AALBORG UNIVERSITY
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Master Thesis

Effect of Immersive (360°) Video on Attitude and Behavior Change

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Abstract

The present study is designed to test how the role of immersion, narrative content (focus on emotional immersion) and presence can affect one's pro-environmental attitude and behavior with specific interest in 360° videos (i.e., immersive videos (IV)) and meat consumption as a non pro-environmental behavior. This thesis describes a between group design experiment that compares two systems with different levels of immersion (a tablet screen as the low immersion system and a head-mounted display as the high immersion system) and two types of narratives, one involving emotional content and the other not. In the study, 21 participants were subject to the IV condition (high immersion) where they watched, with an HMD, an emotional 360° video about meat consumption and its effects on the environment; another 21 participants experienced the Tablet condition (low immersion) where they viewed the same video but with a 10.1 inch tablet; 22 participants in the Control condition viewed a non emotional video about submarines with an HMD. The purpose of the experiment was to test the effect of presence and emotional impact on pro-environmental attitude and behavior. In a questionnaire, self-reported measurements were used to address presence, emotional impact and pro-environmental attitude, while an unobtrusive method evaluated pro-environmental behavior. The method consisted of offering the participants two snack options (pizza with and without meat), after being exposed to the videos, and then registering their choices. The results suggest that both immersion and emotional impact enhance self-reported presence; higher immersion and emotional impact led to a more pro-environmental attitude; narrative content and emotional immersion (i.e., personal attachment to the characters) enhanced pro-environmental behavior. However, no significant difference was found in pro-environmental behavior in relation to

immersion and self-reported presence.

Keywords: Immersive Video, 360°, Narrative, Presence, Behaviour, Immersion, Empathy, Emotional Immersion

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Introduction

Whoever controls the media, controls the mind. - Jim Morrison

1.1 Motivation

The emergence of immersive videos (360° videos visualized with a head mounted display), as any other new type of media, generates various questions about its potential uses. Can it be a new chapter in the history of film? Or is it just a stepping stone to something greater (perhaps, cinematic VR)? How can society benefit from it? According to the immersive storyteller Chris Milk, virtual reality has the potential to create empathy in people [35]. Although he refers to cinematic VR i.e., stereoscopic video and ambisonic audio, this project aims to test with the same emotion (i.e., empathy) and to accomplish it with 360° video (monoscopic).

With the development of 360° cameras and software, the concept is within the general public reach. Also, due to the current development of head mounted displays (HMD), the technology is evolving towards the end user and not only available for developers.

360° video allows the viewer to be surrounded by the video, becoming immersed in the environment and interacting with it by rotating the head when wearing a HMD (similar to virtual reality, however not to be confused with). It invites the viewers to participate in the scene without allowing them to take action in the story. As proposed by Vosmeer and Schouten [52], a 360° video can be considered *lean-in media*.

It's unclear if immersive videos can influence human behavior and attitude towards real world issues such as environmental problems. The motivation for this study is not to convert people into vegetarians but to discover whether immersive videos can alter attitudes and behaviors that negatively affect the environment.

2

Related Work

A study by Ahn & Bailenson [3] shows that when comparing mental simulation with embodied experiences in immersive virtual environments (IVE), the latter produces significantly higher pro-environmental behavior. In the experiment, participants who embodied a tree cuter in the virtual world, used less napkins afterwards when asked to help clean water spilled from a glass.

Ahn & Bailenson [3] suggest that instead of relying on traditional media, promoting pro-environmental behavior could become significantly more persuasive for the general public if presented as an embodied experience in virtual environments e.g. designing the message into a video game.

Nevertheless, it's relevant to ask what happens when instead of the traditional media, the message is present in a 360° video with similar visual input as in an IVE.

As referred by Witmer and Singer [54], involvement can be obtained with overall media such as movies, books, video games. While immersion depends on one's perception of being part of the VE stimulus, i.e., feeling as part of the environment [54]. 360° videos provide us with the sense of immersion, of being inside the story.

Considering the findings by Baños et al. [6] that showed no differences between stereoscopic and monoscopic presentations in virtual environments regarding presence and emotional reactions, one can argue that by using 360° video (monoscopic video) in this project, the results should be applicable to cinematic VR (stereoscopic video).

As a storytelling medium, a narrative is present in a 360° video. For the sake of the experiment, a proper narrative that fits the format had to be created. As suggested by Vosmeer et al. [51] one possibility could be the use of the "string of pearls" approach (an interactive storytelling structure). As Tanenbaum [48] proposed, the sense of participating in a scene may be as important as the actual power to influence its outcome. Also, it's important to evaluate its dimensions to assure whether the final results depend on the narrative itself or on the sense of presence due to the methods of display (screen vs HMD). For example, if we assume that the narrative does not have the desired effects, i.e., it is not sufficiently convincing or engaging for the viewer, it might influence the results. Busselle & Bilandzic [11] presented a scale for measuring narrative engagement with elements such as empathy and narrative presence (sensation of leaving the actual world and entering the story). Storytelling and hardware can be used as strategies to heighten the immersive experience of the viewer [52].

Another study [50] found that higher immersion led to an increase of the intensity of the viewer's emotions. This suggests that 360° video visualized with an HMD should have greater impact on the viewers when in comparison with watching on a low immersion screen.

Since 360° videos are a combination of motion pictures (film/cinema) with the surrounding environment existent in virtual reality, it's relevant to consider the role of films in human behavior and attitudes.

Movies have the capability of influencing viewers [2] [26] [13]. The direct

relation between the effects of films in viewers' minds originated a new research approach named *Neurocinematics*. Hasson et al. [21] results show that some films establish a higher level of correlation between the activated brain regions of viewers. This indicates how much control the director has over the audience's experience i.e., it's possible to produce and edit a film in such a way that triggers the same regions in the brain's of the whole audience.

The second component of 360° video, immersion, amplifies senses e.g. stronger immersion leads to more intense emotions [50]. This project research aims to find if the combination of both is powerful enough to exert a certain behavior in the viewers.

2.1 Presence (Mediated Environment)

Presence is the mental state, a perceptional illusion created by a mediated environment that appears to be "real" [31]. It is the human reaction to immersion [45].

Presence as well as its conditions (immersion and involvement) is something that the individual experiences [54]. Thus, an individual property [31].

Involvement happens with one's focus and attention on a coherent stimuli [54]. It varies according to how well the activities and events attract the viewer's attention [54]. In this experiment, the narrative is part of the stimuli, therefore it is important to provide the sense of presence. The narrative's events and flow, will determine the level of presence even if great levels of immersion can be obtained by the HMD viewing.

Immersion describes a unique affordance present in digital media that heightens the mediated content reality, as mentioned by Ahn [3]. Some define

immersion as a state of being included in and interacting with an environment that provides a continuous stimuli, a vivid illusion of reality to the senses [54] [46].

Immersion is affected by isolation from the physical environment, perception of self-inclusion in the VE, natural modes of interaction [54] i.e., rotating the head to look around. A VE that produces greater sense of immersion, produces higher levels of presence [54]. This can be comparable, in some extent, to a person driving a car versus driving a motorcycle. In a car, everything is seen through a frame, like a screen, comparable to a TV. One becomes a passive observer, such as when watching a 360° video on a screen. While driving a motorcycle, the frame disappears, allowing the driver to become inside the scene and not just watch it within the limits of a frame.

Overall, immersion is the capability of a digital technology to simulate and surround the user with layers of sensory information [3] [54] [46]. In this project, 360° video visualized with a head mounted display is referred as immersive video (IV), given the factors mentioned previously.

Greater levels of immersion, heightens the sense of presence [54], therefore:

> H1: Participants in the IV condition will report higher levels of self-reported presence than those watching the video on screen.

In this study, immersion refers to what the technology provides [45] i.e., the layers of sensory inputs delivered, such as auditory input, visual input, etc. Presence is used as a measurement of the individuals' evaluation towards the IV realism and credibility.

2.1.1 Behavior Change

Consumers with higher sense of presence were more likely to be persuaded after watching infomercials on television, than those who felt less presence [25]. The study also suggests that the users are likely to feel persuaded when they experience presence [25]. Therefore, it can be argued that presence vividness offers viewers' such realistic experiences that leads to persuasion changes.

Participants exposed to vivid messages regarding hot water usage during a shower in a virtual environment, used cooler water compared with when exposed to not vivid messages [5]. Their results suggest that technology which provides vividness may be effective in encouraging pro-environmental behaviors. One can consider 360° videos a medium that provides vivid experiences. Given the fact that these recorded moving images produce a clear replica of the real world.

Because the specific IV (concerning meat eating and it's issues) is expected to transmit vivid messages and a greater sense of presence, thus anticipated to lead to greater behavioral change and persuasion compared to the video visualization on screen (low immersion, thus low sense of presence). Therefore, it is hypothesized that:

> H2A: Viewers in the IV condition will engage in a more pro-environmental behavior than the ones watching the video on screen.

> H2B: Viewers in the IV condition will report a more pro-environmental attitude than the ones watching the video on screen.

Finally, a broader subject is explored. Based on previous discussions,

> RQ: Can immersive videos influence the viewer's attitude and behavior

in the non-mediated real world?

2.2 Narrative Presence

As mentioned previously, presence can be considered the human reaction to immersion [45]. Other than being a technological aspect, immersion has become popular in contemporary culture and has been used to describe highly intense satisfaction provided by an engaging activity, such as an artistic experience [42].

A sequence of events i.e., narrative, through text, motion pictures, etc. can provide the user with the sense of presence [42] [43]. According to [43], until VR is perfected and becomes available to the general public, motion pictures is considered the most immersive of all media. Perhaps IV can be considered a primary sketch for a greater masterpiece that VR will provide (cinematic VR).

If one looks attentively at one of the four rhetorical modes in literary work, namely description, in this study, the IV footage can be considered its visual representation. Taking into reflection the mental representation engendered by the reader, which is provided by the descriptive writing [43], an IV can allow a vivid representation of the story being narrated, putting the viewer in the actual place. This is a comparison between the descriptive work in literature and the footage used in this study. It works as a complement to the story.

Due to the fact that an IV is recorded in 360° degrees, the viewer, when experiencing the medium, has the sense of being present in the movie, being in the actual scene. Contrary to typical film where the viewer watches it from the outside, in an IV the viewer's sense of presence is defined as "being

in the story world" [40].

In this project it is believed that the use of a voice over suits the sense of presence experienced by the viewers in an IV, by allowing them to be immersed in the visual imagery. As mentioned by Ryan [42], the narrator tells the story as true facts.

A second person perspective, where the narrator talks to the audience directly, can be considered a better fit to the immersive qualities provided by the IV. This meets with what is referred by Vosmeer and Schouten [53] after they have experimented with different voice over perspectives. A second person perspective provided the audience the best sense of presence, of being part of the narrative that they were experiencing [53].

The narrative for this study includes alterations in space (scene location changes), therefore in order to not disturb the sense of presence, the transitions done between footage should be taken into account. One possible solution could be fading the video into and from black, resembling opening and closing the eyes slowly. This is implemented in this study.

According to Ryan [43] there are three forms of involvement with narratives: spatial immersion, temporal immersion and emotional immersion. The most relevant two for this project are the sense of being on the scene of the narrated events (spatial immersion), as it was referred previously, and the personal attachment to the characters (emotional immersion). Regarding the latter, it's given a specific focus on empathy.

2.2.1 Empathy

Studies showed that the relation between empathy and attitude towards a stigmatized group, where those induced to feel empathy reported more pos-

itive attitudes towards the group as a whole [8] and even increased action on their behalf i.e., readiness to help [7]. Empathy is also positively related to pro-environmental behavior, where individuals in an empathy condition reported stronger pro-environmental tendencies than those in a low empathy condition [38]. Due to this, empathy is considered in the narrative presented to the viewers in this study.

Empathy can be felt by the viewer towards a character in the story [24]. The audience's identification with a character allows them to share the same emotional state (empathy) e.g. feel the emotional pain the character is feeling [24].

In this project, the narrative aims to create empathy in the viewers by exposing them to a certain character's point of view. How meat consumption affects the character directly and indirectly. By doing so it's also expected that the viewer becomes moved by another person's suffering i.e., feels compassion [28]. One can presume that this will lead to a more personal connection with the environmental issue, by giving it a "face" and showing the other side of the problem. Hence, by inviting empathy, it's anticipated that it will contribute towards a pro-environmental behavior, in this case. The remaining question is whether immersive video enhances this behavior.

3

Experiment

In this study, meat eating is considered non-environmental-friendly, i.e., non pro-environmental behavior. The core of the experiment is to test whether immersive videos can contribute to curb the issue by changing a person's attitude and behavior regarding meat eating.

Various studies have shown the weight of livestock production and meat eating for climate change [47] [16] [14]. Some also suggested the decline of meat consumption as a measure to halt the increase of greenhouse gas emissions [33] and yield public health benefits [22]. Climate change creates a negative impact in agriculture and human well-being, namely in developing countries where the climate change will cause food yield declines due to the change of rainfall patterns [37].

The effects of meat consumption on the environment [4] and personal health [12] have been exposed by some documentaries such as *Cowspiracy* and *Forks Over Knives*. Even though the awareness to the topic has been increasing and reaching more people, it's clearly not enough since it keeps being widely practiced. Partially because of certain mentalities raised due to the education received throughout life. The psychology of meat eating is a vast study area of the problem [32].

As mentioned previously, it's clear that meat eating is an aggravating

factor of climate change. Since reducing meat consumption can be essential to restrain climate change and because it is such an extensive practice in society, as one can reckon, it was considered to be the right subject for this experiment.

Taking into consideration how virtual reality (VR) is formed by computer generated graphics, one can compare VR with being inside a video game, while cinematic VR is like being inside the movie, stepping into the frame. IV is a step closer to it. By being easier to produce due to the various cameras and software available in the market, IV is a good way to test and experiment with narratives.

In short, this experiment consists in presenting a 360° video with emotional content in two types of displays, HMD and tablet screen, and compare results regarding sense of presence, narrative engagement (emotional impact), pro-environmental attitude and behavior.

The next sections of this chapter explain in what the narrative consists of, how the IV was developed, the methods implemented in the experiment, ranging from limitation of design to control group, pilot test, participants' sample, apparatus used and procedure, as well as the applied measurements.

3.1 Narrative

The narrative is presented by an off camera narrator, i.e., voice over (text attached in Appendix A), presenting facts about the effects of meat consumption and how it's related to climate change. At the same time, showing the mentioned places (or related) in the 360° video.

The audio was recorded with a Zoom H4nSP Recorder in Adobe Audition

CS6. Here it was applied an audio treatment, including noise reduction, vocals enhancer, de-essing and center channel extractor effect to remove voice and background music from the video clips. Figure 3.1 shows audio file in Adobe Audition (left picture) and the use of center channel extractor effect (right picture).

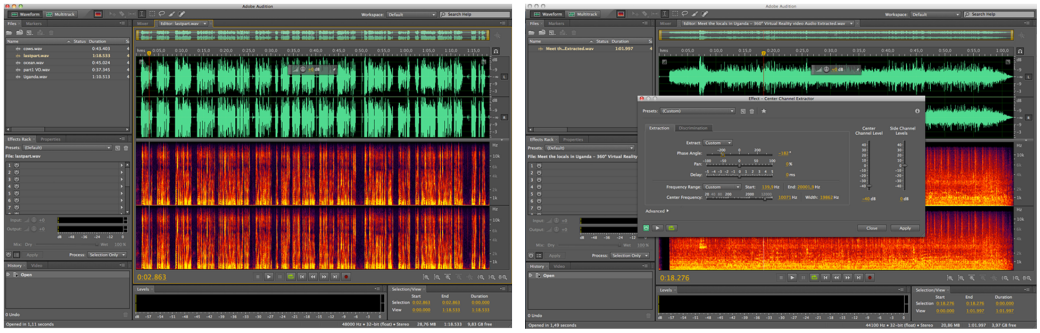

Figure 3.1: Audio file treatment in Adobe Audition.

Even though the characters mentioned in the voice over are fictitious, the narrative is based in facts and real data.

A second person narrator is used, as suggested by Vosmeer et al. [51] in order to not disrupt the viewer's sense of presence. This way the viewer is also guided through the story and informed about the places they are "visiting". For example, in the beginning of the video the viewers are "placed" in the Amazon rainforest while the voice over informs where they are: "You're at the lungs of the planet, the Amazon rainforest" (see Appendix A).

3.2 The Making Of 360° Video

The video is constituted by five parts from five different online videos. Each video was downloaded from Youtube in 4K resolution (3840x1920) with the

4K Video Downloader program [29]. These videos were imported to Adobe Premiere as equirectangular videos. Figure 3.2 shows a video clip after being imported to Adobe Premiere (left side image) and the audio composition from the voice over to sound effects (right side image).

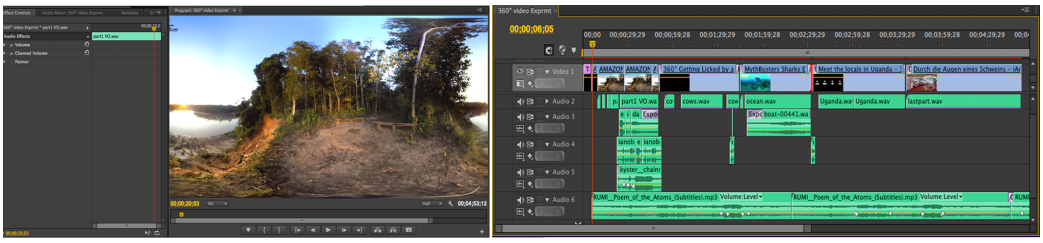

Figure 3.2: 360° video montage in Adobe Premiere.

The sound effects were added to give another layer of reality/vividness to the experience. These effects consist in reinforcements of what is being narrated. E.g. the sound of motors, trees getting cut, breaking and falling while mentioning the Amazonian deforestation, underwater voice effect in sharks footage. As well as the sound of diving into water before the underwater footage appearance, along with the sound of emerging from the water after it. This gives the narrative continuity and fluidity, therefore it is expected to contribute to maintain and/or enhance the viewer's sense of presence.

The desired scenario would be to have a layer of visual effects that would represent what was being narrated. For example, some trees would disappear in the Amazonian forest footage, while being narrated the deforestation facts. Another concrete example would be the cows disappearing while being mentioned their slaughter. This can be compared to a infographics video, where information is represented visually in order to be clearly understood. This also meets what is presented by Bailey et al. [5], that vividness may be effective in encouraging pro-environmental behaviors. These visual effects could be implemented by using Mettle SkyBox Studio, a 360° plugin

for Adobe After Effects [34]. However, this wasn't implemented due to the limit access to the product. Instead, as mentioned above, audio effects were used to work around the issue.

The Ricoh Theta S camera was tried out to film one part of the whole video. Nevertheless, it was concluded that the image quality wasn't enough (1920x1080) for the intended purpose i.e., watching it as an immersive video. As concluded by Bracken [10], image quality is an important factor as it leads to greater sense of presence. Despite the fact that the latter study compared image quality in television, it is taken into consideration for this study as well. One can argue that the better the image quality of the immersive video, the more realistic it will look, hence leading to a higher sense of presence.

The output (final) video was exported with 30 frames per second, in 4K resolution and uploaded to Youtube. In order to be visualized as a spherical video, Youtube offers a 360° video metadata app. With this the viewer is able to move around with the tablet (with gyroscope sensor) and view the video as if through a portal to the story world. Kolor Eyes player [27] was chosen to visualize the video with the HMD. From other possibilities, this was considered the most effective way to play and control the video during the experiment.

Figure 3.3 shows screen-shots of the different scenarios the subject views while watching the 360° video. In the beginning of the video, participants were notified with a graphic content warning (A). Then the video starts and the footage of Amazonian forest is shown (B) (video extracted from *Amazon vr, kingdom of forests* [23]). After this, the participants view the cows in the field (C) [23], followed by the underwater footage with sharks (D) (video extracted from *Mythbusters: Sharks everywhere!* [17]). Next, the Uganda footage is seen (E) (edited from *Meet the locals in Uganda* [49]) and lastly the test subjects view a pig slaughter house (F) (video extracted from *Durch*

die augen eines schweins [19]).

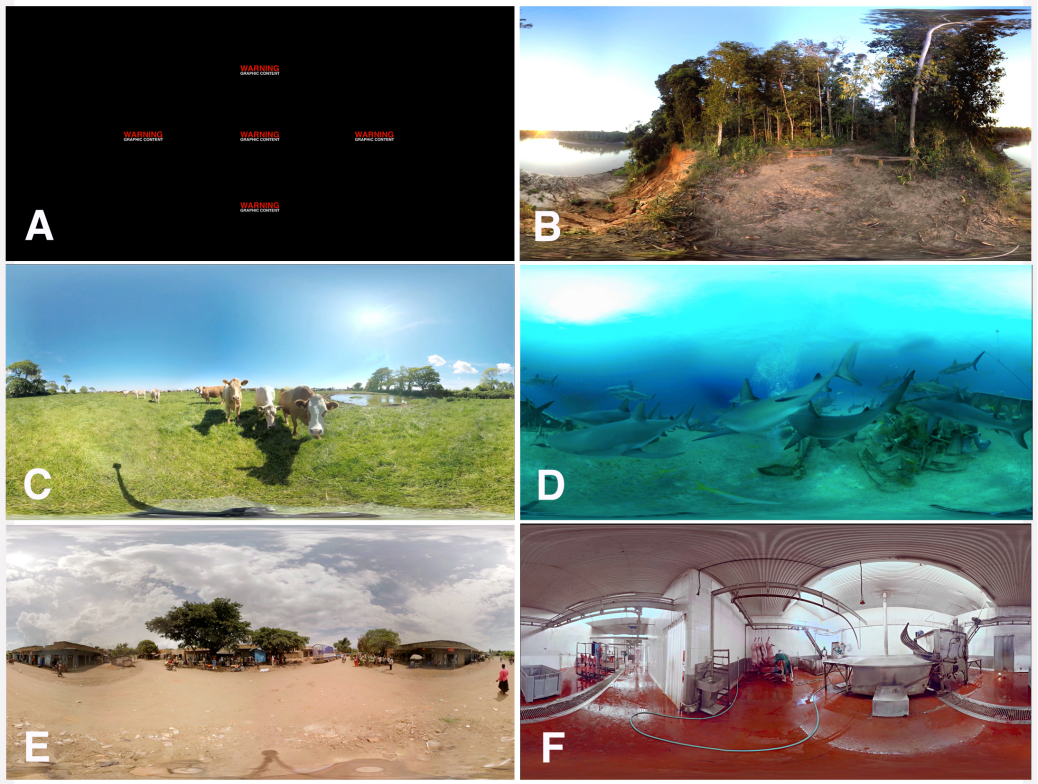

Figure 3.3: Scenes from the 360° video.

3.3 Methods

3.3.1 Limitation of Design

Certain points regarding the IV production should be addressed when aiming to obtain higher levels of realism and consequently a higher degree of presence. Ranging from the narrative understanding (author-audience distance), scene editing/transition, to the angle of the objects and/or subjects in the

scene regarding the viewer, e.g. if the viewer is visualizing the IV seated then the camera should be positioned at a credible height.

The fact that the camera's tripod is visible in some footage (cows in the field, underwater footage and Uganda scene), might break the illusion.

In the underwater footage the camera moves slightly because of the water current (stream). In this case, it didn't cause any disturbance to the viewers, perhaps because it is very subtle. However, a more shaky footage wouldn't work properly since it wouldn't respond correctly to the movements by the viewer, thus potentially decreasing presence.

The fact that there is no visible body in the video, might be a limitation for the perception of presence. At least until the viewer is engaged in a certain activity or looking at a certain place. Nevertheless, one can argue that the absence of a body provides a better experience, than a representation of one that wouldn't respond to the viewer's movements.

Due to limit access to the places mentioned in the narrative, it was decided to use existing online footage. Therefore, only some aspects mentioned previously were taken into consideration in the video montage. Stationary footage and a credible camera height (i.e., close to the person's height) were criteria taken into consideration in all the videos when selecting footage. However, if the camera is positioned too high or low for the average participant, couldn't be addressed.

3.3.2 Control group

There is a need to know whether the snack measurement is valid i.e., if any effect can be measured by the method. A possible way to certify the measurement is to have a control group viewing an IV that is unrelated

to meat consumption. For this, the Australian National Maritime Museum submarine 360° video [36] was chosen. It consists in a submarine tour video, explaining how the watercraft works complemented with historical facts. It was considered to be a good fit for the control group test due to its neutrality regarding emotions.

In order for this video to have a similar length to the experiment video, it was edited and shortened from around 7 minutes to 4 minutes and 30 seconds (the submarine's control room scene was removed).

The control group was also used to test the narrative engagement i.e., narrative involvement and empathy. By comparing the results from the submarine video to the experimental video, differences are expected mostly in the emotional area (experimental video should provoke a more compassionate feeling than the control group video).

Overall, the control group test is executed in order to compare the emotional impact effect on presence, as well as to validate the narrative and the snack measurement.

3.3.3 Pilot test

A pilot test was conducted with 4 participants in order to test the technical aspects of the video. Participants reported to be distracted by the surrounding visuals in the IV, loosing focus of what was being narrated. It is a possibility that this might be a limitation of the medium, i.e., the participant being so immersed and visually distracted that they cannot pay attention to the audio. However, it is important that the test subjects listen to the facts (information) mentioned in the narrative. Therefore, some adjustments were done to the 360° video to minimize the issue. It is worth mentioning that the following changes were decided as a workaround, due to the lack of other

suitable clips for the purpose as well as their length, i.e., video clips need to have a certain duration to work in tandem with the voice over. It shouldn't be forgotten that the voice over complements the video, having an important role in sensitizing the viewer.

Music is used in the video to create a compassionate mood and enhance empathy and compassion in the viewers. After the pilot test, the background music volume was lowered and fades out in the 4th scene (Uganda clip), instead of at the end of the video. It should be mentioned that prior these changes, the audio had the same volume along the video. The reason why this change was made was to enhance the voice over and to create a contrast between the other clips and the slaughterhouse scene. By doing so, it highlights the ruthless reality of the latter scene, allowing the viewer to focus their attention on the harsh visuals.

On top of this, the narrative was reduced. In the beginning of the slaughterhouse scene, a pig is hanging upside down being bled out, when it violently moves and falls over a big container to where the blood leaks. The test subjects reported that they couldn't keep track of the voice over during this scene. Therefore, to take advantage of the power of this scene, the voice over was removed to target the viewer focus only in the video.

Adjustments to the voice over audio were also done. The duration of the breaks in the speech was increase. This way the viewer has more time to "digest" the information presented. Thus, it is expected that they better assimilate the facts exposed.

3.3.4 Sample

Participants were randomly recruited from Aalborg University. In total 64 participants were used in a between group design experiment. 22 participated

in the control group test, 21 in the IV test and other 21 in the tablet test.

The sample consisted in 27 women and 37 men aged 19 to 53. Participants that didn't want the snack were ignored in the snack measurement count. The ones who were vegetarian were disregarded in the analysis of the snack measurement as well as in the attitude towards meat consumption.

Studies showed that the amount of meat consumption between genders differ, where men eat meat more often than women [18] [39]. Therefore, in this study it was taken into consideration the amount of male and female participants on the 3 group tests. Being the IV group composed of 9 female participants and 12 males, as well as the tablet group. This was also taken into account in the control group since this test it's a way of comparing the final results, ensuring its reliability. Hence, by having a similar amount of female and male participants as in the other tests, allows a starting point to compare with the other tests (IV and tablet). In the control group 9 female and 13 male participants took part.

In order to have reliable results, all the participants were naive to the purpose of the experiment. This was to ensure the validity of the snacks measurement, as well as the subjects' answers to the questionnaire. By not knowing what the experiment is really about, the participants are able to give sincere answers to what is being asked in the questionnaire. More in particular to the section regarding their attitude towards meat eating. By knowing the real purpose of the experiment, apart from creating a bias in the participant's answers, they could feel social pressure by the experiment facilitator, i.e., feel judged by the person for opting for a certain snack (in this case meat). Consequently, by keeping the participants ignorant to the purpose of the experiment, diminishes the possibility of social pressure.

3.3.5 Apparatus

The experiment was conducted in the Aalborg University's AVA lab (Audio Visuals Arena). All the tests took place at the same location.

Figure 3.4 shows the experimental apparatus, from the HMD and headset used to the tablet. In the IV test and the control group test, an Oculus Rift DK2 was used as the HMD which was tracked by its positional tracker (see Figure 3.4). The tracker was positioned on a tripod over a table in order to be at the HMD level with the person standing up.

A Samsung Galaxy Note 10.1 2014 edition, with full HD video resolution (1080p) and a video frame rate of 30 fps [44], was used in the low immersion test (tablet group).

JVC stereo headphones HA-RX300 were used in the 3 tests in order to give the same audio immersion.

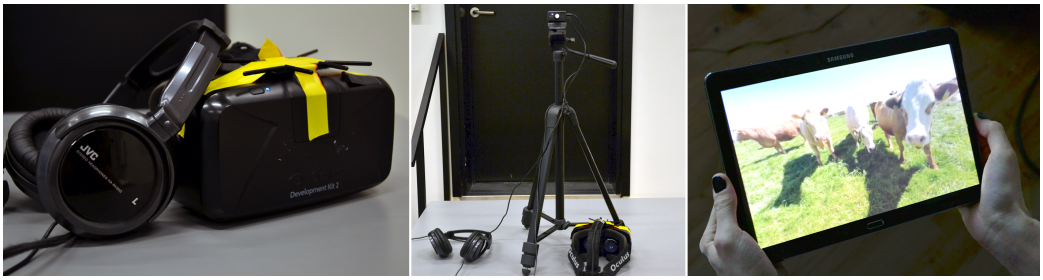

Figure 3.4: Apparatus used in the experiment.

3.3.6 Procedure

The between subjects experiment compares two visualization displays, of the same video, regarding their effectiveness in sensitizing the viewer. The experiment is disguised to all the participants as a test regarding immersion

and presence in a 360° video. This deception works well since they are asked to fill in questionnaires regarding these subjects.

The experiment is divided into 3 tests: control group, IV group and tablet group. Participants were randomly assigned to the 3 conditions. The ones in the IV condition ($n = 21$) and Tablet condition ($n = 21$) experienced the same experimental 360° video. While the control group participants watched the Australian National Maritime Museum 360° video [36]. In the IV condition (see Figure 3.5) and in the control group test, the participants viewed the video using the same equipment (Oculus Rift + headphones). They came to the laboratory and were asked to stand in front of the table where the positional tracker was (see Figure 3.4).

Figure 3.5: Experiment participants (IV and tablet condition).

In order to create a higher contrast between what the participants perceive as the experiment and the snacks measurement, the lights in the room were used. When the participants entered the AVA lab, the lights were off. It was explained to them that this was part of the experiment, as a way to increase their immersion. Then, the participants were helped adjusting the equipment to become as comfortable as possible. The participants were then

informed that they were going to watch a 360° video. As well as that they could move their heads and look around in order to explore the world. After watching the video, participants were instructed to sit on a chair and answer a questionnaire. Any doubts that arose while filling in the questionnaire, were clarified. The lights were maintained off during this time and only after the subjects completed the form the lights were turn on. Then, the tablet was removed from the participants' hands and they were instructed to choose a snack, if they'd like, as a "thank you" gift for participating: pizza without and with meat (see Figure 3.6). The plates were calibrated so that each participant would be exposed to the same amount of pizza slices. Immediately after instructing the test subjects, the experimenter turns around as if doing something on the desk, to give the participants the illusion of not being observed, thus making them more comfortable to take a snack. Additionally, by appearing to be uninterested in whatever pizza the participant might take, the facilitator is also contributing to the facade of the snacks not being part of the experiment, while reducing social pressure. Even though it's not perceived by the participants as part of the experiment, their choices were registered. To the participants who chose the vegetarian pizza, the facilitator asked them if they are vegetarians, before they left the room. The participants who already didn't ate meat (vegetarians/vegans) were discarded in the snack measurement as well as in the attitude towards meat consumption.

Figure 3.6: Snacks given to the participants.

Whereas in the tablet group, the subjects are shown the 360° video on the Samsung Galaxy Note 10.1 while wearing headphones. For this, they were seated on a chair. In order to move the camera and explore the whole video, the participants were instructed to slide the image with their fingers (see Figure 3.5). This was used because it's a similar motion as when using a computer screen to visualize the video (click and drag). The rest of the procedure regarding lights on/off, questionnaire and snacks, was identical to the IV group and control group tests.

3.4 Measures

The measurements are listed in the same order as presented in the questionnaire, hence as well to the participants (see form attached in Appendix B).

Presence. Assuming that greater immersion engenders higher user presence, which in turn, increases the effectiveness of the mediated environment, it is hypothesized that the IV condition is more successful in changing the participant's behavior than the Tablet condition. Therefore, a self-reported

presence questionnaire was conducted to test H1 and to better interpret the final results.

According to Witmer and Singer [54], involvement is considered a necessary condition for presence, therefore, it is an important determinant of presence. Hence, participants were asked to indicate how involved they were by the visuals and audio in the video (e.g. "How much did the visual aspects involve you?"). A 5-point scale (Likert scale) was used (1 = *Nothing at all*; 5 = *Completely*). The three items were based on Witmer and Singer's presence questionnaire [54] and used to access presence on the different displays (tablet vs HMD).

Narrative engagement: Presence & Empathy levels. In order to compare the displays' role i.e., whether higher immersion influences the narrative engagement, the post-experiment questionnaire also includes questions to measure empathy and narrative presence.

On a 5-point scale (1 = *Completely Disagree*; 5 = *Totally Agree*), participants were asked to mark the level of presence provided by the narrative (e.g. "I felt I was inside the story."). Empathy was measured similarly (1 = *Nothing at all*; 5 = *Extremely*), with two items also adapted from the narrative engagement scale [11] (e.g. "To what extent did the story affect you emotionally?").

This is also compared between the control group and IV group to validate whether the narrative fits the purpose of the experiment i.e., engages and creates empathy within the viewers.

Attitude towards meat consumption. These questions were administered to measure how the experiment's 360° video about meat eating,

affected the participants attitude towards meat consumption (H2B).

On a 5-point scale (1 = *Completely Disagree*; 5 = *Totally Agree*), the subject's opinion towards global warming was analyzed, i.e., whether they believed in its existence and if they agree that it needs to be addressed ("Global warming is a serious threat and needs to be addressed."). The answers for this question that show a negative attitude towards the issue, are not expected to have a change of attitude towards meat consumption. Therefore, these participants are not expected to show a pro-environmental behavior.

Attitude towards meat consumption was measured similarly: a question where participants report their interest in information regarding vegetarian/vegan foods ("I would like to have more information about vegetarian/vegan foods.") (1 = *Completely Disagree*; 5 = *Totally Agree*); and to what degree they consider consuming less meat after the experiment ("To what extent are you considering eating less meat after what you've acknowledged in this experience?") (1 = *Nothing at all*; 5 = *Totally*).

Snacks. To obtain naturalistic responses outside the experimental environment, it was decided the use of an unobtrusive method to measure the participants' behavior (test H2A).

In order to outwit the subjects product preferences, it was decided the use of pizza as a snack (see Figure 3.6). The participant's decision in taking a meat free snack was used to measure the effectiveness of the immersive video on pro-environmental behavior.

4

Results

P-values and difference in means for most of the dependent variables can be viewed in Table 4.1. The table includes what was addressed in the questionnaire, therefore excluding the snacks measurements.

Table 4.1: P-values and Difference in Means (values between 1 and 5 for the IV condition minus values for the Tablet/Control condition) for Dependent Variables by Condition (p <0.05).

Condition	IV & Tablet		IV & Control	
Dependent Variables	*p-value*	*DiM*	*p-value*	*DiM*
Visual Involvement (Presence)	.0003	1.095	.032	0.431
Auditory Involvement (Presence)	.916	-0.048	.879	.058
Realistic Feel (Presence)	.001	1.047	.033	.455
Narrative Presence	.0009	1.142	.017	0.686
Empathy (Emotional Impact)	.049	.524	7.322e-06	1.623
Sympathy for Characters (EI)	.017	.666	7.264e-07	2.080
Interest in Vegetarian Foods (Attitude)	.018	1	.004	1.398
Reducing Meat Eating (Attitude)	.016	.857	1.308e-05	1.718

In order to compute the *p-values*, Mann–Whitney U tests were run. When comparing IV and Tablet conditions, the results show a significant difference (p <.05) in all the dependent variables but the auditory involvement. The difference in means shows that the IV condition scored higher than the tablet condition, on the 5-point scale, in each respective categories. Only with the exception of the auditory involvement, where the tablet condition scored slightly higher than the IV condition, with no significant difference.

Likewise, when comparing the IV with Control conditions, results show a significant difference in all dependent variables but the auditory involvement. Also, by analyzing the difference in means between the two groups, it's visible that the IV condition ranked higher in all dependent variables. The fact that the Control video scored significantly lower, proofs that the narrative constructed for the experiment serves the purposes of the study by having a high emotional impact on the viewers.

4.1 Presence

The following bar charts display the questionnaire's results for the Presence section. They show the participants' answers in the 5-point scale, for each dependent variable. The charts show the number of participants that answered a certain level in the scale and the respective percentage for each condition (Control, IV and Tablet).

When examining the visual involvement, it's visible a significant difference between the IV condition and the Tablet condition (p = .0003). The bar chart 4.1 shows that, in the IV condition, the participants gave positive answers towards visual involvement, where the majority of the participants (20 out of 21) answered being *involved* and *completely involved* in the visual aspects (rank 4 and 5 in the 5-point scale). While in the Tablet condition the

answers are more spread out along the 5-point scale, with the higher number of participants reporting to be *somewhat* involved in the visual aspects (level 3 in the 5-point scale). There's a significant difference between the Control group and the IV group ($p = .032$). In the Control condition, the participants answered positively in regard to visual involvement, where the majority of answers concentrated on level 4 of the 5-point scale.

Regarding the auditory involvement, there is no significant difference between the IV and the Tablet condition ($p = .916$). Figure 4.1 shows that some participants rated the Audio Involvement negatively (low rank) in both conditions, however the amount is higher in the IV condition, with 6 out of 21 participants. Nevertheless, in both groups, a higher amount of participants rated the Audio Involvement positively (rank 3 and above) than negatively. Regarding the Control group, there's no significant difference in comparison with the IV group ($p = .879$). The answers are spread out along the whole 5-point scale, with 6 participants ranking it negatively (rank 1 and 2). However, the overall ratings are positive.

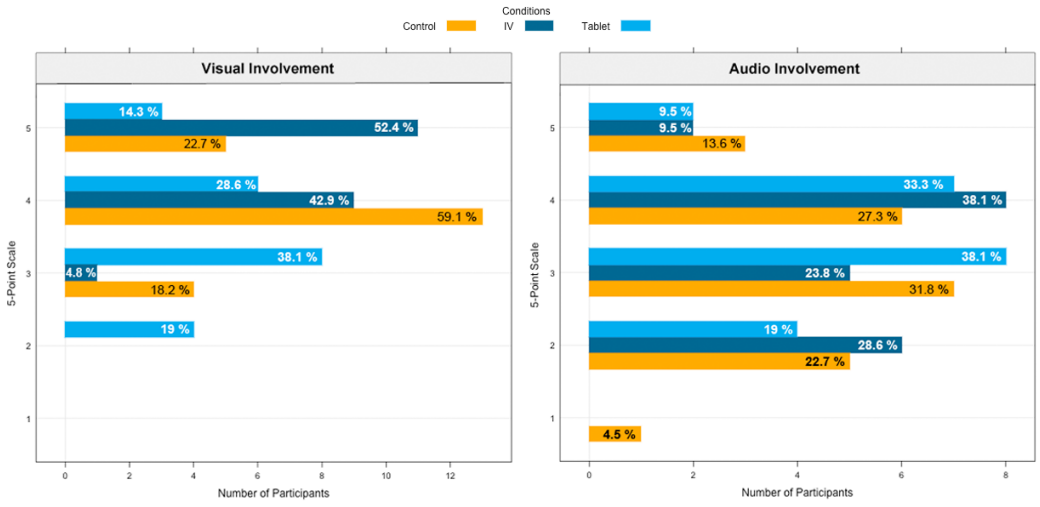

Figure 4.1: Bar charts with visual and auditory involvement.

Another presence measurement used was realistic feel. There's a significant difference between the IV and the Tablet condition ($p = .001$). Figure 4.2 shows that the IV condition ranked positively (rank 3 and above), where the majority of participants evaluated the experience as being *realistic*. While in the Tablet condition, the answers shift downwards. 8 participants (out of 21) ranked it negatively (rank 2 and below). Nevertheless, more than half of the test subjects rated it positively. However the IV condition was ranked higher than the Tablet condition, meaning that IV participants self-reported a higher sense of presence. H1 was supported. In regards to the Control group, there's a significant difference in comparison with the IV condition ($p = .033$). Most answers stand in the middle of the scale. In comparison with the IV condition, in the Control test, most participants ranked the experience as being *somewhat realistic* (rank 3), while in the IV condition, participants ranked it as *realistic* (rank 4). Overall, the experience provided in the Control test, was positively ranked.

Narrative presence was also addressed. The results report a significant difference between the IV and Tablet condition ($p = .0009$). Figure 4.2 shows a shift in the distribution of the answers along the 5-point scale. The answers in the IV condition, ascend the scale, with only one person reporting not feeling inside the story world (rank 2). The majority of the participants rated the condition positively. While in the Tablet group, the rates descend the scale. Note in particular the large amount of negative ratings (9 out of 21) regarding narrative presence.

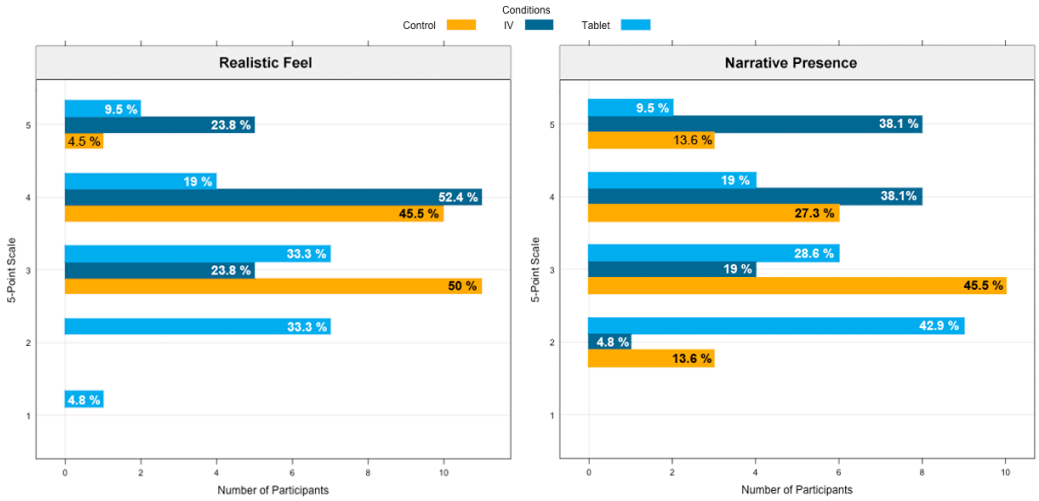

Figure 4.2: Bar charts with realistic feel and narrative presence.

The IV and Control condition are also significantly different ($p = .017$). The bar chart shows a concentration of answers in the rank 3, meaning that a large number of participants reported to be inside the story world to some extent. It's also visible a few negative ratings.

More data visualization charts are available in Appendix C.

4.2 Emotional Impact

The next section in the questionnaire refers to the Emotional Impact caused by the experience. The bar chart regarding empathy (Figure 4.3) shows a rank shift between the IV condition and the Tablet one ($p = .049$). A few negative answers are visible, being the highest number of them in the Tablet condition. Overall, both conditions were ranked positively, however the IV condition scored higher with more answers in the highest ranks. Comparing IV and Control conditions, there's a clear difference in rankings between

them (p = 7.322e-06). The majority of Control participants (16 out of 22) ranked the narrative negatively. Overall, while the IV condition was the highest ranked of all condition, the Control group scored the lowest, showing the difference between narratives in the empathy field.

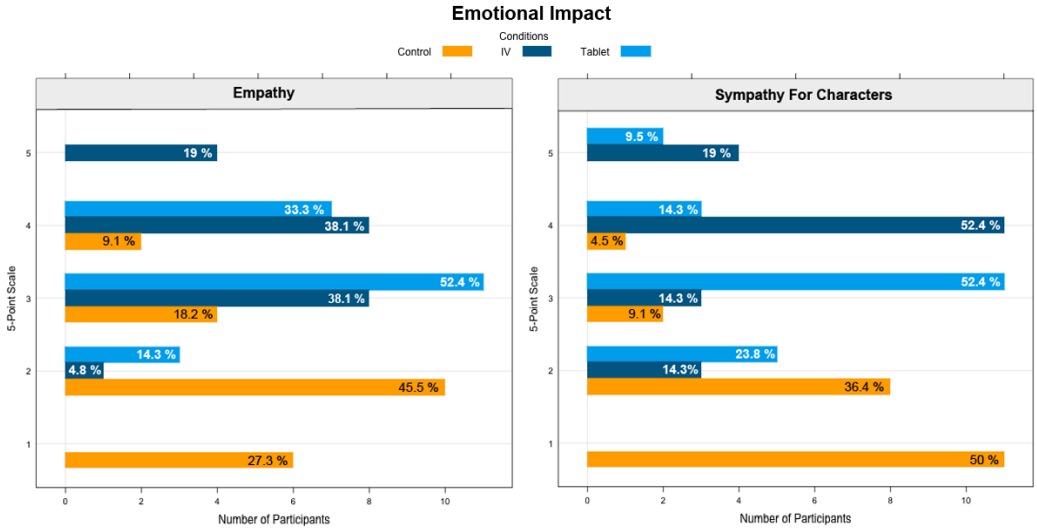

Figure 4.3: Bar charts with empathy and sympathy felt by the participants towards the characters in the story.

In the sympathy for characters field, Figure 4.3 shows a level decrease in the Tablet condition comparatively to the IV condition (p = .017). Both conditions have a few negative answers, however, in the Tablet group more participants ranked negatively. In the IV condition, a higher number of participants felt a higher level of sympathy for the characters in the video. While in the Tablet group, the answers are concentrated in the middle of the 5-point scale. Regarding the Control group there is a clear difference in rankings with the IV condition (p = 7.264e-07). The majority of the Control test participants (19 out of 22) reported not feeling sympathy for the characters in the video.

More data visualization charts are available in Appendix C.

4.3 Pro-Environmental Attitude

In this study, one of the objectives is to find whether there's an attitude change towards meat eating. Therefore, participants who already removed meat from their eating habits (vegetarian and vegan), were excluded from this data analysis. Also, all the participants involved in the following results, consider global warming a serious threat and that it needs to be addressed.

By analyzing the following bar chart regarding interest in vegetarian/vegan food (Figure 4.4), it's evident that the answers are spread out along the 5-point scale. However, there's a significant difference between the IV and Tablet condition ($p = .018$). The answers in the former are concentrated in the highest rank (5) and in the latter condition the answers are dispersed between the middle ranks. This shows that participants in the IV condition reported to be more interested in vegetarian or vegan food, than the ones in the Tablet condition. Regarding the Control group, the number of answers ascend in the lowest ranks of the scale, meaning no interest in food without meat (11 out of 19 participants). In comparison with the IV condition, the Control group subjects reported less interest in vegetarian foods ($p = .004$).

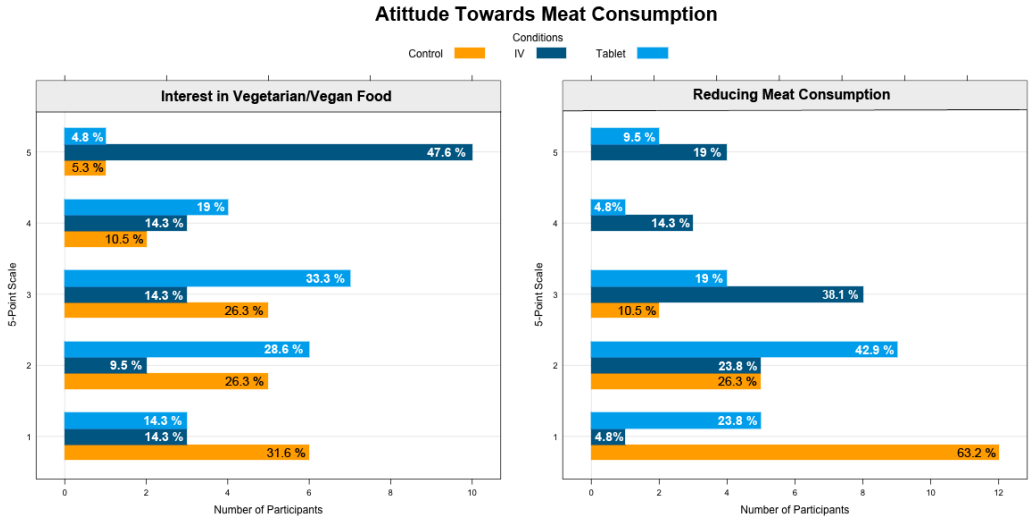

Figure 4.4: Bar charts with participant's attitude towards meat consumption.

In the bar chart regarding reducing meat consumption (Figure 4.4), it's visible the distribution of answers along the scale in both conditions, IV and Tablet. However, there are significant differences between the two ($p = .016$). A higher amount of participants reported being whiling to reduce their meat consumption in the IV condition (15 out of 21) than in the Tablet condition (7 out of 21). Hence, in the Tablet group, a higher number of participants reported not reducing their meat intake after what they've acknowledge in the experience (14 out of 21). H2B was supported. In the Control group, the overall answers were negative, where 17 out of 19 participants reported not reducing their meat intake after the experience. Therefore, existing a significant difference between the IV and Control conditions ($p = 1.308e\text{-}05$).

More data visualization charts are available in Appendix C.

4.4 Pro-Environmental Behavior

Participants who didn't pick a snack, as well as vegetarians, were removed from the pro-environmental behavior analysis. This way, the sample consisted of 18 participants for the IV condition, another 18 participants for the Tablet condition and 16 participants in the Control group.

A Fisher Exact test was run in the number of vegetarian and non-vegetarian snacks intake by the participants. A comparison between the IV condition and the control group shows that the snack measurement is valid. The Fisher test results show a significant difference between the two conditions, with a $p < .05$ ($p = .001$).

Another Fisher test was run to compare the IV condition with the Tablet condition. The results show that there is no significant difference between the two ($p = .499$). H2A was not supported.

When comparing the Tablet with the Control condition, there's a significant difference between the two, with a $p = .0197$.

Below is a contingency table 4.2 with the amount of participants who chose pizza with meat and without, in the snack measurement.

Table 4.2: Snacks' measurement contingency table by condition

	IV group	Tablet group	Control group
Meat	9	12	16
Without Meat	9	6	0
Total	18	18	16

Even though it's not a significant difference, in the IV condition more participants chose the vegetarian snack, in comparison with the Tablet group.

50% of the participants in the IV group chose the vegetarian snack, while in the tablet group the percentage was a lower 33.3% (See Figure 4.5).

In the Control group, from the participants who took a snack and that weren't a vegetarian/vegan already, none chose vegetarian pizza.

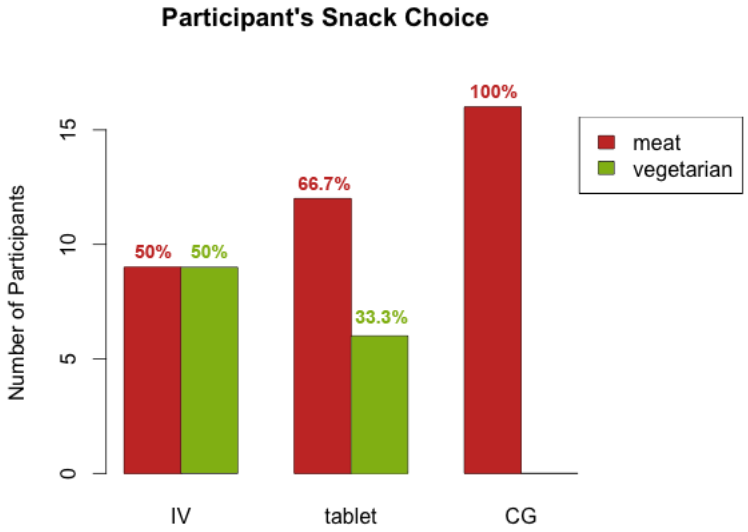

Figure 4.5: Amount of vegetarian and meat snacks chosen by the participants on the 3 group tests.

4.5 Observations

Some observations were made throughout the experiment, as well as some feedback collected from the participants.

During the IV condition test, participants expressed their amazement by the immersion provided. Commentaries such as "Oh wow! Where am I?"; reacting to the visuals of the video, such as getting scared by the cows and backing off, others even tried to touch them. Some participants tried to

circumvent the sharks underwater, as if they were really there.

After viewing the IV, some participants shared feedback from their experience. Some mentioned the fact of being too distracted with the surrounding visuals and missing some parts of the narration (i.e., voice over). A participant referred to the Uganda footage as feeling like "being at home", while another person admitted being afraid of the ocean and that the underwater footage was "a bit frightening" and "hard to cope" with.

No similar feedback or reactions originated from the Tablet condition (low immersion).

5

Discussion

Different points can be discussed from the results of this study. They show that both an emotional content and immersion, influences sense of presence. Participants in the high immersion condition (IV) felt significant higher levels of presence compared to those in the low immersion (Tablet group). This is also supported by the observations during the experiment. While less often used than self-report methods, there are more objective ways of measuring presence, such as behavioral measures [20]. These measures include reaching for a virtual object (as some participants tried to touch the virtual cows) and reflex reactions (avoiding the virtual sharks). The results between the IV and Control condition, show that the emotional content might be a crucial part in the sense of presence. Both conditions provide the same immersive display (HMD), but by having different types of narratives, convey different levels of presence. The stronger emotional immersion [42] provided by the IV condition appears to reflect in a higher sense of presence.

The reason why participants reported a higher visual involvement in the IV condition than in the Control condition, might be due to the fact that the IV footage had more movement/action, hence becoming more engaging. Also, when comparing IV and Tablet condition, it's clear that immersion affects visual involvement.

No significant difference was expected between the media in the auditory involvement, since the audio provided is identical. However, filming an immersive video with spatial audio [41] would likely increase the viewers' sense of presence. For example, by capturing sound with an Omni Binaural Microphone [1], one can provide the audience with omni directional binaural audio, i.e., reproducing audio as human ears hear it and thereby increasing the sense of presence during the experience.

Realism is affected by immersion. One can argue that an IV, by displaying accurate real world dimensions, i.e., virtual objects with real world scale, such as humans, trees, etc., enhances the scene realism and therefore presence. This is clearly visible in the results between the IV and Tablet condition. Realism factors are also related to the meaningfulness of the experience [54]. Presence should increase as the experience becomes more meaningful to the participant [54]. This can be related to the identification with characters (emotional immersion) or even the fact that climate change is an issue affecting the world's population, therefore creating higher interest in people. This can explain the results between IV and Control condition.

Narrative presence seems to be enhanced by immersion as well as the emotional immersion. As mentioned by Busselle and Bilandzic [11], engagement in a narrative results in loss of awareness of oneself and it's related to the connection with the characters (emotional immersion). The higher the connection with the characters, the higher the narrative engagement. Hence the difference between IV and Control conditions in narrative presence, where the emotional immersion differs due to the change of narrative. Narrative presence consists in the sensation of leaving the actual world and entering the story world [11]. By having a high immersion medium, such as the IV, facilitates this process by isolating the viewer from the outside world. Therefore, the results between IV and Tablet where the immersion factor varies.

Higher immersion leads to an increase of emotional impact on the viewers. This echoes the findings of Visch et al. [50], that higher immersion increases the intensity of the viewer's emotions. It can be argued that the proximity experienced by the viewer in an IV, enhances their emotions towards the event. IV viewers experience the story world in a first person view, as a witness, experiencing stronger emotions. This explains the differences between IV and Tablet regarding emotional impact. As suggested by Codispoti and Cesarei [15], image size provokes sympathetic changes, more specifically, the larger the image, the higher the emotional viewer arousal. Thus, the difference between IV and Tablet in sympathy for the characters. Also, the fact that the IV benefits more from the sympathy for the characters than empathy, might also be due to the image size. As presented by Lombard [30], subjects watching larger television screens reported more positive emotional responses to the persons' on screen. This could be related to the fact why participants in the IV condition reported higher sympathy for characters than in the Tablet condition. It's possible that the more positive emotional responses the participants had towards the characters, more sympathy they felt for them. Also, watching a video on screen can be considered more impersonal than watching an IV. Furthermore, empathy seems to be less influenced by immersion and image size than sympathy for the characters.

Higher empathy led to improve pro-environmental attitude. As shown by Batson et al. [8], feeling empathy for a member of a stigmatized group can improve attitudes towards the whole group. This study shows that empathy was enhanced by immersion and led to higher pro-environmental attitudes towards meat eating (i.e., reduce meat consumption).

By using an unobtrusive method to measure behavior, one is able to obtain natural responses outside the experimental environment. Also, by using the room lights to assist in the outline of the experiment, helped reinforce the facade and distance the snacks from the experiment. The lights worked

as a signal. The same is used in other areas such as cinema, theater, live performances, where the lights are turned off when the show is about to start and turned on when it's over, giving the audience a subtle notice. By distancing the snack measurement from the experiment, it is unlikely that participants recognized the purpose of the experiment, suffered from any peer pressure or worry about the socially desirable answer. This works towards validating the method.

The narratives' content and emotional immersion affected pro-environmental behavior. When comparing the IV condition with the Control group, there's a significant difference in the meat snack intake. Participants in the empathetic condition (IV and Tablet), chose significantly less meat snacks in comparison with the ones in the Control test. This meets the findings by other studies [38] [9], that empathy is positively related to pro-environmental behavior. However, the hypothesis that viewers in the IV condition would engage in a more pro-environmental behavior than the ones watching the video on screen, was not supported by the unobtrusive method. The results did not show that immersion affects pro-environmental behavior.

5.1 Limitations and Future Work

Limitations of design mentioned in chapter 3 might have negatively influenced the participant's sense of presence to a certain extent. In future research, one should create an IV with a more immersive audio (as mentioned previously) and address the limitations of design in this experiment. Also, it should be taken into consideration the fact that an immersive video is immensely visually involving. Therefore, it might be wiser to invest in transmitting a message visually, rather than through narrated text. However, this doesn't mean that one should underestimate the power of audio. For instance, if the

goal is to portrait the deforestation issue, instead of investing in the voice over text, a better idea could be to visually represent the issue. Either by showing the before and after scenario, or having the trees fading away depicting the deforestation issue. To further enhance sense of presence, having binaural audio recordings of the environment, where one could hear forest noises, such as birds, wind, leaves rustling, etc. would increase the scenes' realism. It's difficult for the viewer, to cope with the surrounding visuals, paying attention to the action around them, while still trying to notice what the narrator is saying. It's reasonable to assume that the viewer's direct their attention to what is more interesting, entertaining and therefore, enjoyable. That being the visuals. Hence, one should use the right dosages of engaging visuals, immersive audio, narration and time for the viewer adjust to the environment. This, in order to reach the perfect balance and allow the viewer to take the most out of the experience.

Empathy, i.e., feel what the character is feeling, could possibly be enhanced by a different type of narrative. For example, a video about the journey of a slaughter animal, through it's own POV, allowing the viewer to see what the animal sees. This is often referred to narrative situation [24]. In addition to, creating a longer narrative focused in one main character, could enhance character identification, which also invites empathy [24].

This study addresses short-term behavior. It's not possible to know how the video affected the participants over time. Also, locus of control is not addressed. The extent to which a person believes they can control events affecting them might or might not affect how they behave towards meat eating. Even if the individuals believe that meat consumption affects climate change, it's possible they won't change their behavior simply because they might feel that it won't contribute to stop climate change. That a one person's actions won't affect the world. For other people, the opposite happens. Nevertheless, this is not considered in the present study. Instead, a general

sample of population was used, without addressing self-efficacy.

6

Conclusion

The current study attempted to test the effectiveness of an empathetic video in a high immersion display (immersive video) in influencing pro-environmental attitude and behavior.

The level of immersion was manipulated through the visualization display, increasing the degree of vividness of visual input provided to the participants in the IV condition. Higher level of immersion and narrative content, more specific emotional immersion, enhance self-reported presence.

Participants in an empathetic condition reported more pro-environmental attitude compared to the ones in a non empathetic condition. Also, higher immersion and emotional immersion influences pro-environmental attitude.

The study did not show that immersion influences pro-environmental behavior. However, the narratives' content and emotional immersion affected pro-environmental behavior. Participants in the empathetic condition engaged in a more pro-environmental behavior.

This study demonstrates the potential of an immersive video in enhancing the audience's emotional involvement. With a certain content and emotional impact, the immersion provided by the medium, works as an emotion magnifier, influencing attitudes in the real world. In any case, it appears to be

more effective than a low immersive medium. One can only imagine the potential of an even stronger medium such as cinematic VR, where presence is even more enhanced than in a 360° video. For now, in order to promote pro-environmental attitudes, such videos could be used in Education and even public service announcements. HMDs are becoming affordable, light and accessible to the public. With the industry growth in the virtual reality area, this seems to be within a closer reach.

This even raises questions on what other changes immersive videos might have in us. Perhaps in areas such as Social Sciences. Can it be a form of fighting prejudice? Can we change attitudes towards racism, homophobia, misogyny and other social issues in modern society? Perhaps, immersive videos are not enough to change minds, but they seem to have potential in shifting perspectives.

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Appendices

A

Voice Over

What's your excuse?

(Amazon forest footage) Hear the birds... The trees... The life inside the forest... You're at the lungs of the planet, the Amazon rainforest (after few seconds, sound of machines and trees falling comes in). Major deforestation is happening here. 70% of the forest has been cut down. Do you know why? Because of livestock production, for meat consumption. 70% of the forest is gone, occupied by pastures and feedcrops. Animal agriculture is responsible for 91% of Amazon destruction.
(cows in the field footage) The white one is Julia and these are her friends... Take a moment and enjoy their presence... More than 3,000 animals die every second in slaughterhouses around the world. An estimate of 9.7 billion are killed every year. Meat is not the only thing. In the milk industry, a cow is impregnated every year, so she continues to produce a steady supply of milk. Calves are removed from their mothers either right away or within 3 days after birth... Julia will be slaughtered in a few days. (butcher knife sound and cow scream) It's quite possible you'll eat Julia or one of her friends.
(sound of diving in water)(footage underwater with sharks) In this ocean, 2.7 trillion animals are pulled each year. But nobody tells you that 40% of fish caught globally every year are discarded. There's more... For every 1Kg

of fish caught, up to 5Kg of unintended marine species, such as sharks and whales, are caught and discarded as by-kill. 50 million sharks are killed in fishing lines and nets. This has repercussions in the ecosystem since sharks keep it balanced. If they disappear we'll pay the price. We could see fishless oceans by 2048. That's in 32 years. (sound of emerging from the water)
(Uganda footage: dry, 3rd world country, water crisis) You're now on a street in Uganda. Damba is 10 and he lives in this town. You can't see him right now cause he went fetch water for his family. Damba is just a kid but his life is about to get worse... Livestock and their byproducts account for 51% of all worldwide greenhouse gas emissions. 51%! You know what this means, right? Because of the rising temperatures, dry countries are becoming even more dry due to the changing rainfall patterns. This affects agriculture and water sources. It is happening here, in Uganda... Some things are inconvenient to tell... Livestock production not only increases the world's temperature but it also consumes resources. 82% of starving children live in countries where food is fed to animals, and the animals are eaten by western countries...
(pig slaughterhouse footage) Perhaps it's time we start looking for a sustainable way of feeding the world. Animal agriculture and dairy products are definitely not it! One person can save more than 600,000L of water annually by giving up burgers, bacon and nuggets. This water would be enough for 445 people! Protein? You get protein from many other sources. Just so you know, there is 15x more protein on any given area of land with plants, rather than animals. The number of people giving up meat keeps rising. By doing so you're not only saving up to 95 animals a year but you're also reducing your carbon footprint to half and helping feed other people! What happens next? Well, that's up to you...

B

Questionnaire

IV group questionnaire attached below serves as reference. Tablet group and Control group questionnaire's are identical. The form attached is the exported format of the questionnaire, hence its basic structure.

IV Group

Please choose a number that better states your opinion, regarding what you've experienced.

*Required

1. **Gender:** *
   Mark only one oval.
   - ◯ Female
   - ◯ Male
   - ◯ Other: .....

2. **Age:** *
   .....

3. **Nationality:** *
   .....

Untitled section

4. **How much did the visual aspects involve you?** *
   Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Completely

5. **How much did the auditory (audio) aspects involve you?** *
   Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Completely

6. **How real did the experience feel?** *
   Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Extremely

7. **I felt I was inside the story world** *
   Mark only one oval.

	1	2	3	4	5	
Disagree Completely	◯	◯	◯	◯	◯	Totally Agree

Please choose a number that better states your opinion, regarding what you've experienced.

8. **To what extent did the story affect you emotionally?** *
   Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Extremely

9. **Throughout the story, to what degree did you become concerned for certain characters?** *
   Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Extremely

Please choose a number that better states your opinion, regarding what you've experienced.

10. **Global warming is a serious threat and needs to be addressed.** *
    Mark only one oval.

	1	2	3	4	5	
Totally disagree	◯	◯	◯	◯	◯	Totally agree

11. **I would like to have more information about vegetarian/vegan foods.** *
    Mark only one oval.

	1	2	3	4	5	
Totally disagree	◯	◯	◯	◯	◯	Totally agree

12. **To what extent are you considering eating less meat after what you've acknowledged in this experience?** *

Mark only one oval.

	1	2	3	4	5	
Nothing at all	◯	◯	◯	◯	◯	Totally

C

Data Visualization

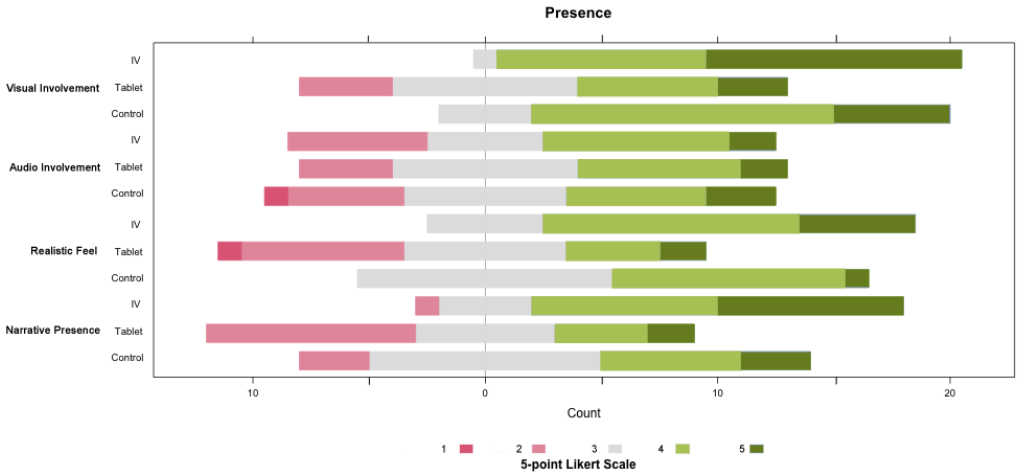

Figure C.1: Diverging Stacked Bar Chart with Presence variables and respective conditions.

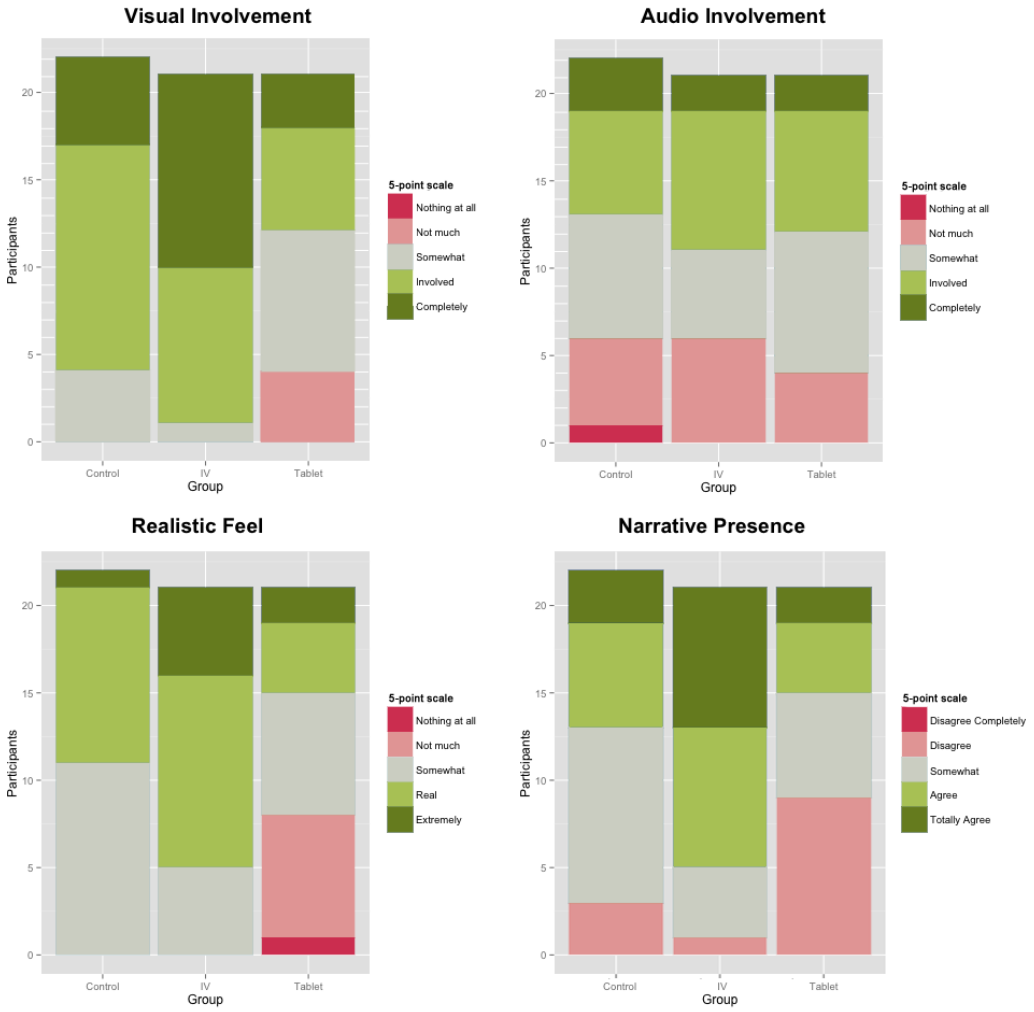

Figure C.2: Presence Stacked Bar Chart.

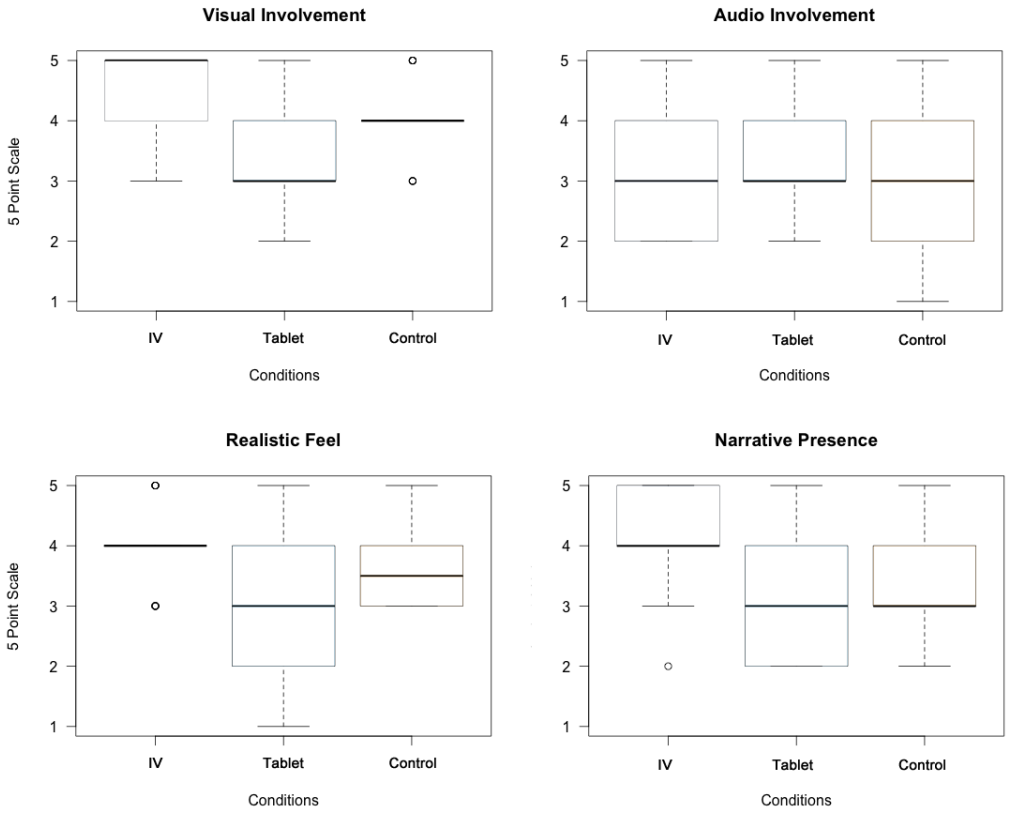

Figure C.3: Boxplots with display's presence and narrative presence.

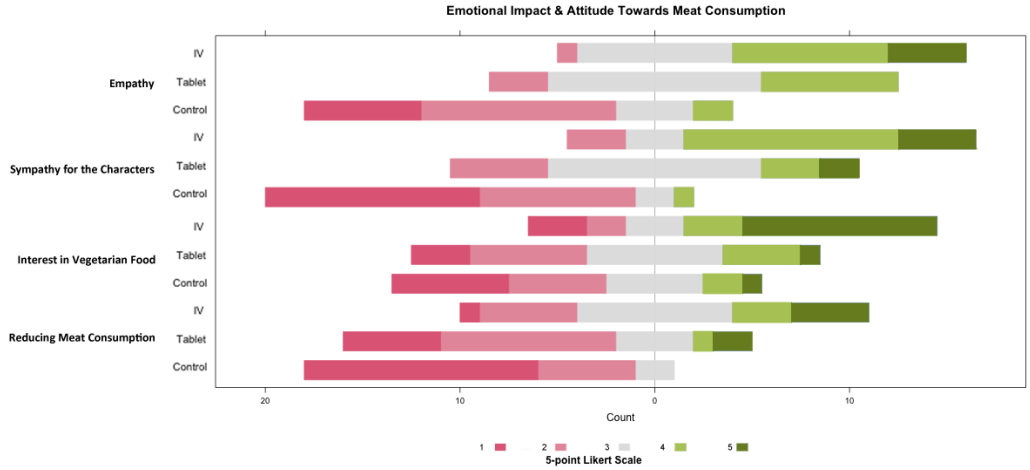

Figure C.4: Diverging Stacked Bar Chart with Emotional Impact and Attitude Towards Meat Consumption variables, with respective conditions.

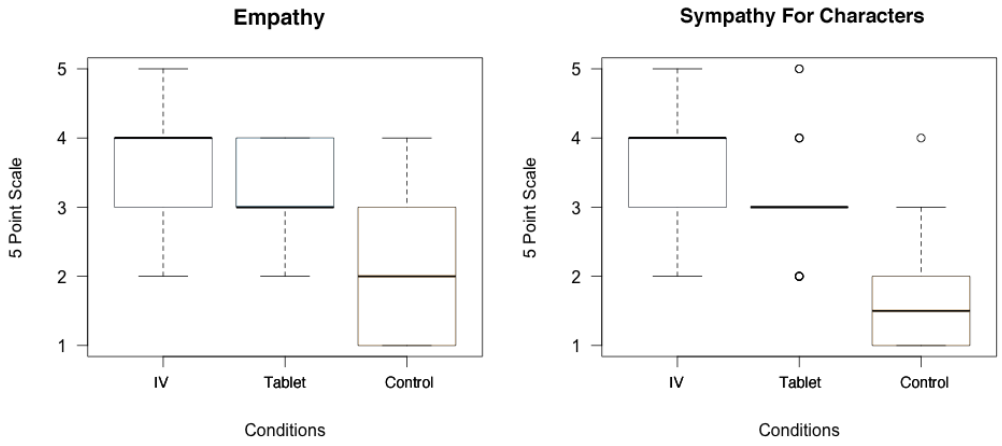

Figure C.5: Boxplots with empathy and sympathy felt by the participants towards the characters in the story.

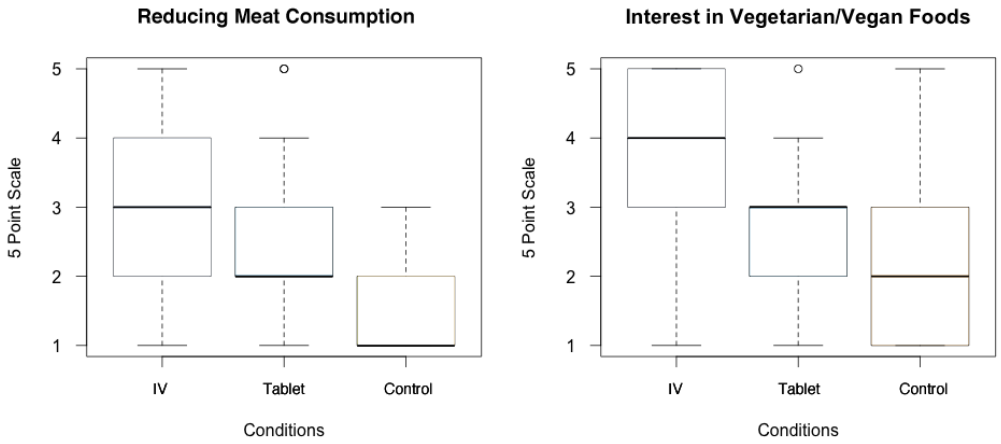

Figure C.6: Boxplots with participant's attitude towards meat consumption.