Science Talks 10 (2024) 100346

Contents lists available at ScienceDirect

Science Talks

journal homepage: www.elsevier.es/sctalk

Improving immersive consumption contexts using virtual & mixed reality

Imogen Barker [a,b,c,*], Qian Yang [a], Martin Flintham [b], Rachel Ankeny [c], Rebecca Ford [a]

[a] Sensory Science Centre, School of Biosciences, University of Nottingham, Nottingham, United Kingdom
[b] Mixed Reality Lab, School of Computer Science, University of Nottingham, Nottingham, United Kingdom
[c] School of Humanities, University of Adelaide, Adelaide, SA, Australia

ARTICLE INFO

Keywords:
Virtual reality
Mixed reality
Immersive experiences
Wine
Sensory evaluation

ABSTRACT

Immersive technologies, such as Virtual Reality (VR), provide a great opportunity to create relevant contexts in consumer studies. However, challenges persist in consuming food and drink during immersion and ensuring effective data collection. This study addressed these challenges using an innovative approach incorporating Mixed Reality (MR), embedding virtual questionnaires responsive to hand gestures and using custom-made wine glasses. Two virtual contexts were created – a sensory booth and a wine bar with integrated audio and avatars. The purpose of this study was to investigate the effect of context elements on participant experiences. Thirteen participants consumed two different rosé wines (40mls each) in the two different virtual contexts, Participant insights regarding their immersive experience were collected using a structured questionnaire. Results showed participants effectively used hand gestures to respond to various questionnaires, whilst zones of real-world visibility enabled wine glass interactions. Audio and avatars played pivotal roles in creating a realistic and immersive virtual bar environment. Using MR, custom glassware, hand gesture recognition, embedded questionnaires and wireless headsets proved to be an effective approach for collecting data from multiple fully immersed participants, simultaneously. This innovative approach demonstrated sensory evaluations can be undertaken entirely within virtual environments, eliminating the need to break immersion. This advancement could yield more valuable consumer insights, enhancing understanding of consumer preferences and experiences.

Video to this article can be found online at https://doi.org/10.1016/j.sctalk.2024.100346.

* Corresponding author at: Sensory Science Centre, School of Biosciences, University of Nottingham, Nottingham, United Kingdom.
E-mail address: Imogen.Barker@nottingham.ac.uk (I. Barker).

http://dx.doi.org/10.1016/j.sctalk.2024.100346
Received 8 February 2024; Accepted 30 March 2024
Available online xxxx

Figures and tables

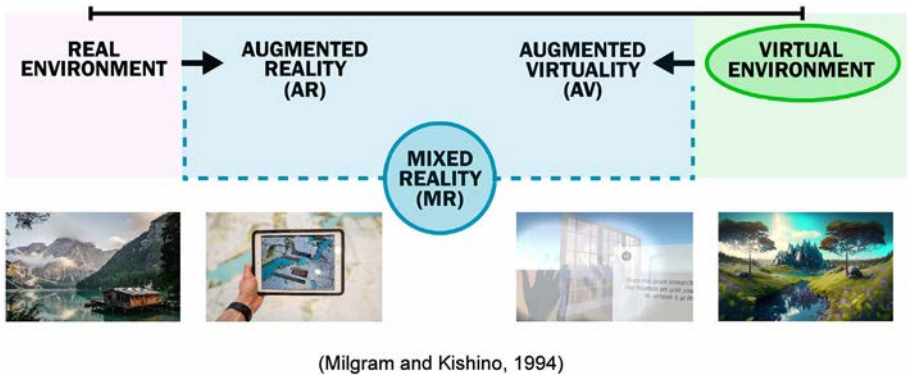

Fig. 1. A diagram visualising Milgram and Kishino's [1] 'reality-virtuality continuum'. The scale starts with a completely real world at the left-hand side anchor. The right-hand anchor represents Virtual Reality (VR), or a completely virtual world. In between these two extremes is referred to as Mixed Reality (MR). This term encompasses the technologies that combine both real and virtual elements, namely Augmented Reality (AR) and Augmented Virtuality (AV). AR overlays digital content onto the real world whereas AV does the opposite, overlaying digital content in the virtual world. In this study, the participant's ability to see their own hands within the virtual contexts is an example of AV and is therefore a form of MR.

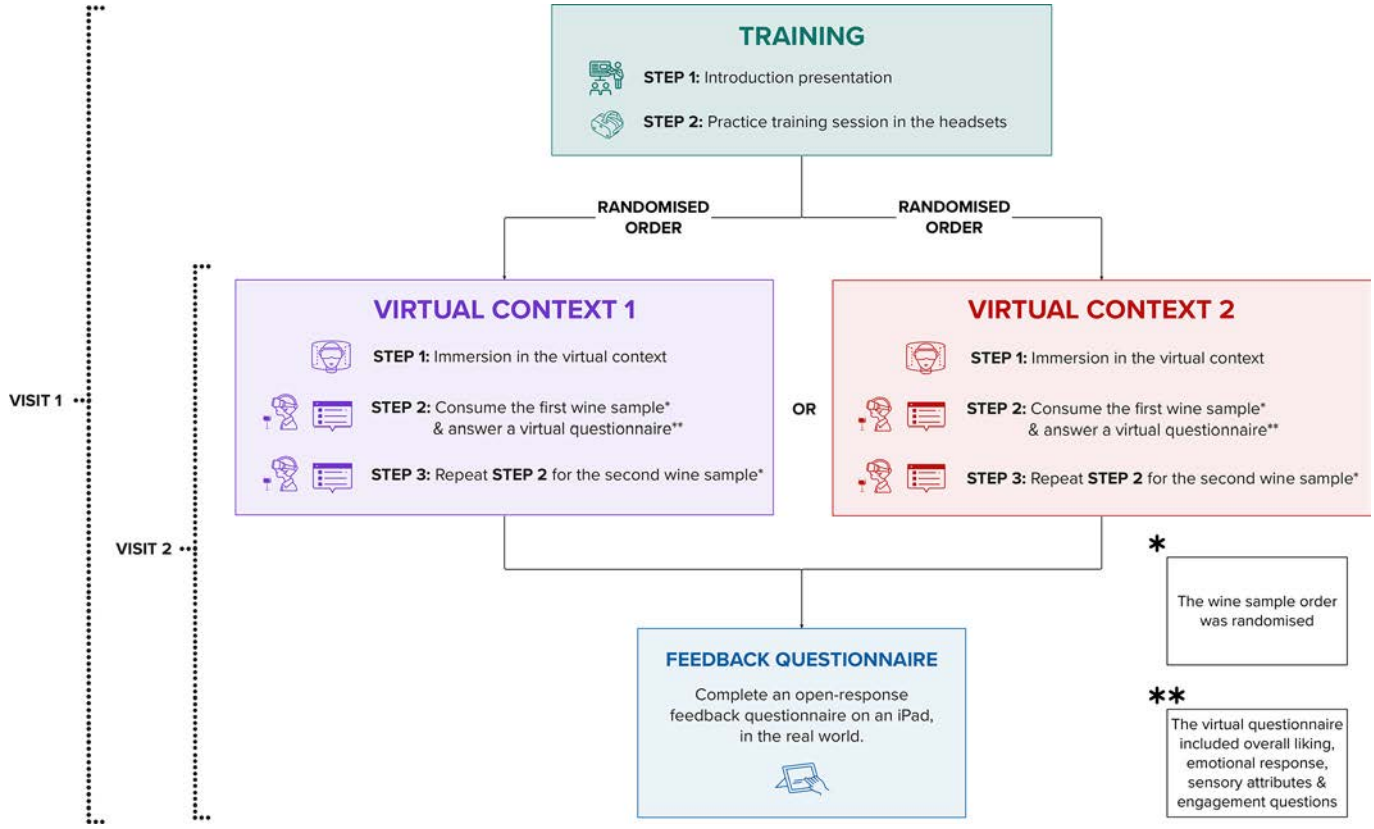

Fig. 2. A flow diagram illustrating the study's design. Participants engaged in two sessions. Initially, they were introduced to a set of reference attributes and then immersed in a virtual training exercise where they practised drinking water from a bespoke wine glass and interacting with the virtual questionnaires [2]. Once complete, the experience automatically moved them into their first virtual consumption context, where they consumed their first rosé wine sample. Contexts and wine samples were presented in a randomised and balanced order. During consumption, they indicated their overall liking (9-point hedonic scale), emotional response (EsSense25) and perception of sensory attributes (Check All That Apply) for each sample via a virtually embedded questionnaire. The experience then automatically moved them into a virtual palate cleanse scene before returning them to the same scene to complete the process for the second rosé wine sample. At the end of the session, after participants had removed their headsets, they provided feedback about their immersive experience via a range of structured open-ended questions. Participants were invited back for a second visit, during which they were immersed in another virtual consumption context. They then repeated the sensory evaluation for the same two wines.

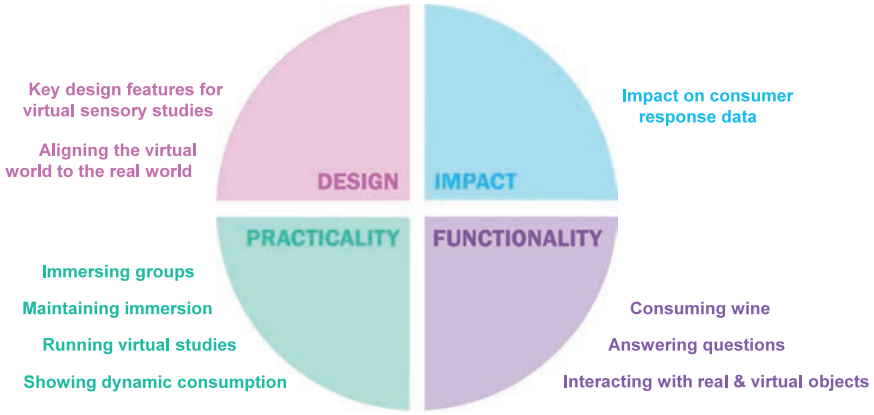

Fig. 3. Open-ended questions were coded and analysed using NVivo software. Four overarching key themes revealed themselves in the feedback – design, impact, practicality and functionality. The immersive sensory research challenges being addressed by this pilot study are shown around the edge. Their colour-coding indicates where they align with the four feedback themes. The feedback provided for each theme will be used to refine and optimise this study approach, with the continued goal of addressing the listed challenges.

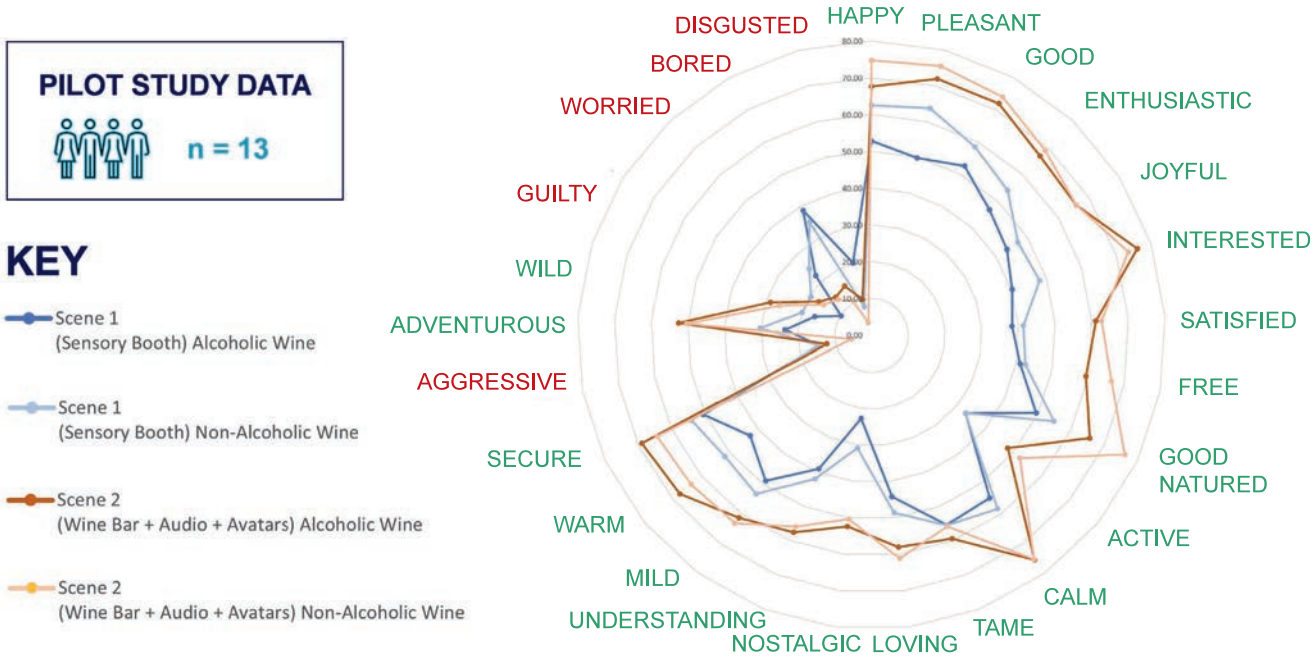

Fig. 4. A spider diagram showing the emotional response data. The blue lines are the sensory booth and the orange lines are the wine bar. The darker coloured lines are the alcoholic wine sample and the lighter coloured lines are the non-alcoholic wine sample. Green text indicates positive emotions and red text indicates negative emotions.

Disclose instructions

During the preparation of this work the author(s) used Adobe Firefly to generate some slide imagery for decorative purposes.

CRediT authorship contribution statement

Imogen Barker: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing – original draft. **Qian Yang:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Martin Flintham:** Conceptualization, Methodology, Software, Supervision. **Rachel Ankeny:** Conceptualization, Supervision. **Rebecca Ford:** Funding acquisition, Supervision, Writing – review & editing.

Data availability

Data will be made available on request.

Acknowledgements

Funding: This work was supported by an Australian Government Research Training Program Scholarship and a consumables sponsorship from Campden BRI UK.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] P. Milgram, F. Kishino, A Taxonomy of Mixed Reality Visual Displays, IEICE Trans. Information Systems, 1994.
[2] Q. Yang, M. Nijman, M. Flintham, P. Tennent, R. Hidrio, Improved simulated consumption context with virtual reality: a focus on participant experience, Food Qual. Prefer. 98 (2022), 104531.

Further reading

[1] R.G. Bangcuyo, K.J. Smith, J.L. Zumach, A.M. Pierce, G.A. Guttman, C.T. Simons, The use of immersive technologies to improve consumer testing: the role of ecological validity, context and engagement in evaluating coffee, Food Qual. Prefer. 41 (2015) 84–95.
[2] D.A. Guttentag, Virtual reality: applications and implications for tourism, Tour. Manag. 1982 (31) (2010) 637–651.
[3] M.H.C. Meijers, E.S. Smit, K. De Wildt, S.-G. Karvonen, D. van der Plas, L.N. van der Laan, Stimulating sustainable food choices using virtual reality: taking an environmental vs health communication perspective on enhancing response efficacy beliefs, Environ. Commun. (2021) 1–22.

Imogen Barker is currently a PhD student at the Sensory Science Centre at the University of Nottingham and the University of Adelaide. Her research is focused on using immersive technologies for sensory and consumer research.

Dr. Qian Yang is an Assistant Professor in Sensory and Consumer Sciences, the University of Nottingham. Her research focuses on bringing relevant contexts to consumer testing *via* advanced technology (*e.g.* virtual reality), investigating individual variation in sweet liking, particularly in the diabetes population, investigating motivations/barriers behind novel protein choices, and cross-cultural studies in sensory perception and consumer behaviour.

Dr. Martin Flintham is an Associate Professor in the School of Computer Science at the University of Nottingham. His research in the field of human-computer interaction includes virtual and augmented reality for new consumer experiences and product development.

Professor Rachel Ankeny is a Professor of History and Philosophy of Science at the University of Adelaide. Her research interests span a variety of areas including bioethics, science policy, and food studies.

Dr. Rebecca Ford is an Associate Professor of Sensory and Consumer Science at the University of Nottingham. Her research is focused on understanding variation in sensory perception, investigating multimodal sensory perception and the use of digital technologies to understand consumer behaviour.