

Group Decision Making in Immersive Virtual Reality and Video Conferencing

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Objectives

- Head-mounted displays enable social interactions in immersive virtual environments. However, it is yet unclear whether the technology is suitable for collaborative work between distant group members.
- Research comparing computer mediated communication (CMC) with face-to-face interaction in terms of group performance has led to inconsistent results (Lu et al., 2012).
- In contrast to non-immersive CMC, VR enables users to convey spatially directed, non-verbal behavior (i.e., selective gaze and gestures), which was shown to be beneficial for group performance (Werkhoven et al., 2001).
- Moreover, thanks to covering the entire visual field, VR allows to reduce extraneous cognitive load by means of controlling task-irrelevant stimuli.
- However, little previous experience with VR and lack of facial cues might be an issue for the effective use of the virtual environment.

Methods

- Sample: 105 participants (mean age: 17.68 ± 1.2 yrs)
- 1st appointment: familiarization with VR and video-conferencing
- 2nd appointment: **Hidden Profile Paradigm**
- Groups of three working on a fictional personnel selection case; randomly assigned to face-to-face, VR, or video-conference
- Individual information sets containing shared and unshared information about four fictional candidates (Schulz-Hardt et al., 2006).
- The correct (i.e., most favorable) candidate can only be identified if sufficient unshared information is exchanged during the subsequent group discussion.
- Bayesian Generalized Linear Mixed Models predicting the correctness of the group decision, and the probability of shared vs. unshared information being discussed during and remembered after discussion.

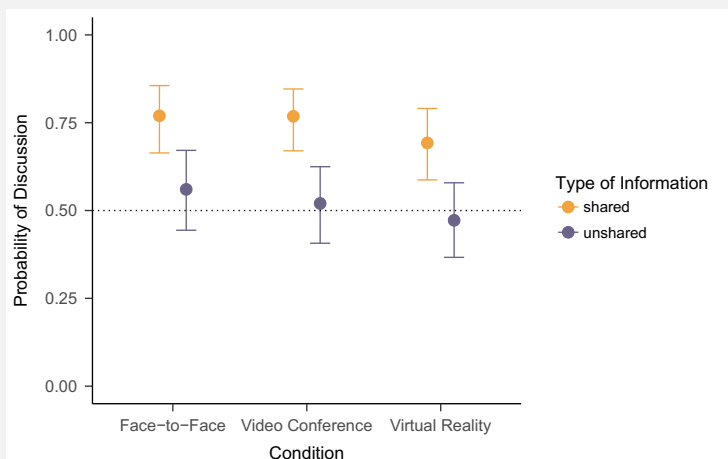


Fig. 1: Posterior estimates and 95% credible intervals for the Bayesian Generalized Linear Mixed Model predicting the Probability of Discussion of an item as a function of Condition and Type of Information (shared vs. unshared).



Fig. 2: Three participants represented by virtual representatives (i.e., avatars) engaging in the group discussion. The virtual environment was modelled after the lab where the face-to-face condition took place. It was rendered using the Unreal Engine 4 and presented by means of a HTC Vive Head-mounted display.

Results

- 49% of participants had previous, however limited experience with immersive VR.
- **Decision Quality** did not differ between VR and Face-to-Face ($\beta = 3.43$, CI = [-27.44; 40.34]). In contrast, video-conferencing groups lead to fewer correct solutions of the task ($\beta = -65.50$, CI = [-216.36; -3.54]).
- **Discussion Quality** did not differ between conditions. Groups discussed the same proportion of the information set. Moreover, all groups showed the same discussion bias for shared vs. unshared information (see Fig. 1).
- **Memory:** After discussion, participants in VR, video-conferencing and face-to-face did not differ with respect to memory retention and information gain (i.e., post-discussion recall of newly learnt information)
- **Extraneous Cognitive Load** did not differ between conditions.
- **Social Presence** was lower in VR compared to face-to-face groups ($\beta = -0.25$, CI = [-0.47; -0.04]), however not different from video-conferencing ($\beta = -0.07$, CI = [-0.29; 0.17]).
- Neither extraneous cognitive load nor social presence predicted decision quality. The same was observed for discussion quality.

Summary

- VR, face-to-face and video-conferencing did not differ in terms of discussion quality (i.e., discussed information set) and individual performance (i.e., memory) respectively. However, VR and face-to-face outperformed video-conferencing in terms of decision making.
- Furthermore, we found that both cognitive load and social presence are not directly linked to group performance.
- We argue that VR can be readily used for collaborative work between distant group members, even in the absence of previous VR experience.

References:

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