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# Aging Positively: Enhancing Positive Emotions in Older Adults through Natural and Social Experiences in Immersive Virtual Reality

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## Abstract

Recently, immersive technologies such as Virtual Reality (VR) have become believable candidates for enhancing individuals' well-being. However, there are several barriers to using VR to improve well-being, including design, and the availability of diverse video content. Thus, our study aimed to investigate the impact of immersion and virtual environment content (natural vs. social) on different age groups, as there is limited research on this aspect. 38 undergraduates and 25 older adults were recruited for the present study. They watched and rated 360° videos of natural and social contents under a highly immersive Head-mounted display (HMD) and a less immersive screen, while their skin conductance and heart rate were collected. Overall, preliminary findings suggest that while video content matters and leads to specific emotional responses in younger adults, older users reported high levels of positive emotions and arousal throughout most immersive experiences. As these are encouraging results VR for fostering positive emotions in elderly users, potential applications for a "successful aging" or vulnerable users will be discussed.

## Keywords

Aging, Virtual Reality, Positive Emotions, Physiological responses

## Context

Positive emotions are known to have long-term benefits on people's health, quality of life, and overall well-being [1]. Therefore, there are clear benefits to promoting positive experiences and emotions, especially among vulnerable and/or isolated adults. Recently, technologies have become believable candidates for enhancing individuals' health and well-being, leading to the emergence of the "positive technology" framework [2]. This framework suggests that technologies may improve user emotions, well-being, and interactions. Within the positive technologies framework, virtual reality (VR) enables users to have experiences in safe and controlled environments [3] and can trigger changes in their emotions [4]. As such, VR has great potential in improving users' emotions and well-being.

However, there are several barriers to using VR to improve well-being, including cost, design, and the availability of diverse video content [5]. Therefore, it is necessary to investigate which characteristics of the VR experience are essential to efficiently elicit positive emotions. Furthermore, it

is crucial to investigate the VR features that influence users' emotional responses across different age groups. In this context, our study aimed to investigate the impact of immersion and virtual environment content (natural vs. social) on different age groups, as there is limited research on this aspect.

## Methodology

For the present study, 38 undergraduates (19 women, 19 men,  $22.4 \pm 2.5$  years old) and 25 older adults (17 women, 8 men,  $70.3 \pm 5.8$  years old) were recruited. None of the participants had a history of neurological or psychiatric disorders.

The material consisted of two technologies with variable levels of immersion: a highly immersive Head-Mounted Display (HMD) (110° Field of View 1440 x 1600 pixels resolution) and a less immersive computer screen (25-inch screen, 1920 x 1080 pixels resolution). The stimuli consisted of 360-degree videos, with natural, social, or neutral (control) content. To assess participants emotional responses, we employed both self-report and physiological measures. Self-reports consisted of valence and arousal ratings on the Self-Assessed Manikin Scale (SAM). Physiological emotional measures were acquired using the Empatica E4 wristband, which collects Electrodermal Activity (EDA) and Heart Rate (HR) data. Additionally, sense of presence was assessed using the Spatial Presence Experience Scale (SPES), and the Social Richness subscale from the Temple Presence Inventory (TPI-SR).

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Each participant was exposed to 360-degree videos on both a screen and an HMD in a counterbalanced order. For both levels of immersion, participants followed the same procedure. Participants were first asked to watch a control video (an empty waiting room with shapes on the walls) twice for two minutes. The first viewing session served as a training phase so that the users could get comfortable with controlling the exploration in the 360° virtual world. During the second viewing, participants were asked to relax to record physiological data. Next, they watched two natural and then two social videos (or in reverse order). After each video, participants filled out questionnaires to report their emotions and sense of presence. Physiological data were acquired while viewing each video. This procedure was repeated for both technologies (HDM and screen).

## Results and Discussion

As expected, the highly immersive HMD proved to be more efficient than the less immersive screen presentation for inducing positive emotions in both younger and older users. This finding was further supported by higher levels of sense of presence reported by both age-groups for the HMD compared to the less immersive screen presentation.

Interestingly, elderly users reported high levels of arousal for all videos, whereas younger adults reported variable arousal depending on the content viewed. Indeed, younger adults reported the highest levels of arousal for social content, followed by natural content, and finally the control content.

Preliminary analyses conducted on physiological responses indicated a HR deceleration for all participants while viewing natural contents. The HR deceleration was mostly apparent for older adults while watching the natural video contents under the HMD, supporting the relaxing properties of said contents. Additionally, an increase in electrodermal activity can be observed when participants watched social content under the HMD, confirming their arousing properties in comparison to natural content. This increase in EDA is more pronounced for younger adults than for their older counterparts, which is in line with the participants' self-reported arousal.

## Conclusion

Overall, these findings suggest that while video content matters and leads to specific emotional responses in younger

adults, older users reported high levels of positive emotions and arousal throughout most immersive experiences. These results are encouraging, as they confirm the acceptability of highly immersive VR for eliciting emotions in healthy elderly users. Additionally, our results suggest that video content are differently prioritized by users depending on their age: while younger adults have specific responses to different video contents, this was less the case for elderly users. This is an important finding because the lack of diversity in video content has been raised as a barrier to employing VR for improving well-being in older adults. Since these findings support the effectiveness of VR for fostering positive emotions in elderly users, it appears relevant to further investigate the efficacy of VR experiences for more vulnerable and/or isolated elderly users.

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