

Do Cartoons Feel Pain? Using the Virtual Hand Illusion to Test Human Response to Degrees of Realism

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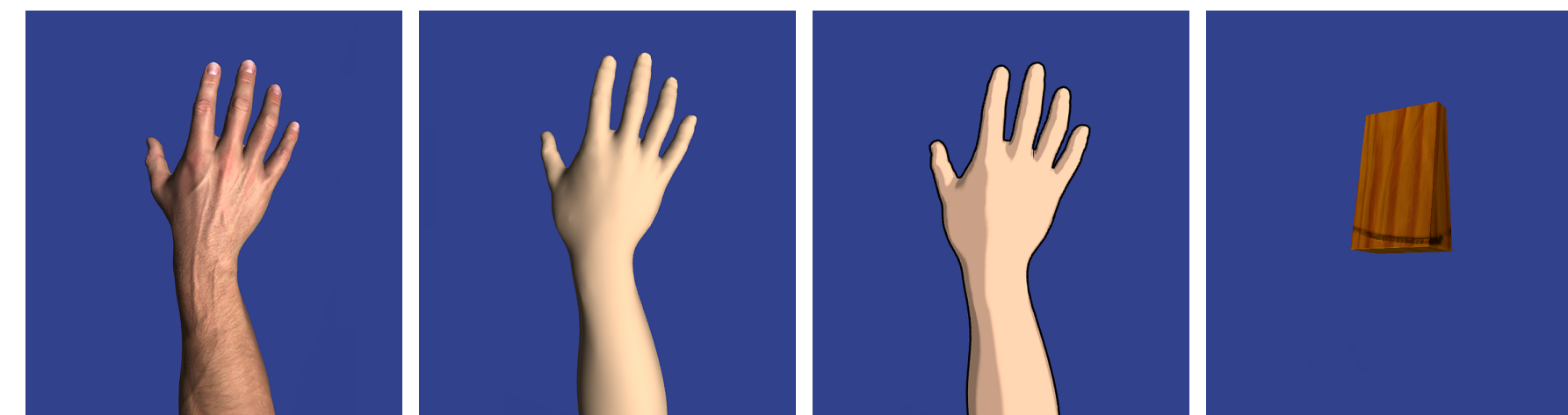


Figure 1: The four geometric models with different levels of realism used in this study. From left to right: realistic hand, toony hand, very toony hand, wooden block

Motivation

The rubber hand illusion [Botvinick and Cohen, 1998] can occur in virtual reality; this effect is known as the IVR (immersive virtual reality) arm ownership illusion [Yuan and Steed, 2010]. Previous studies reached different conclusions on the intensity of the perceived illusion and what influences that intensity.

Our method

We investigate the influence of the realism of a controllable virtual hand model on human reaction in IVR. The motions of participants' right hands are tracked and represented with one of four virtual hands (see Figure 1). After participants block spheres for three minutes in a virtual environment, a knife as a virtual threat hits their virtual hand (see Figure 2). We expected participants' perceived illusion to rank from highest to lowest for the four models in the order of realistic hand, toony hand, very toony hand, and wooden block.

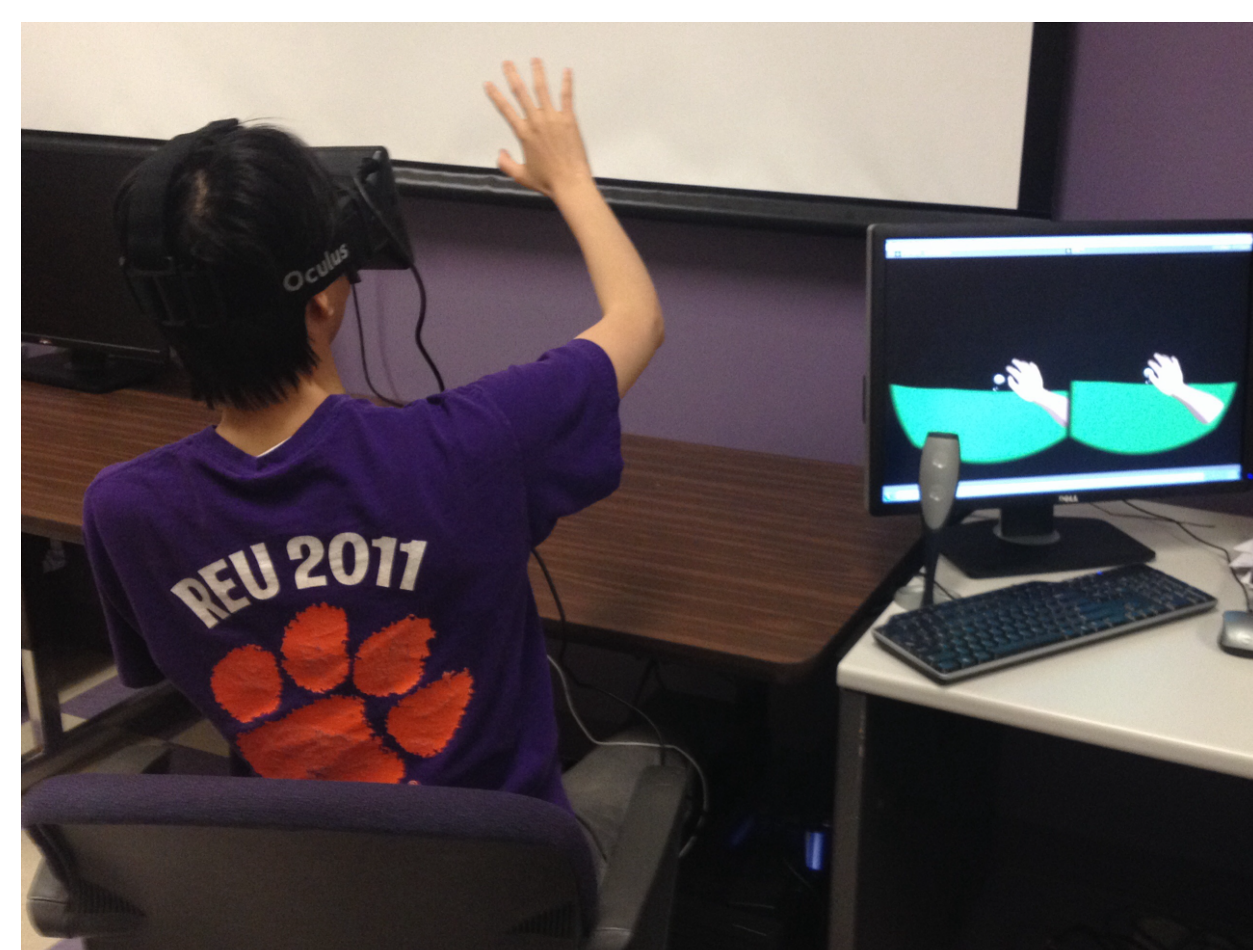


Figure 2: The experimental setup.

Questionnaire

We measure responses towards the virtual hand being threatened with a questionnaire and using galvanic skin response. On the questionnaire, participants chose a rating on the seven-point Likert scale, ranging from 1 to “strongly disagree” to 7 for “strongly agree” for the following statements:

1. Sometimes I had the feeling that I was holding a real ball.
2. I had the sensation that I felt the knife on my hand in the same location where the virtual hand on the screen was in contact with the knife.
3. I felt like the sensation I felt on my hand was caused by the contact of the knife with the virtual hand on the screen.
4. The movements of the virtual hand on the screen were caused by myself.
5. It sometimes seemed my own hand was located on the screen.
6. The virtual hand on the screen began to resemble my own hand in terms of shape, skin tone, freckles, or some other usual feature.
7. Sometimes it seemed as if what I was feeling was caused by the knife that I was seeing on the screen.
8. Sometimes I felt as if the virtual hand on the screen was my own hand.
11. I anticipated feeling pain from the knife on the screen.
12. During the experiment there were moments in which it seemed that my own hand was being hit by the knife.
13. I thought the virtual hand on the screen looked realistic.
14. I was so immersed in the virtual reality, it seemed real.

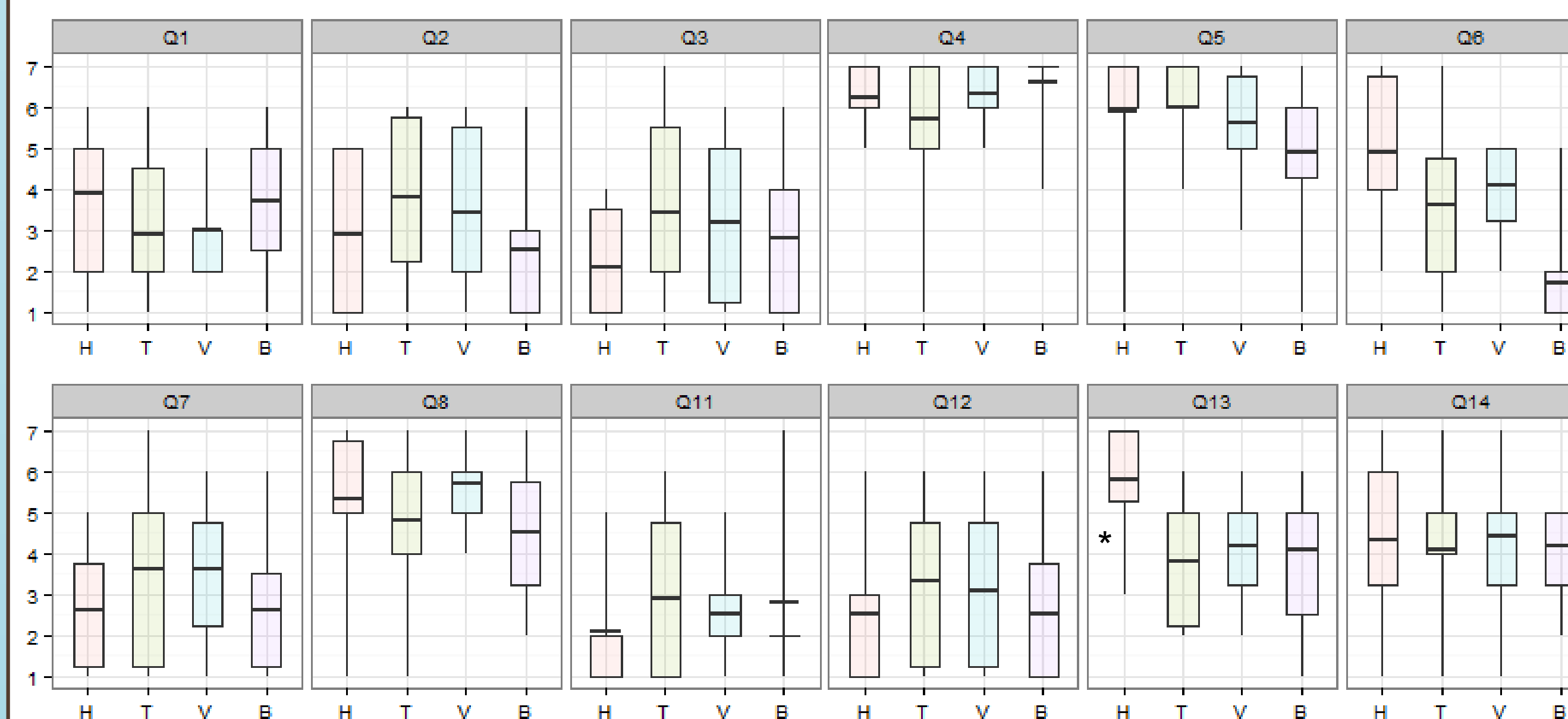


Figure 3: Boxplots of the questionnaire results. H stands for the realistic model, T for toony, V for very toony, and B for wooden block. The boxes indicate inter-quartile ranges and the bars show the range of the ratings.

Results and Conclusion

The effects vary highly depending on the participants but not based on the realism of the hand model (see Figure 3).

To guarantee that our models have distinct levels of realism in appearance, we also carried out a brief online survey evaluating the perceived realism and sensitivity to pain of all four models (see Figure 4).

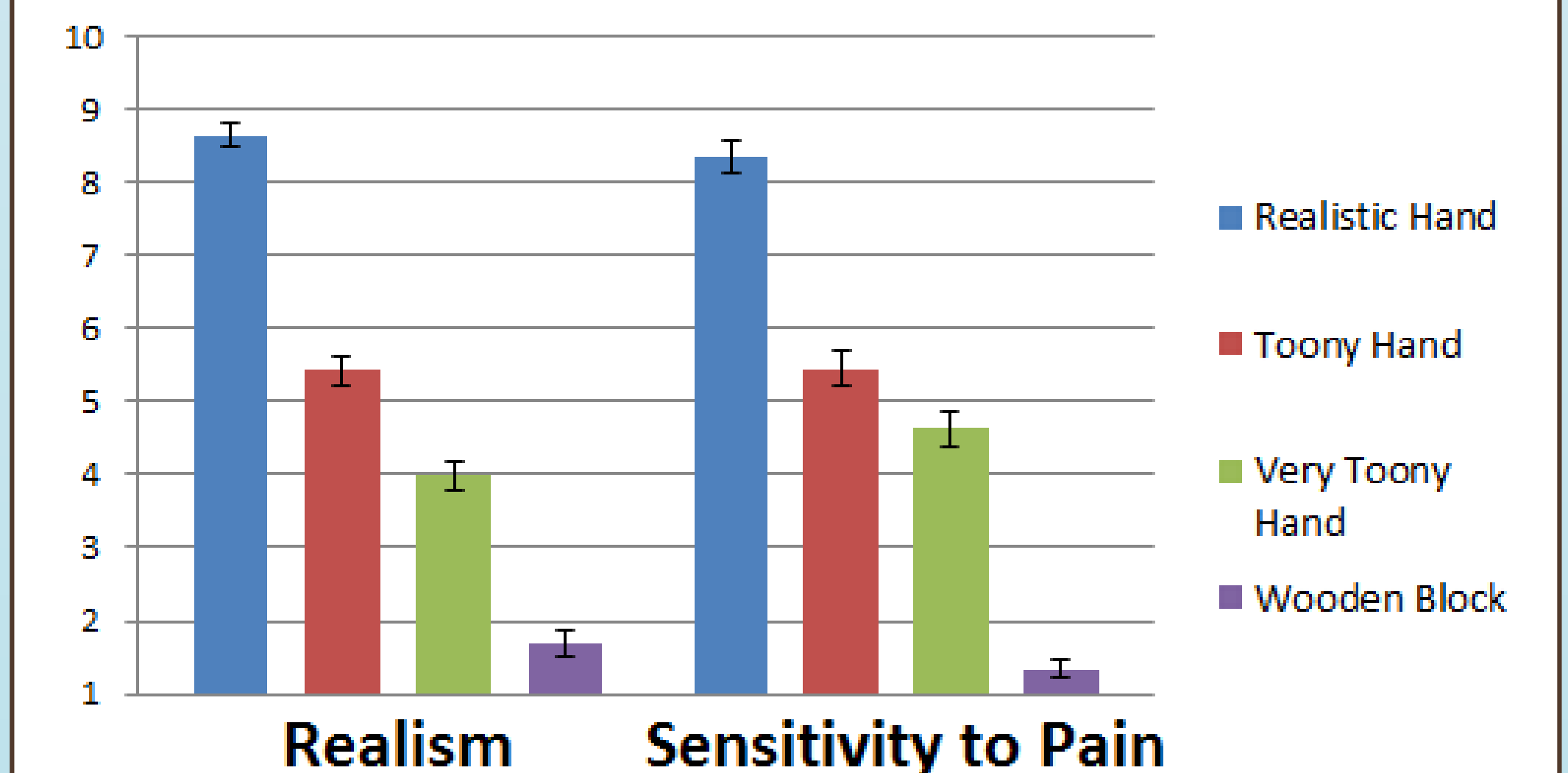


Figure 4: Perceived realism and sensitivity to pain of the hand models

Future work

Data collected from participants suggests that a reaction to the virtual knife can only occur if participants are prone to experiencing the rubber hand illusion. We plan to run an extension of the study consisting of a pre-test to observe if participants experience the illusion in reality, then a following virtual reality test to observe how prone the same participants are to the illusion in virtual reality.

References

- Botvinick, M., and Cohen, J. 1998. Rubber hands ‘feel’ touch that eyes see. *Nature* 391 (Feb.), 756.
- Yuan, Y., and Steed, A. 2010. Is the rubber hand illusion induced by immersive virtual reality? *Virtual Reality Conference (VR)* (Mar.), 95-102.