

Enjoyment

We also test whether enjoyment is influenced by the incorporation of additional sensory stimulation, which we note may be driven by presence (as observed by others, e.g, Jung, Dieck, Lee and Chung, 2016; Tussadiah, Wang, Jung and Dieck, 2018). Tussadiah, Wang, Jung and Dieck (2018) conducted two studies exploring attitude change towards tourist destinations when people experienced a VR virtual walkthrough of Tokyo, Japan, (experiment 1), and Porto, Portugal (experiment 2) via Google Cardboard viewers (experiment 1) and Samsung Gear VR (experiment 2). Via survey assessment, presence was found to predict enjoyment ratings (in experiment 1 the standardised regression coefficient for presence predicting enjoyment was 0.34; in experiment 2, 0.27). The authors argued that this relationship is mediated by the state of flow (Csikszentmihalyi and Csikszentmihalyi, 1990; Weibel, Wissmath, Habegger, Steiner and Groner, 2008).

The *Enjoyment Hypothesis*, predicts that enjoyment will be modulated by presence, as observed previously (Jung, Dieck, Lee and Chung, 2016; Tussadiah, Wang, Jung and Dieck, 2018).

Methods

Unless otherwise stated, methodology is as stated in the main manuscript.

Design

Whole experience presence, *ExperiencePresence*, was assessed by averaging the results of 4 separate Likert scale based questions each with five options scored from 0-4 (Verhulst, Woods, Whittaker, Bennett and Dalton, 2021; based on a subset of a presence measure developed by Schubert, Friedmann and Regenbrecht, 1999).

Analysis

For the analyses focusing on *Enjoyment* (entered as an ordered factor), we included the predictors *ElementPresence* (here entered as an integer, ranging from 1-5), *Element*, *ElementPresence*, *Age*, reported *Gender*, *EverUsedVR*, *LocationBased* and *OverallExperiencePresence*, as well as the interaction *ElementPresence:Element*. We did not

include *ExperiencePresence* as a predictor in the main analysis as we assumed covaried both with the dependant variable *ElementPresence* and with the predictors (n.b. ‘colliders’ have strong detrimental effects on model efficacy; e.g. Asendorpf, 2012).

Results

Enjoyment Analyses

The Cumulative Link Mixed Model (CLM) focusing on enjoyment was developed. A summary of the final model ($AIC = 4689.6$), $\text{enjoyment} \sim 1 + \text{age} + \text{gender} + \text{ownVR} + \text{everUsedVR} + \text{locationbased} + \text{element} + \text{experiencepresence} + \text{elementpresence:element}$, is provided in Supplementary Table S1. Dropping the interaction did not impact model fit, $AIC = 4689.2$, $\chi^2(df = 4) = 7.66$ $p > 0.05$, implying the interaction had little predictive value. People reporting as male (enjoyment $EMMs = 4.58$, $CI = 4.54\text{--}4.62$) were 0.85 less likely to rate Enjoyment of the experience on a higher star rating (by 1 star) than women ($EMMs = 4.61$, $CI = 4.58\text{--}4.65$), $CI = 0.72\text{--}1.00$, $p = 0.05$. Each increase in experience presence (4-point scale), led to an increasing in likelihood of 4.45 for an increase of 1 star rating, $CI = 3.86\text{--}5.14$, $p < 0.001$ (scoring 1 on the experience presence, $EMMs = 3.86$, $CI = 3.79\text{--}3.93$; scoring 4, $EMMs = 4.93$, $CI = 4.89\text{--}4.98$). Unsurprisingly, an increase of *ElementPresence* by 1 unit led to a 1.61 likelihood increase in rating by 1 star, $CI = 1.27\text{--}2.04$, $p < 0.001$ (Table 5 showing this relationship). Those who had taken part in a location-based VR experience before ($EMMs = 4.56$, $CI = 4.52\text{--}4.60$) were 0.74 times less likely, compared to those who had not taken part in such an experience ($EMMs = 4.63$, $CI = 4.59\text{--}4.66$), to rate the experience 1 star more than they had done so, $CI = 0.60\text{--}0.90$, $p < 0.01$.

Table S1.

Summary of the enjoyment model

Enjoy			
Predictors	Odds Ratios	CI	<i>p</i>

1 2	0.90	0.24–3.32	0.873
2 3	2.44	0.72–8.29	0.152
3 4	31.90	9.72–104.66	<0.001
4 5	249.17	75.16–826.01	<0.001
everUsedVR [Once or twice]	0.95	0.77– .19	0.673
everUsedVR [Occasionally]	0.79	0.59–1.07	0.126
everUsedVR [Regularly]	0.65	0.42–1.02	0.062
gender [1]	0.85	0.72–1.00	0.050
age	1.00	1.00–1.01	0.241
ownVR [2]	0.95	0.69–1.30	0.748
experience-presence	4.45	3.86–5.14	<0.001
element-presence	1.61	1.27–2.04	<0.001
msi [free-roam-walking]	0.78	0.19–3.20	0.728
msi [audience-avatars]	2.60	0.67–10.07	0.167
msi [floor-vibration]	2.82	0.73–10.86	0.133
msi [virtual-hands]	3.48	0.98–12.37	0.054
locationbased [2]	0.74	0.60–0.90	0.003
element-presence × element [free-roam-walking]	1.07	0.79–1.46	0.668
element-presence × element [audience-avatars]	0.83	0.61–1.12	0.213
element-presence × element [floor-vibration]	0.81	0.60–1.09	0.168
element-presence × element [virtual-hands]	0.79	0.59–1.05	0.103

Observations

3462

Discussion

The *Enjoyment* hypothesis predicted that presence would influence enjoyment ratings, and we observed that here, in line with past research (e.g., Jung, Dieck, Lee and Chung, 2016; Tussadiah, Wang, Jung and Dieck, 2018).

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