Awestruck: Natural Interaction with Virtual Reality on Eliciting Awe

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ABSTRACT

In the study of transformative experiences, the feeling of awe is found to alter an individual's perception in positive, lasting manners. Our research aims to understand the potential for interactive virtual reality (VR) in eliciting awe, through a framework based on collection of physiological data alongside self-report and phenomenological observations that demonstrate awe. We conducted a mixed-methods experiment to test whether VR is effective in eliciting awe, and if this effect might be modulated by the type of natural interaction in the form of a "flight" lounger vs. "standing". Results demonstrate both interaction paradigms were equally awe-inspiring, with overall physiological (in the form of goose bumps with a 43.8% incidence rate) and self-report data (overall awe rating of 79.7%), and females showing more physiological signs of awe than males. Observations revealed 360-degree interaction and operability of hand-held controllers could be improved, with the consequence of designing even more effective transformative experiences.

Keywords: Virtual reality, immersion, awe, affective VR, interaction

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems —Artificial, augmented and virtual realities; I.3.6 [Computer Graphics]: Methodology and Techniques —Interaction techniques

1 INTRODUCTION

It is widely discussed that virtual reality (VR) may be the future of communication, yet there is little known on the effectiveness of interactive VR in provoking profound emotions. We know these emotions are positive: when immersed in real-life confined, extraordinary environments such as space flight, astronauts experience a well-documented awe phenomena when seeing earth, termed the '*overview effect'* [1]. Due to the effectiveness of these experiences on lasting, positive change in perspective, we are interested in eliciting aspects of the overview effect through interactive VR, which at its core largely comprises of awe and self-transcendence [2]. Awe can be experienced physiologically in the form of feeling of chills and appearance of goose bumps [3], with this specifically linked to a state of 'being moved' and 'in awe' [4]. Additionally, previous research discovered that experiencing awe may give the sensation that time is abundant, and lead to generous behaviours. The strong connection on awe-inspiring experiences to cognitive shifts can be seen with VR, with reports of shifts in empathy and self-awareness [5]. Hence, awe is a potentially significant experience within the controllable, personalized environment VR offers. This has been discussed by previous researchers [2], but so far there is limited research to support this proposed potential, which motivated the current study. To this end, we investigated whether head-mounted,

interactive VR could indeed generate both subjective and physiological indicators of awe (hypothesis 1). In extending previous research and to make initial findings into virtual reality on eliciting awe, we also studied whether a more embodied interface in the form of a 'flying lounger' might be more effective in eliciting awe than a standing, vertical posture in VR (hypothesis 2). The reason for this prediction is based on previous user interface testing we have conducted that demonstrated user preference towards simulated flight in VR environments. In the interest of exploring cognitive shift, we reason that user preference may be closely tied to embodiment, and this allows opportunities for the shift to occur.

2 METHODS

2.1 Participants

Sixteen participants (10 males and 6 females, average 27.3 years of age) were recruited from a Canadian University and local VR meetup group. Nearly all of the student participants received course credit in exchange for their participation and none were monetarily reimbursed.

2.2 Procedure

After signing informed consent, participants experienced two conditions using a counterbalanced within-subjects design: "flight", where they were directed to semi-recline face forward, and "standing" upright (see Figure 1). The participants were shown how to use equipment prior to the experiment, and were fitted with a purpose-built optical recording device on their non-dominant arm. Each condition lasted 10 minutes, with participants filling out a questionnaire on their experience after each condition. We collected phenomenological observations during the participant's session, such as whether they utilized the full 360 degrees rotation of the headset, and how they handled the controllers (with ease, or not at ease).

Figure 1: "Flight" condition on left, "standing" on right, both use hand-held controllers and head-mounted display.

2.3 Stimulus and Materials

Participants spent a total of 20 minutes in Google Earth VR, an immersive flying demo [6]. The stimulus is interactive through tracked head position and handheld controllers, allowing the user

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to fly and select locations. It was presented on HTC Vive VR with a head-mounted display (2160x1200 resolution, 90 Hz at 110 degree FOV). Audio was presented on Sennheiser noise-cancelling headphones. Physiological goose bump data was recorded using an optical recording device comprised of a Logitech HD C270 webcam and LEDs casting unidirectional light. This system was based on the "Goosecam" [7]. The interface for the "flight" condition was a Jaxx bean bag model, 168cm long. The post-treatment questionnaire for each condition contained questions pertaining to awe, feeling moved, wonder, curiosity, humility, comfort and fear (with definitions provided). These questions were displayed on a visual analog scale of 0 to 100.

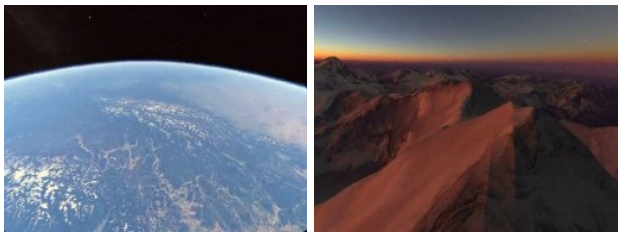

Figure 2: Earth as seen in Google Earth VR.

2.4 Results

Overall, participants rated their emotional engagement high for feeling awed (female M = 84.0, SD = 11.7; male M = 77.1, SD = 19.7). 43.8% of the participants experienced goose bumps. Those who experienced goose bumps showed significantly higher ratings of awe (M = 90.9, SD = 9.8) than those who did not experience goose bumps (M = 70.9, SD = 16.6); $t(14) = 2.82$, $p = .014$, $r = .36$. In confirming hypothesis 1, we could demonstrate that interactive VR can induce both subjective and physiological indicators of awe.

There was a gender difference seen, with 66.7% of females versus only 30% of males having experienced goose bumps. Within the "flight" condition, goose bumps occurred more often in females (M = .86, SD = .96) than males (M = .24, SD = .4), see Fig. 3. Similarly, in the "standing" condition, females had a higher incidence (M = .53, SD = .52) than males (M = .15, SD = .3).

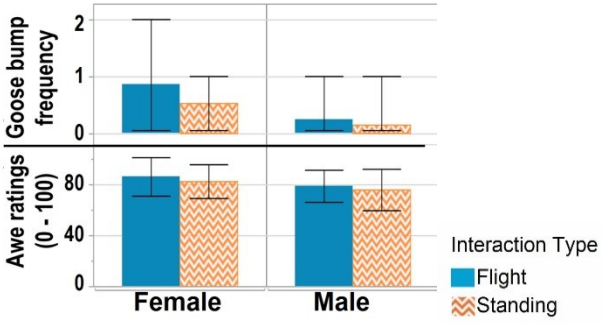

Figure 3: Goose bump frequency and awe ratings (means and 95% confidence intervals) within interaction mode by gender.

Overall, awe was rated similarly between "flight" (M = 81.3, SD = 16.3) and "standing" interaction type (M = 78.1, SD = 19.2) with no significant differences ($F(1, 15) = 1.45$, $p = .24$, $r = .30$), see Fig. 3. The effect of the interaction type on goose bump frequency within subjects was analyzed using the non-parametric Wilcoxon signed-rank test. Although there was a trend for somewhat more frequent goose bump occurrences for "flight" (M = .44, SD = .73) over "standing" (M = .25, SD = .44), this trend was not significant, $Z = 1.13$, $p = .26$, $r = .20$. The small effect size indicates that a larger sample size may yield clearer results. At least for the current study and interfaces used, we thus found no support for hypothesis 2 in that the pillow-based "flight" interface that was assumed to be more embodied was not significantly more effective in eliciting awe than a standing interface.

3 Discussion & Conclusion

This research investigated whether interactive VR can elicit the experience of awe (hypothesis 1) with results demonstrating that interactive, head-mounted VR was indeed effective in eliciting awe in participants, quantifiable with goose bumps (43.8%) and self-reports of awe (79.7%). The goose bump frequency of 43.8% is slightly higher than the 40% in findings from previous research on audio and non-immersive video stimuli eliciting awe [4]. While females had a higher incidence of goose bumps than males, there was no difference between genders when it came to self-reports of awe. Phenomenological observations draw insight into the lack of support for hypothesis 2, as most participants (93.8%) in the "flight" condition" elected to rest on the lounger like a chair rather than semi-reclined as instructed, with only one participant having leaned in a face down position. The seated position is similar to the vertical position that participants maintained during the "standing" condition, and this may explain the lack of differences between conditions. Additionally, ten of the sixteen participants were observed to struggle with the controllers while demonstrating reliance on them in navigating the virtual environment, instead of using the head or body position to navigate. This is likely an artefact of experience with face-forward seated gaming, and leads to discussion around how to prompt interaction within VR environments. Our future work includes the design of improved locomotion interfaces that promote embodiment without introducing cognitive load or arduous interactions. Despite the limitations on interactive interfaces, the results from this study demonstrate the effectiveness of interactive VR content on eliciting awe, which can be measured through both physiological and self-report data.

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