discrimination*.

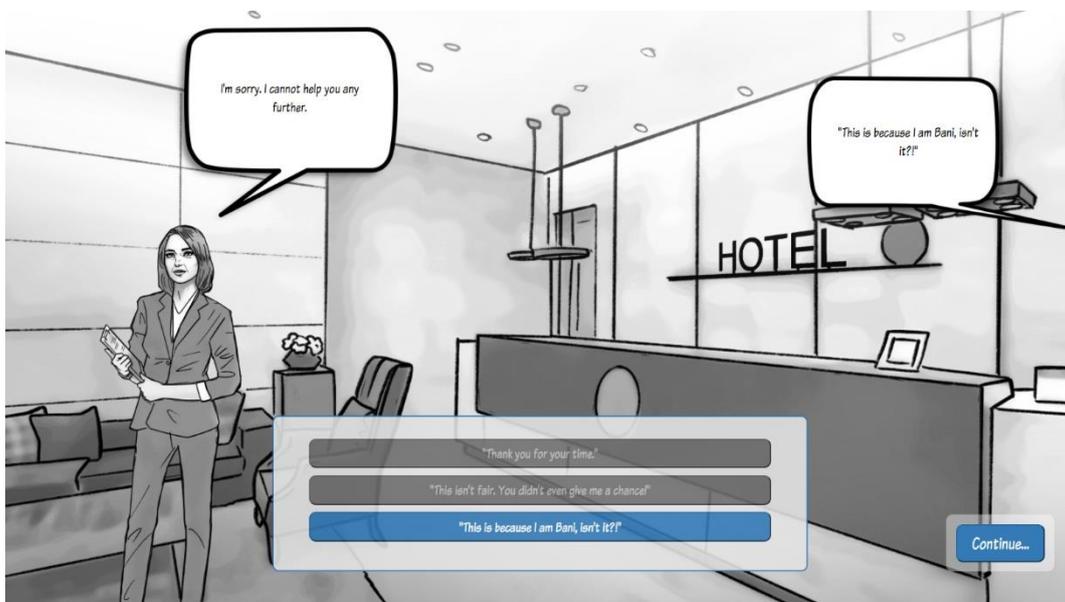


Figure 4: Interaction responses

The game also includes more traditional repeated-measures psychological questions on inner states (*beliefs, attitudes, motivations and feelings*) that are collected in conversations with NPCs (Figure 5).

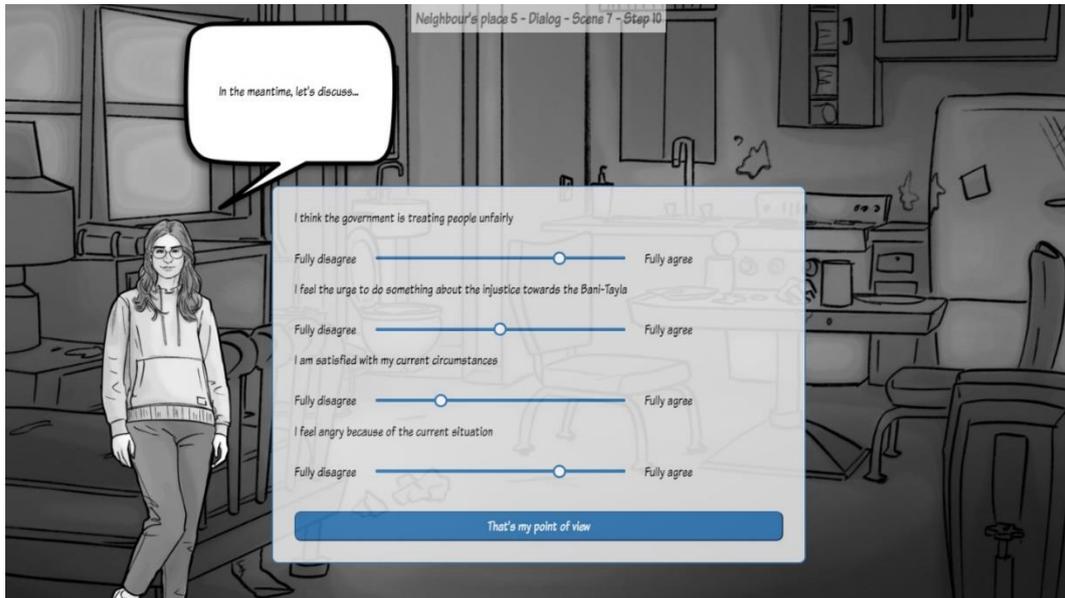


Figure 5: Conversation as repeated measurement inner state

By recording the participants actions and interactions we can learn about the implications and interplay of known triggers for extreme behavior with certain needs, beliefs, attitudes, emotions and (non)normative behavior of the game participant. Before starting the game, participants were encouraged to respond to the scenario as themselves under the given circumstances.

Game visuals

One of the key design decisions concerned the visual fidelity of the game. It is possible to design a storytelling game as a text based adventure without graphical elements (such as 'Zork'; 1980) [32] or as a graphic adventure game (such as 'Day of the Tentacle'; 1993) [33]. More contemporary renditions add 3D visuals such as Telltale games' 'The Walking Dead' [34] narrative adventure games. As our goal is to stimulate the immersive experience in order to elicit more authentic behavior, while also making the game accessible to a broad audience online, a 2D graphic adventure style was chosen.

To determine whether the *presentation* of detailed graphics contributes to immersion in a game, participants were randomly assigned to two conditions: a 1) a *visual* condition, where participants saw detailed character and background images and a 2) *no-visual* condition, where participants saw silhouettes and abstract background images. Figure 6 below shows a sample depiction of the difference between both conditions of the same scene.



Figure 6: Visual vs non-visual condition

5 Method

Participants (N = 204) were recruited in two waves through Prolific Academic, an international online participant pool platform. The first wave took place on July 4th, 2020 (N = 100), and the second wave on October 13th, 2020 (N = 104). To enhance participant pools similarity, data collection was executed at the same time and day of the week. Participants needed to be at least 18 years of age. We excluded participants who did not finish the game. This resulted in 192 participants in total. To guarantee the privacy of the participants and the ethical integrity of the research, an independent ethical committee reviewed and approved the experimental method.

Captured data

Data is captured for every game session of a participant. The data includes identifiers for every circumstance or trigger, plus identifiers for every response. Using the scenario blueprint coding described in the previous chapter, these identifiers are coupled to specific triggers and measures. In this experiment, the (non)-normative response of the participant is quantified using this dataset and related to the other measures.

Questionnaires

Before starting the game, and after filling out an informed consent, participants are presented with a number of short questionnaires asking about their gender, age, and education.

Additionally, in order to measure the immersive experience of the participant, the post-test included an immersion questionnaire. The questions used were adapted from literature aimed to measure immersion in games using augmented reality [17]. While the original questionnaire contained 21 items, we limited our shortened version to seven items due to time constraints, assessing the three previously mentioned levels of immersion: engagement, engrossment and total immersion. Table 1 below shows which items were used and the concepts they measure.

<i>Immersion levels</i>	<i>Measures</i>	<i>Questions</i>
Engagement	Interest	“The activity captured my attention”
	Time-Investment	“I wanted to spend time to participate in the activity”
Engrossment	Emotional attachment	“I often felt suspense by the activity”

	Emotional attachment	“I was curious about how the activity would progress”
	Focus of attention	“Everyday thoughts and concerns faded out during the activity”
Total Immersion	Presence	“I felt that what I was experiencing was something real, instead of a fictional activity”
	Flow	“The activity became the unique and only thought occupying my mind”

Table 1: *Immersion items and concepts measured*

Finally, in order to determine whether participants responded to stimuli in the OIG with authentic reactions, they were asked the following question after they completed the game: “What were your main motivations for choosing the actions and responses for your character?” They were given the following options as responses: 1) “I chose what I would have chosen in my own life” (authentic), 2) “I chose what I thought my character would have done” (non-authentic roleplay), “I chose the most interesting options” (non-authentic exploration), “I chose randomly” (non-authentic arbitrary), or “Other” (determined from textual elaboration).

6 Results

Before performing any analyses, we checked the data for any outliers in relevant continuous variables, and examined the observed variable distributions. We excluded three participants who indicated that their motivations for selecting responses in the game were not either “I chose what I would have chosen in my own life” or “I chose what I thought my character would have done”. Outliers were detected using the `identify_outliers` function from the `rstatix` package [36]. Participants that were determined to be extreme outliers ($Q3 + 3 \times IQR$) were removed ($N = 1$). Additionally, participants were removed if they reported selecting responses in the game for any reason aside from choosing what they would have in real life or choosing what they thought their characters would have done ($N = 3$). This resulted in a dataset of 188 participants who completed the game. All analyses in this study were conducted in the statistical package R [37].

In order to determine whether we need to include individual immersion items, i.e. flow, presence, instead of aggregated measures of engagement, engrossment and total immersion (Table 1), we performed a reliability analysis using the `psych` package [38] on the measures described in Table 1. The modified seven-item immersion questionnaire was found to be reliable for the engagement questions (Cronbach’s $\alpha = .71$), but not for the engrossment questions (Cronbach’s $\alpha = .44$), and also not for the total immersion questions (Cronbach’s $\alpha = .63$). We decided to use the individual items in a multivariate analysis instead of aggregated measures to represent immersion.

To test the hypothesis that *higher levels of immersion will lead to participants authentically responding to the game*, a logistic regression was used with authenticity as the outcome measure and the immersion items as the predictors. Variance inflation factors (VIF) were calculated in order to ensure that variables were independent of each other. Since none of the VIF values were high, we carried on with the logistic regression. We found that only flow was a significant predictor of authenticity, regression weight $b = 0.307$, significance level $p < .05$, odds ratio OR = 1.360 (95% confidence interval CI: 1.004, 1.858). Flow was higher in participants who responded as they would in real life (mean $M = 5.296$, standard deviation $sd = 1.357$) than in participants who responded as they thought their characters should (mean $M = 4.826$, standard deviation $sd = 1.539$). The other immersion items (interest, time investment, emotional attachment, focus of attention and presence) were not shown to be significant predictors of authenticity.

To test the second hypothesis that *authenticity results in less violent extremist behavior*, a chi-square analysis was done on the frequency distribution of the authenticity questionnaire item and the measure of in-game violent behavior that was part of the game scenario. A different rate of violent behavior was found between people who respond as themselves versus people who responded as they expected their character to respond, chi-square $\chi^2(1, N = 188) = 10.362$, significance level $p < .01$. In a follow-up Cramer's V calculation to determine the effect size of the significant effect, it was found that this was a small to moderate effect, Cramer's $V = .25$. Table 2 shows that participants who were responding as themselves in the game were less likely to use violent extremist behavior while participants who were responding as they thought their characters should or would were more likely to use violence.

	<i>Non-violent behavior</i>	<i>Violent behavior</i>	<i>Total</i>
Authentic reactions	84 (44.68%)	58 (30.85%)	142
Inauthentic reactions	14 (7.45%)	32 (17.02%)	46
Total	98	90	188

Table 2: *Authentic reactions by Violent Extremism: Percentage of people engaging in violent behavior or not for those reporting to give authentic reactions versus inauthentic reactions.*

Due to there being multiple outcome variables, we test our third hypothesis that more detailed graphics in the game would be associated with more immersion using a Multivariate analysis of variance (MANOVA); here we used the immersion items as the outcomes and condition as the predictor. The test showed that there were no significant effects of condition on immersion items, F-value $F(7, 180) = 0.279$, significance level $p = .961$.

In addition to the quantitative analyses, participants' opinions on the game were also analyzed. Participants had the option to share any additional thoughts about the OIG after they completed the game. In the post test, we asked participants, "Do you want to share anything else about how you experienced the scenario?". Eighty-four participants did not have any additional comments. However, 104 of the 188 participants answered the question with additional thoughts. These answers were coded into three categories: 1) answers which indicated they the game had a positive impact on them 2) answers which could not confirm the participant's sentiment towards the game, and 3) answers which indicated that the game had a negative impact on them. Seventy-five of the participants who mentioned that the game had a positive impact expressed curiosity about the game with regards to real-life events such as the Black Lives Matter protests, or indicated that they enjoyed participating. Less than five percent of the participants for which the game had a negative impact indicated that they found the scenario too unrelatable, that they felt that there was a lack of agency in paths they could follow in the game, or that they disliked certain aspects of the game. Roughly twenty percent of the participants' sentiments could not be categorized given their responses. Examples of answers that fell into different categories are included in the table below.

<i>Sentiment</i>	<i>N</i>	<i>Examples</i>
Positive impact	78 (75%)	"No, nothing to say more than compliments. You did a really nice job during this scenario. All was perfectly clear and smooth, like a videogame."
		"It felt very relevant considering what is happening to the USA. The incident of the scenario with the policeman reminded me of the police brutality towards the black community."

		“The scenario was successful in creating feelings of anxiety and anger.”
Unconfirmed	21 (20.2%)	“The test was our view of the government but the “harmful” acts were from civilians like the store, pharmacist or hotel manager. There is no implication of that in the government.”
		“I’m not sure I’d behave exactly as described.”
		“I couldn’t have what others have without [...] struggling but at the same time I don’t find the use of violence a right solution.”
Negative impact	5 (4.8%)	“I think this scenario was pushing you to choose violence over any other options.”
		“It became hard at times to imagine the scenario, because I have been very privileged my whole life.”
		“I feel the scenario was constantly pushing me to choose the “violent” or the “rebel” side. I got no options to change things through a peaceful path.”

Table 3: Categorization of participants’ sentiments towards the OIG

7 Conclusions

In this study, we investigated whether the use of experimental data acquired in a newly developed online serious game contributes to the understanding of causes of extreme behaviors under unfamiliar circumstances.

In order to examine this, we investigated three research questions. First of all, we hypothesized that a higher level of immersion could contribute to more authentic behavior in the game. This, in turn, could allow for exhibiting behavior that reflects real-world behavior.

Most participants indicated that they responded to game events as they would in real life. Others, however, responded in ways that they expected their character would, given some event experienced in the game. Although participants were encouraged to respond to events in the game as they would in real life, this might be difficult to do for a reason: entertainment games often encourage roleplay and fantasy. Here, players are encouraged to use their imagination and act out of their ordinary character [39]. Furthermore, Przybylski et al. [40] point to the appeal of video games stemming from their ability to allow players to be an idealized version of themselves. We found that only flow had a significant relationship with authentic reactions. The more flow that was experienced during gameplay, the higher the likelihood participants were showing authentic behavior. Answering the first research question (RQ1), we can state that the construct of flow, a subcategory of immersion, is positively correlated with authentic reactions. This implies that games that elicit flow from participants might be better at eliciting authentic behavior from participants. These findings are aligned with previous research that also found that flow was related to character identification during video game play [41]. It is possible that the association of flow with authenticity is due to participants being able to identify with the character. This finding opens a new line of research for future game-based research as it stresses the importance of designing a game to encourage the flow experience in order to elicit authentic behavior. In further development of the OIG, we might try to encourage authentic behavior by altering the game in line with the GameFlow theory [42] that applies the concept of flow to game design. Other ways in which future studies might be able to encourage flow is to enhance ways to identify with the game’s character. This can be done, for example, by allowing players to customize their own avatar.

Our second research question focused on whether participants who used authentic behavior in the game made different choices in the game than participants who used inauthentic behavior. More specifically, we expected that participants who responded as they would in real life were less likely to make extreme decisions in the game. We found that this was indeed the case. Roughly 40% (58 of 142) of participants who were responding as they would in real life used extremist behavior whereas almost 70% (32 of 46) of participants who responded as they thought their characters would use violent extremist behavior. This confirms the second research question (RQ2). This finding is in line with our hypothesis, and shows that experimental data collected from immersive games studying a real-world phenomenon should stress participants to respond to the scenario authentically.

Our third research question focused on whether variation in the visual detail in the game affected immersion levels; we hypothesized that participants experiencing the less detailed visuals would be less immersed than participants experiencing the more detailed visuals. We found that the lack of detailed visuals did not necessarily reduce participants' immersion; in our study, there was no effect of graphics on the level of immersion. Therefore, there is no evidence to confirm the third research question (RQ3). Previous literature has stressed the importance of images, claiming they can "make or break a game" [19]. Although the gaming community might stress high-quality graphics for game development, there has been previous research that found that good graphics in a game do not necessarily affect a player's immersion [43]. Coutu et al. collected and analyzed 70 Metacritic and Steam reviews of a reboot of the game *Thief*. They found that many of these reviews spoke positively about the graphics in the game, but most reviewers did not feel engaged or immersed in the game. This, in combination with our findings, suggests that high-quality graphics for games does not necessarily lead to increased immersion. Alternative reasons for immersion could lie in story-telling and interactive content.

While some participants did not respond at all to an open question asking for additional feedback, more than half of the participants did. The findings answer the fourth research question (RQ4) on sentiments towards the game experience. A large majority indicated playing the game had a positive impact on them, and many participants commented on the game's unique ability to allow players to experience prejudice and hardships that they do not normally face on a day-to-day basis. This is encouraging for future studies since it means that participants were provided with a unique experience to take the perspective of others that are less privileged than they are. In addition, it suggests that participants are more inclined to give high-quality data instead of only trying to quickly finish the game.

In all, this study shows the potential of graphic adventure games to empirically investigate extreme and unfamiliar behaviors such as the path toward violent extremism. Participants spontaneously mentioned the advantages of taking the perspective of those who are repeatedly discriminated against, and at least a selection of them is able to respond in the game as they would have done in real life.

8 *Future research*

One of the conclusions of this research is that modalities of immersion other than system technology and the perceptual response deserve further study. Since there was no effect of presence or absence of graphics on immersion in the game, it is likely that the two other drivers of immersion (narrative and challenge) are of more importance when eliciting authentic behavior in a graphical adventure game. An immersive narrative, where the story is in line with the previous experiences of the participant, may be of great importance for immersion. Future research may be done in this area regarding the use of interactive or adaptive storylines. In the domain of Virtual Reality Exposure Therapy, such concepts are

already being used [44] for treatment of specific phobias. It is worth investigating how the participants' path through the storyline can be less linear and more personalized in game-based research.

Another interesting avenue for future research with the OIG is to examine how differences in pre-existing experiences, needs, and traits affect their behavior in the game. For example, some participants might be more vulnerable to discrimination triggers in the game than others. This could affect how much participants relate to the character and scenario, thereby affecting the way they respond. Additionally, pre-existing video game habits such as types of games played or frequency of playing might affect how participants play the game.

Regarding the study of radicalized behavior, future research might focus on a more granular approach that identifies which specific events in the game impact people's decisions to engage in violent behavior. This topic will be addressed in a forthcoming manuscript by den Elzen, Feddes, Berg, Schaap and Boonekamp (in preparation).

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