

## **RHI vs IHI comparison**

An interesting experiment including a comparison between the Rubber Hand Illusion (RHI) and the Invisible Hand Illusion (IHI) was conducted by a member of our research team, Gábor Hegedüs. The main results of the RHI/IHI comparison have been made available here, as some conclusions based on these results are cited in our recent paper.

See: Darnai G. et al. (2016). Hearing visuo-tactile synchrony – Sound-induced proprioceptive drift in the invisible hand illusion. *British Journal of Psychology*, DOI:10.1111/bjop.12185.

<http://onlinelibrary.wiley.com/doi/10.1111/bjop.12185/abstract;jsessionid=294D53497869E79716945D22AF2346A0.f01t02?userIsAuthenticated=false&deniedAccessCustomisedMessage=>

### **Materials and methods**

Thirty-two healthy university students participated in the experiment (16 females, 16 males, mean age: 24.2±3.8). Participants had no previous experience with the RHI (or with related illusions), and were blind to the study hypothesis.

### **Procedure**

The experiment consisted of three conditions including an RHI and an IHI condition. The sequence of experimental conditions was counterbalanced across subjects. Basically the same procedure was used to elicit the illusions as in the study mentioned above (Darnai et al., 2016). Relevant exceptions: 1) before starting the induction of the IHI, participants were instructed to try to imagine that their right hand - which was hidden out of view - was visibly on the table (in the portion of empty space above which the brush was then moved during the induction of the illusion); 2) two minutes stroking was used to elicit the illusions; 3) pretest proprioception measurement was conducted before starting the experimental session.

## Measurements

### 1. Hand proprioception

The very same method was used to measure the participants' felt hand position as in the study mentioned above (Darnai et al., 2016).

### 2. Questionnaire

To measure the main characteristics of how participants subjectively experienced the illusions, questionnaires were administered consisting of 8 statements. In both the RHI and the IHI conditions, items Q1-Q2 was about the mislocalization of tactile stimuli, items Q3-Q4 measured the feeling of ownership over the rubber / invisible hand, while items Q5-Q6 measured the feeling of the loss of own hand (disownership). Two statements (Q7-Q8) were used as control questions. The questions were adopted from Guterstam et al. (2013) as well as from Longo et al. (2008), and items Q1-Q4 were slightly rephrased in the IHI condition so that they included the term 'imagined hand', in accordance with the hypothesis of the experiment. It is important to mention that the experiment described here, therefore, differed from the study of Guterstam et al. (2013), as in Q1-Q4 statements measuring the subjective experience of the IHI, the term 'imagined hand' was used instead of the terms 'empty space' or 'invisible hand'.

## Results

### 1. Proprioceptive drift

Proprioceptive drift data were compared by using a paired samples t-test (see below Fig. 1). The test showed that the proprioceptive drift was significantly greater in the RHI than in the IHI [ $t(31) = 2.647, p = .012$ ].

## 2. Questionnaire data

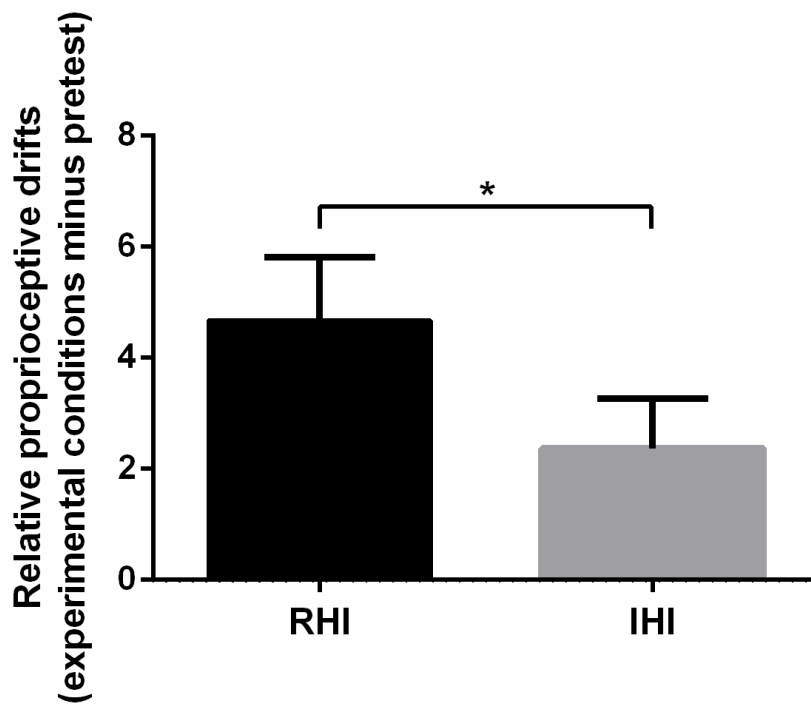
A 2 X 2 analysis of variance (ANOVA) was performed on the subjective scores with two within-subjects factors. The factors were (a) Illusion Type (RHI vs. IHI), (b) Question Type (illusion vs. control). The repeated measures ANOVA revealed a significant main effect for both Illusion Type [ $F(1,31) = 8.795$ ,  $p = .006$ ,  $\eta^2_p = .221$ ] and Question Type [ $F(1,31) = 81.366$ ,  $p < .001$ ,  $\eta^2_p = .724$ ]. In addition, the interaction was also significant [ $F(1,31) = 10.351$ ,  $p = .003$ ,  $\eta^2_p = .250$ ], showing that the difference between the illusion and control scores was significantly higher in the RHI than in the IHI.

For post-hoc analysis paired samples t-tests were used, and comparisons were made between the component scores (mislocalization, ownership, disownership, control) of the RHI and those of the IHI (see below Fig. 2). P values were Bonferroni-corrected by multiplying them by the number of comparisons (4). Both the mislocalization and the ownership scores were significantly higher in the RHI than in the IHI [ $t(31) = 2.889$ ,  $p = .028$ ]; [ $t(23) = 3.325$ ,  $p = .008$ ].

## References

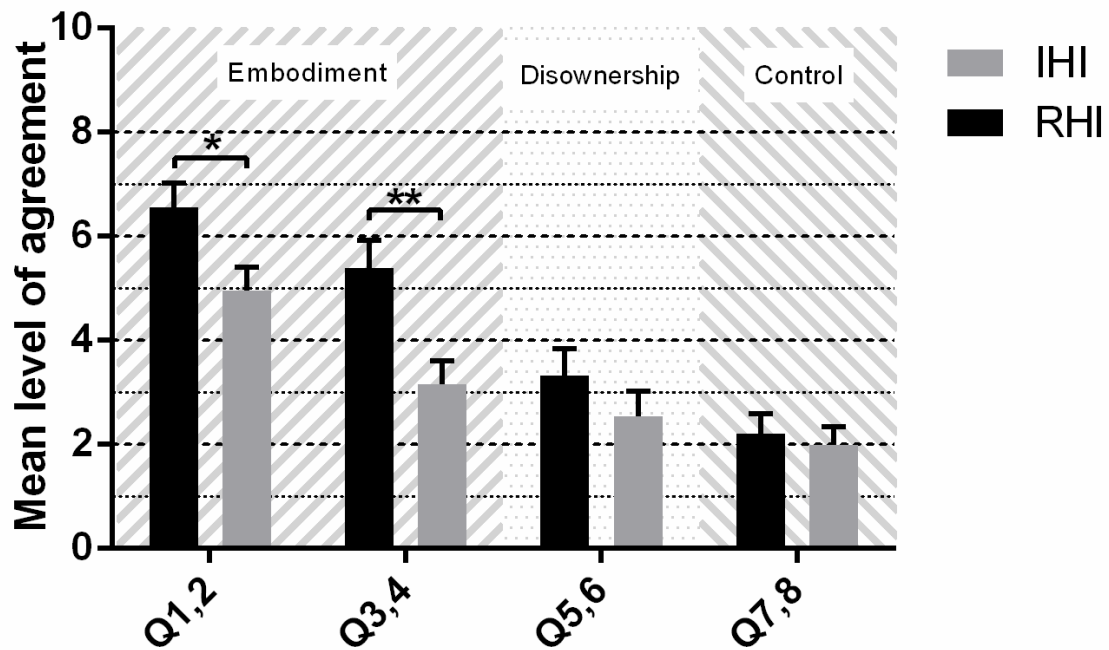
- Darnai G. et al. (2016). Hearing visuo-tactile synchrony – Sound-induced proprioceptive drift in the invisible hand illusion. *British Journal of Psychology*, DOI:10.1111/bjop.12185.
- Guterstam, A., Gentile, G., & Ehrsson, H. H. (2013). The invisible hand illusion: multisensory integration leads to the embodiment of a discrete volume of empty space. *Journal of Cognitive Neuroscience*, 25(7), 1078–99.  
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<http://doi.org/10.1016/j.cognition.2007.12.004>

Figure 1.



Mean proprioceptive drifts. Values represent the degree of shifts towards the rubber / invisible hand, as compared to the felt position of the right index finger in the pretest (baseline) measurement. One asterisk denotes  $p < 0.05$ , paired t-test. Horizontal bars represent standard error to the mean.

Figure 2.



Mean questionnaire scores on a 0-10 scale. Q1-2 questions measured the mislocalization of tactile stimuli, while Q3-4 measured the feeling of ownership over the rubber / imagined invisible hand. One asterisk denotes  $p < 0.05$ , two asterisks denote  $p < 0.01$ , paired t-test with Bonferroni correction. Horizontal bars represent standard error to the mean.