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The Rubber Hand Illusion
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Corresponding Author:	Jonathan Flombaum UNITED STATES
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	
Corresponding Author's Secondary Institution:	
First Author:	Jonathan Flombaum
First Author Secondary Information:	
Order of Authors:	Jonathan Flombaum
Order of Authors Secondary Information:	

PI: Jonathan Flombaum

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The Rubber Hand Illusion

Overview

Reaching for objects, walking without hitting obstacles, landing on a chair as you sit (instead of falling to the floor), these and all our physical actions depend on an ability to perceive our own bodies in space, to know where our limbs are relative to one another and relative to the rest of the world. One way that the human brain encodes this information is called proprioception, the brain relies on its own control and feedback signals to keep track of limbs. Along with proprioceptive inputs, the human brain incorporates vision, touch, and even sound in order to represent the parts of the body in space. How does it combine all this information? In 1998, Botvinick and Cohen described a striking illusion, called ‘The Rubber Hand Illusion,’ that has been used to investigate how the human brain integrates sensory and proprioceptive inputs to represent the body in space. This video will demonstrate how to induce The Rubber Hand Illusion and it will describe how it has been used by subsequent studies.

Procedure

1. Materials

- 1.1.** This experiment requires three critical pieces of equipment: A rubber hand, two paint brushes, and an occluder box.
- 1.2.** To build the occluder box, you will need a piece of cardboard that is about 1 foot high and two feet long. Draw a straight line down the middle, and then in the middle of each of the two squares cut a tunnel large enough for a hand and arm to pass through. **Figure 1** shows a schematic drawing of this portion of the box, as it would be seen from the point-of-view of the participant in the task.
 - 1.2.1.** Next, on one side of the card box attach an opaque top along with an opaque divider between the two halves of the box. The participant’s real arm will go into this part of the box, where it will be visually occluded from the participant. **Figure 2** shows a schematic drawing of the completed box with this attachment on it, as it would be seen from the point-of-view of the person conducting the experiment.
- 1.3.** Finally, you will need to make survey in order to asses the extent to which your participant experienced the illusion. **Figure 3** is such a survey, modelled directly on the methods used by Botvinick & Cohen (1998).

2. Inducing the illusion

- 2.1.** To induce the illusion in a participant, seat her at a table in front of the flat side of the occlude box. The box should be placed so that she can insert her left arm comfortably into the hole furthest from her left shoulder.

- 2.2. Once the participant is seated comfortably and with her arm inserted, place the rubber arm so that it exits from the hole closer to the participant.
- 2.3. Instruct the participant to move her left arm and fingers as little as possible.
- 2.4. Ask the participant to look over the wall of the occlude. Her own arm will not be visible, as it will be inside of the box portion of the occlude box. But the rubber arm should be fully visible to her.
- 2.5. Now sit in front of the participant, and slowly brush both her real hand and the rubber hand with the paint brushes. Try to brush in synchrony. Continue brushing for 10 minutes.
- 2.6. The participant may react during the brushing period, exclaiming that she feels like the rubber hand is her own. Let the participant know that such experiences are normal in the context of the experiment.
- 2.7. After 10 minutes, remove the box and the rubber arm, and ask the participant to complete the survey.

Representative Result

Figure 3 shows typical survey results for one participant. In the first three items, a participant tends to strongly agree that the rubber hand felt like her own and that it felt like she could feel the brushing on the rubber hand. These results suggest that the visual perception of the rubber hand—in the place where her actual hand should have been—induced her brain to assimilate the rubber hand into its representation of her body. Moreover, she experienced brushing although the rubber hand obviously has no touch receptors. Thus the visual seeing of brushing, in this context, is sufficient to induce the brain to produce sensations of brushing. That is an important part of the effect—touch can be felt without actual touching of the skin, at least under some conditions. Visual inputs play a surprisingly strong role in our sense of our bodies.

The remaining items in the survey demonstrate that the opposite is not true. People tend to disagree with statements that suggest that their visual representation of the rubber hand began to change. In other words, feeling it to be their own does not make it look like their own in appearance. So vision plays an important role in our sense of touch and body position, but touch and body position do not influence vision in the same way.

Applications

The rubber hand is a strange and striking illusion that has begun to play an important role in our understanding of how the brain integrates information from multiple sensory systems. An important study by Ehrsson and colleagues (2004), for example, induced the rubber hand illusion in much the same way just described, but with participants simultaneously undergoing fMRI. For a point of comparison, the researchers used a condition in which they brushed the rubber and actual hands of their participants asynchronously. This does not usually produce and experience

of the illusion. They could then compare brain activity in this condition to brain activity during the usual, synchronous stroking condition. The result was that the synchronous condition produced greater activity in the premotor cortex. The premotor cortex is a part of the brain that is used to control motor actions. Activity is usually found in this area before someone executes an action. This led the authors to conclude that because the premotor cortex is the site of action planning, in some sense, it is the main site of representation for one's sense of their own body. As a result, it is also the site where information about one's body from different sources becomes integrated.

References

- Botvinick, M. & Cohen, J. (1998). Rubber hands 'feel' touch that eyes see. *Nature*.
- Ehrsson, H.H., Spence, C., Passingham, R.E. (2004). That's my hand! Activity in premotor cortex reflects feeling of ownership of a limb. *Science*.

Legend

Figure 1. Schematic drawing of occluder box seen from the point-of-view of the participant. The two holes in the cardboard wall are large enough for the participant to comfortably insert an arm.

Figure 2. Schematic drawing of occluder box seen from the point-of-view of the experimenter. The two holes in the cardboard wall are large enough for the participant to comfortably insert an arm. The side with the opaque top is the side in which the participant will insert her real arm, allowing the experimenter to brush it during the experiment. The other side will be where the rubber arm will sit during the experiment.

Figure 3. Survey questions with scales. The survey is used after the experiment to assess the extent to which the participant experienced the illusion.

Figure 4. Typical survey responses.

Occluder Box — Participant View

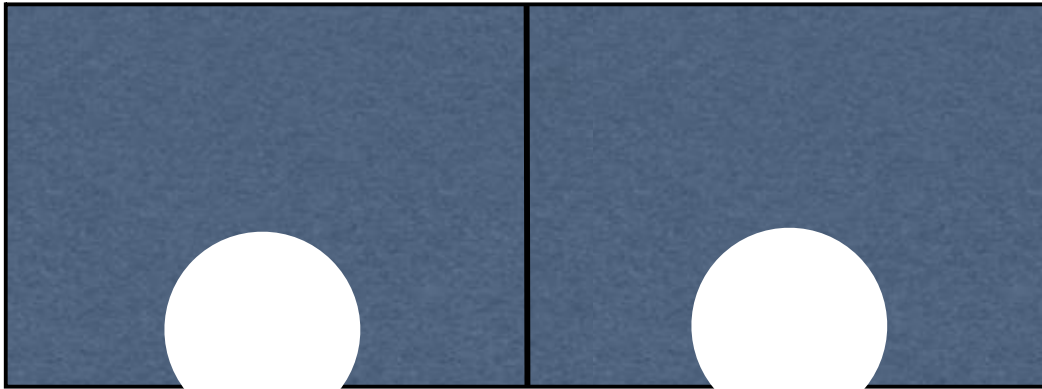


Figure 1.

Occluder Box — Experimenter View

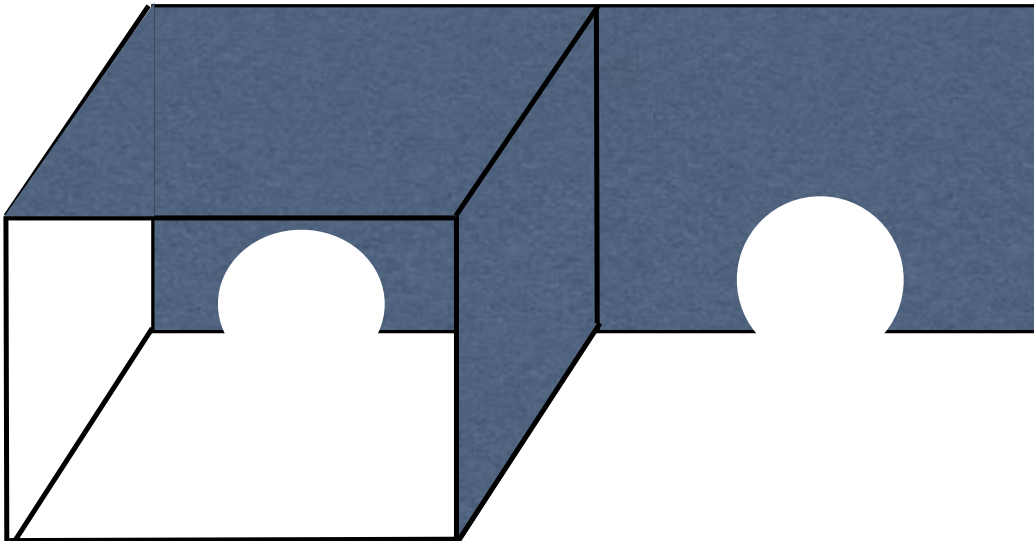


Figure 2.

Instructions: Below, you will find several statements. Please indicate the extent to which you agree or disagree with each statement by making a mark on the line below the statement.

1. It seemed as if I were feeling the touch of the paintbrush in the location where I saw the rubber hand touched.

Strongly DisagreeStrongly Agree
2. It seemed as though the touch I felt was caused by the paintbrush touching the rubber hand.

Strongly DisagreeStrongly Agree
3. I felt as if the rubber hand were my hand.

Strongly DisagreeStrongly Agree
4. It felt as if my (real) hand were drifting towards the right (towards the rubber hand).

Strongly DisagreeStrongly Agree
5. It seemed as if I might have more than one left hand or arm.

Strongly DisagreeStrongly Agree
6. It seemed as if the touch I was feeling came from somewhere between my own hand and the rubber hand.

Strongly DisagreeStrongly Agree
7. It felt as if my (real) hand were turning 'rubbery'.

Strongly DisagreeStrongly Agree
8. It appeared (visually) as if the rubber hand were drifting towards the left (towards my hand).

Strongly DisagreeStrongly Agree
9. The rubber hand began to resemble my own (real) hand, in terms of shape, skin tone, freckles or some other visual feature.

Strongly DisagreeStrongly Agree

Figure 3.

Instructions: Below, you will find several statements. Please indicate the extent to which you agree or disagree with each statement by making a mark on the line below the statement.

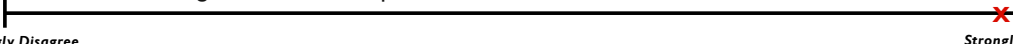
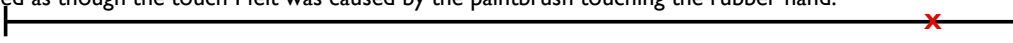

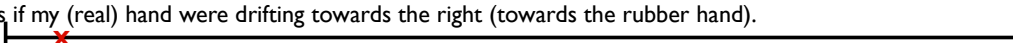
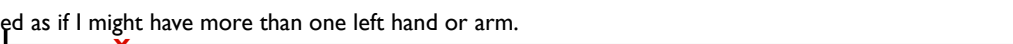
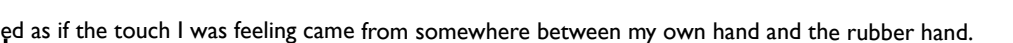



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8. It appeared (visually) as if the rubber hand were drifting towards the left (towards my hand).

9. The rubber hand began to resemble my own (real) hand, in terms of shape, skin tone, freckles or some other visual feature.


Figure 4.