

RAVE-08 Abstract

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Reflections in a Virtual Mirror Influence Body Processing and Behaviour

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Abstract

A virtual mirror placed in an immersive virtual environment has two important effects. The first is that the mirror can be used to extend the virtual environment spatially, without actually requiring the virtual or physical space to be extended. For example, in Cave-like projection systems that do not completely enclose the participant (due to a non-existent ceiling or wall screen) a mirror can be used to provide reflections of the virtual reality that would be seen in the blank area. The second effect is that reflections of the body of the participant must, for plausibility, also be shown. Now suppose that the virtual body is only partially accurate in reflecting the appearance and behaviour of the true body: The participant might reject the environment (loss of plausibility) or alternatively internalise and act out what they see their virtual mirror reflection doing. The latter would be a very strong example of real actions being determined by the experiences in a virtual environment, with an effect on the person's body representation.

There have been many studies that manipulate body ownership, based around the experimental paradigm of the rubber hand illusion [Botvinick and Cohen, *Nature* 391(6669) p756]. Here we adopt a different paradigm, and have carried out an experiment in which 20 participants in a Cave-like 4-screen, head- and hand-tracked projection system, experience events within a virtual room which has a large virtual mirror on one screen. Their body is overlaid with an invisible avatar and its reflection is reproduced in the mirror within the limitations of inverse kinematics from a 6 d.f. head- and one hand-tracker. The right arm of the person is tracked, and its movements reflected by the avatar in the mirror. The left arm is not tracked, but the mirror avatar left arm movements mirror those of the right arm. The setting is a library with some books. For some moments books spontaneously fall, and one can be seen by the participant stuck to the head of their avatar reflection. At another moment a small boy enters the library at first usually visible only in the mirror. The boy floats through the scene exiting through a wall, and this is repeated three times.

Here we show that many of the participants incorporated the mirror reflection as their own. Nine out of the twenty participants matched their real left arm movements with those of their reflection, some of the time. Seven out of the twenty participants touched their head on seeing the virtual book that remained on the head of their mirror reflection. Almost all participants looked behind them when they saw the reflection of the boy in the mirror. Most surprisingly nearly half of the subjects expressed shock or fear on suddenly seeing the floating boy in the room. In answer to the question: "Even though the person in the mirror did not look like me I sometimes had the feeling as if I were seeing myself", the median score was 82% and interquartile range 30%, where 100% meant 'totally agree'.

The responses of participants in this experimental scenario (for example, the unexpected fear responses when seeing the floating boy, the arm matching, the attempts to touch or take off the book on their mirror head) together with their subjective responses suggest that inclusion of the body in the virtual environment through reflection and

virtual shadows substantially increases the likelihood that participants exhibit rave. These results point the way forward both for scientific understanding of body processing, and improvements in virtual reality application design and engineering.

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