**Peer Review and Communication History**

**MS Title**: What do participants expect to experience in the rubber hand illusion? A conceptual replication of Lush (2020)

**Author Names**: Arran T. Reader

**Submitted:** Jan 6, 2022

**Editor First Decision**: Revise & Resubmit

Mar 18, 2022

Dear Dr. Reader,

I have now received four reviews of your manuscript, “What do participants expect to experience in the rubber hand illusion? A conceptual replication of Lush (2020)” from qualified researchers. I also independently read most of the manuscript. I agree with the reviewers that your manuscript will make a valuable contribution to the literature and also that there are some issues that need to be addressed. I therefore encourage you to submit a revised version for further consideration at Collabra: Psychology.

In your resubmission, please include a document with a point-by-point response to both the points I list below and the reviewers’ comments, outlining each change made in your manuscript or providing a suitable rebuttal.

-As more than one reviewer mentioned, it would be valuable for you to give a breakdown of the number of participants excluded for each of the exclusion reasons.

-Reviewer 1’s suggestion of a still photo to illustrate the degree of asynchrony seems sensible.

-In the script (page 7 of the PDF) there are some apostrophe mistakes, e.g. “participants” for “participant’s”. Can you confirm that those mistakes were in the script and are not typos just in the manuscript? If they were in the actual script, can you please insert a short sentence acknowledging them after the script?

-To the captions of Fig 1 and 2, can you please indicate how the error bars were calculated and whether the line inside the box plot is median/mean, and whether the box plot top/bottom indicates interquartile range or something else?

-Can you provide the analysis (Jamovi) files?

-Can you provide your version of the video (without the synchronous/asycnhronous labels used in the Lush)?

-The rubber hand appears Caucasian. Do you know what proportion of your participants have very different skin color?

Please ensure that your revised files adhere to our author guidelines, and that the files are fully copyedited/proofed prior to upload. This is likely the last opportunity for major editing, therefore please fully check your file prior to re-submission.

If you have any questions or difficulties during this process, please contact the editorial office at [editorialoffice@collabra.org](mailto:editorialoffice@collabra.org).

We hope you can submit your revision within the next six weeks. If you cannot make this deadline, please let us know as early as possible.

Sincerely,

Alex Holcombe, Associate Editor

**Reviewer 1**

**Open response questions**

Please write your review here. The author(s) will see this review. Your identity will not be revealed to the authors unless you also include your name (i.e., sign your review) in this box. It is up to you whether to reveal your identity or not, either is fine.

Paper Summary:  
Lush (2020) studied expectancies of participants who viewed a video segment of a rubber hand experiment/procedures, and found differences in expectancies for ‘control’ and ‘illusion’ statements in  
synchronous and asynchronous conditions similar to those observed in actual RHI experiments. Lush concluded that rubber hand illusion control methods are not “fit for purpose”.

The present paper replicates Lush’s design even using the same video, but with more stringent variations of control. First the video was split into the 2 separate conditions, and the labelling captions – possibly worded in a leading way in the Lush study were edited and reworded. The instruction was also different and asked a more open question: “If you were a participant undergoing the procedure shown in the video, what do you think you might experience as you felt the strokes on your real hand and observed the stroking of the rubber hand?”  
Afterwards, participants were asked if they were aware of the synchrony of the touches in each video and the design included a foil statement (“If you are paying attention, please select ‘0’”) to check people were paying attention during the form-filling

Dear Authors,  
Thank you for your paper. I found the paper to be very well written. I have only a few comments:  
Comment 1 (Lines 255): A number of reasons are given for the exclusion of participants e.g. did not watch the entire video, watched it too many times, did not answer the foil, or were unaware of the synchronicity of the touches, were aware of RHI. The breakdown of the number of participants excluded for each reason would be informative. Especially how many were unaware of the synchronicity of the touches.  
Comment 2: In relation to this same point, 160 participants were recruited and only 58 participants were retained in the final analysis. This is a high exclusion rate – only 36% of the initial sample were retained. This rate is much lower than the retention rate in a typical RHI experiment (~90%), and therefore this selection aspect does not really replicate actual experimental test conditions. Could the exclusion criteria have been too strict and resulted in an unusual non-representative sample?  
Comment 3: I have watched the Lush video (<https://osf.io/u2nw9/>) which you used. In RHI experiments the asynchronous condition stroking is typically 180 out of phase, i.e., while one brush is stroking the finger the other brush is still in the air (and not touching the finger). However, in this video, both brushes are on the hand at the same time during asynchronous stimulation (though a few centimetres out of phase). This could have affected results e.g., by making people less aware of the asynchronicity of touch (and this could have resulted in the high exclusion rate reported above for the item: “Were the touches applied to the real and fake hands in time or out of time with each other?”). I think for this reason the Supplementary Material should also show a still photo from the Asynchronous condition, to illustrate that the brushes were not 180 degrees out of phase - see <https://osf.io/u2nw9/> at 55 seconds into video.  
Comment 4: This is really an observation: Line 394 “Perhaps the best way to probe expectations for the real illusion would be to briefly apply synchronous and asynchronous stroking in the real illusion setup, but stopping prior to typical illusion induction (likely less than 11 seconds, (Ehrsson, 2004)).” The onset of the illusion might be quicker than 11 seconds. In one study by Walsh et al – whom you cite – an instant onset was reported by one participant “‘‘I felt that it was my hand the instant the paintbrush touched my [real] hand.’’

Best wishes for your paper.

**Rating scale questions**

|  | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| --- | --- | --- | --- | --- | --- |
| The study/studies in this manuscript have strong construct validity (good measures and/or manipulations of the constructs the authors wish to study). (Choose “Neutral” if this is not an empirical manuscript) |  |  |  | ✔ |  |
| The study/studies in this manuscript have strong statistical validity (appropriate statistical tests, assumptions are clear and reasonable, no statistical errors, appropriate statistical inferences, etc.). (Choose “Neutral” if this is not an empirical manuscript) |  |  |  | ✔ |  |
| The study/studies in this manuscript have strong internal validity (any causal claims or implications are well-justified, alternative explanations are thoroughly considered, etc.). (Choose “Neutral” if this is not an empirical manuscript, or no causal claims are made or even vaguely implied.) |  |  |  |  | ✔ |
| The study/studies in this manuscript have strong external validity (authors appropriately constrain their conclusions based on the limits of the generalizability of their findings to other contexts (including from lab to real world), other populations, other stimuli or measures, etc.) |  |  |  |  | ✔ |

**Reviewer 2**

**Open response questions**

Please write your review here. The author(s) will see this review. Your identity will not be revealed to the authors unless you also include your name (i.e., sign your review) in this box. It is up to you whether to reveal your identity or not, either is fine.

Introduction  
The authors write “….This sensation is believed to stem from multisensory integration, where by different sources of sensory information (e.g., vision, touch, proprioception) arecombined to generatethe feeling that our body is something distinct from the surrounding environment and associated with the self (Ehrsson, 2020; Kilteni et al., 2015; Tsakiris).”  
I think it would be better to write that also top-down mechanisms are bareòy required (e.g., identity, postural congruencies and so on).

Introduction  
The authors write “and the roles of individual differences and suggestibility in influencing participant responses (e.g., (Germine et al., 2013; Lush et al., 2020; 97Marotta et al., 2016; Perepelkina et al., 2017; Romano et al., 2021; Tsakiris et al., 2011; Walsh 98et al., 2015).”  
Other papers reported relationships with individual differences/personality (e.g., Burin et al Front Psychol 2019).  
Thye could be cited here.

Discussion  
The authors write “In addition, this experimentcan only inform us about the ‘classic’ visuotactile RHI. It remains to be seen whether similar expectationsare present inversions of the RHI where touching is spatially incongruent rather than temporally asynchronous, or in versions that use different multisensory stimuli such as the somatic (Ehrsson, 2005) or moving RHI (Kalckert & Ehrsson, 2012).”  
I think this is a very important point, i.e., stressing the limitations. Within this context, I see something worth of attention. The RHI is one (among many others) tool to investigate body ownership. Neuropsychology, for instance, with somatoparaphrenia, pathological ambodiment show RHI-like behaviors due “natural” manipulations (i.e., strokes) rather than experimental. Hence, in general any consideration related to the neurocognitive signature of body ownership with, eventually, its componments of suggestionability, should necessarily take into accounts the other approaches as, in this case, patients (e.g., could it be that a patient embodying someone elses’ arm would be driven by suggestionability?). If not, it should be very clear that the role of suggestionability in human body oenership is very far form being undestrodd since evidence are limited to a single approach. Despite this is neither the aim (nor a problem, given my considerations), I think that it can be pointed out, pheraps among the other nice advices he authors give at the very end.

**Rating scale questions**

|  | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
| --- | --- | --- | --- | --- | --- |
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| The study/studies in this manuscript have strong statistical validity (appropriate statistical tests, assumptions are clear and reasonable, no statistical errors, appropriate statistical inferences, etc.). (Choose “Neutral” if this is not an empirical manuscript) |  |  |  | ✔ |  |
| The study/studies in this manuscript have strong internal validity (any causal claims or implications are well-justified, alternative explanations are thoroughly considered, etc.). (Choose “Neutral” if this is not an empirical manuscript, or no causal claims are made or even vaguely implied.) |  |  |  | ✔ |  |
| The study/studies in this manuscript have strong external validity (authors appropriately constrain their conclusions based on the limits of the generalizability of their findings to other contexts (including from lab to real world), other populations, other stimuli or measures, etc.) |  |  |  | ✔ |  |

**Reviewer 3**

**Open response questions**

Please write your review here. The author(s) will see this review. Your identity will not be revealed to the authors unless you also include your name (i.e., sign your review) in this box. It is up to you whether to reveal your identity or not, either is fine.

The present study is a replication of a study by Lush (2020) that investigated the role of demand characteristics in compliance/suggestibility in the Rubber hand illusion. In the present study, a large sample of participants was presented with videos of the RHI procedure (both synchronous and asynchronous condition), together with their descriptions, and then asked to report the experiences they would expect after each condition via the standard RHI questionnaire and free responses. The key differences from the Lush (2020) study was the counterbalanced order of conditions and the absence of information about the synchronicity of visuotactile stimulation in the video descriptions. Analysis of questionnaire ratings showed the pattern of responses typical for the actual RHI – greater expectations for illusion statements in the synchronous condition and greater expectations for illusion statements than for control ones – but the free responses suggested that this effect might be partially related to the exposure to the questionnaire per se.

The study is well conducted and addresses an important research question that needs further investigation. I have several theoretical questions that might concern more the original study but if the authors can speculate on the possible responses, it might be an addition to their discussion.

1. The evidence in favor of multisensory integration as the core mechanism of the RHI is abundant, however, one study, in my opinion, might be worth mentioning, as its results might be more difficult to explain purely by expectations or suggestibility. That study (Costantini et al., 2016, Cognition) demonstrated that individual differences in the susceptibility to the RHI, especially in the asynchronous condition, are related to the individual differences in multisensory perception (temporal binding window measured in a multisensory perception task different from the RHI). Could the authors comment on that?
2. Can the idea that expectations/suggestibility are the main mechanism of the RHI be generalized to other illusions? For example, visual illusions (e.g., Kaniza figures) often occur after participant is explicitly told, or hinted about, what she should see, yet, they are interpreted as perceptual illusions, even if the role of attention is acknowledged.

I also have a number of rather minor comments that are directly related to the manuscript:

1. Abstract, third sentence (“Asynchronous touches weaken the illusion”) and Introduction, lines 43-44: this suggests that before the asynchronous touches are administered, there is already a certain level of illusion. This is not true for the RHI (it might be true for VR body-ownership illusions where the virtual limb/body visually replaces the real one, thus the 1PP alone is enough to trigger body ownership, but for the RHI it is not the case). Asynchronous stimulation is thought to not evoke the illusion from the beginning, rather than weaken it.
2. Lines 58-62: in my opinion, it is incorrect to list physiological measures of the RHI, e.g. the skin conductance responses, within implicit measures of the RHI together with behavioral measures, e.g., proprioceptive drift. Physiological measures reflect the activity of the autonomic nervous system that is phenomenologically quite different from the implicit behavioral responses.
3. Lines 74-87: could the authors provide some references for studies that used the other control conditions described in these sentences?
4. Results: the illusion scores (both averaged and separate) in the asynchronous condition are higher than in the typical RHI studies (median = 1, which is indicative of the presence of the illusion). The authors do discuss it in lines 399-414 but do not provide any interpretation. Is there any, even speculative, explanation of this result, apart from the obvious differences between the experimental procedure of this study and the real RHI?
5. The authors refer to the extended RHI questionnaire (Longo, 2008) that considers more aspects of the illusion than body ownership and referral of touch. Even though the current study administered a different version of the questionnaire, did any of the free responses indicate anything that could be considered as some of the components of the extended questionnaire (e.g., loss of own hand, deafference)?
6. Line 418: there is a typo (“is” is unnecessary)

**Rating scale questions**

|  | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
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**Reviewer 4**

**Open response questions**

Please write your review here. The author(s) will see this review. Your identity will not be revealed to the authors unless you also include your name (i.e., sign your review) in this box. It is up to you whether to reveal your identity or not, either is fine.

INTRODUCTION  
-line 56～: I’d add temperature (see Moseley, G. L., Olthof, N., Venema, A., Don, S., Wijers, M., Gallace, A., & Spence, C. (2008). Psychologically induced cooling of a specific body part caused by the illusory ownership of an artificial counterpart. Proceedings of the National Academy of Sciences of the United States of America, 105(35), 13169–13173.)  
-line 74-78: references are required.  
-line 83-90: the use of “control statements” in the RHI questionnaire is a very common practice (Kalckert, A., & Ehrsson, H. H. (2012). Moving a Rubber Hand that Feels Like Your Own: A Dissociation of Ownership and Agency. Frontiers in human neuroscience, 6, 40.). Also, the reference the authors mention (Reimer ta al., 2019) is not really an explanation of the limitations of the use of control statements. I think this part should be better explained and the authors should give a more clear justification of why the use of “control” statements in the RHI questionnaire has limitations (with more and better references).  
-line 99-102: can you provide an example of statements with references?  
-line 128.142: I think the perspective that was adopted in the video (first person perpsective) should also be addressed as an issue, since it is proven to be one of the most important factors for illusory embodiment, if not the only necessary factor (see for example Burin, D., Kilteni, K., Rabuffetti, M., Slater, M., & Pia, L. (2019). Body ownership increases the interference between observed and executed movements. PloS one, 14(1)).

PARTICIPANTS  
-was this study done autonomously at home by the participant? if yes, please specify.  
-how many subjects were excluded because they did not realize the difference between synch and asynch stimulation?

ANALYSIS  
-please report sample size calculation and normality of distribution.  
-please consider ipsatization procedure of the questionnaire data (Burin, D., Livelli, A., Garbarini, F., Fossataro, C., Folegatti, A., Gindri, P., & Pia, L. (2015). Are movements necessary for the sense of body ownership? Evidence from the rubber hand illusion in pure hemiplegic patients. PloS one, 10(3), e0117155.)

DISCUSSION  
-I understand the general goal nehind this study, but I’d like to clarify one point: the authors focused on the expectations about the RHI in general or specifically related to the questionnaire itself (I know you partially address this point in paragraph from line 432)? Clearly this is a problem that researhers face very frequently when using subjective measurements; that’s why most of the studies with the RHI usually include subjective and implicit measurements (e.g. physiolgical data). Don’t you think the concordant combination of explicit and implicit results would be enough to describe the presence/absence of the illusion? Do you think there might be a link between implicit and explicit measures, meaning “expectations on the RHI questionnaire can driven the presence of the illusion, therefore also the implcit response is biased”? Please argue these points.  
-It is true that the classical RHI questionnaire from Botvinich and Cohen is not well balanced. But it is also true that most of the researchers nowdays use an adapted version, in order to avoid those problems. I thnk this should be mentioned.  
-How about intra individual differences in the experience of the RHI? see for example Burin, D., Pyasik, M., Salatino, A., & Pia, L. (2017). That’s my hand! Therefore, that’s my willed action: How body ownership acts upon conscious awareness of willed actions. Cognition, 166, 164–173. where only subjects who actually experience the illusion are selected to participate in the experiment. And more in general, it is known that there is a certain degree of individual differences in suggestibility that can affect the perpcetion of the RHI (Marotta, A., Tinazzi, M., Cavedini, C., Zampini, M., & Fiorio, M. (2016). Individual Differences in the Rubber Hand Illusion Are Related to Sensory Suggestibility. PloS one, 11(12), e0168489.)

**Rating scale questions**

|  | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
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| The study/studies in this manuscript have strong internal validity (any causal claims or implications are well-justified, alternative explanations are thoroughly considered, etc.). (Choose “Neutral” if this is not an empirical manuscript, or no causal claims are made or even vaguely implied.) |  |  |  | ✔ |  |
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**Author Response**  
Apr 12, 2022

See a supplemental file “v2\_1706670-response-to-reviewers”

**Editor First Decision**: Revise & Resubmit

Apr 27, 2022

Dear Dr. Reader,

I have read your revised manuscript “What do participants expect to experience in the rubber hand illusion? A conceptual replication of Lush (2020)”, along with the letter describing the changes you made. Thank you for your responsiveness to the concerns that the reviewers and I raised. Your paper is essentially accepted, but this is technically a revise and resubmit because I felt I had to ask about one issue.

Congratulations on this excellent work, I think it will make an important contribution to the literature and I look forward to seeing it published!

My one question about your revision arose as a result of the revision’s mention that this was a “student research project”. As part of our efforts to insure that the range of contributors to a paper are appropriately recognized, in accord with our diversity, equity and inclusion principles, I felt I should ask whether the student(s) might qualify for co-authorship, or at least should perhaps be mentioned in the Acknowledgments. Typically this is appropriate for student research projects. A number of people are already acknowledged in the Acknowledgments, but only one seems to not have a PhD (Dominika Radziun) and, based on the wording of the study, she seems to be thanked for comments rather than for conducting the study. If you would like to communicate with me directly about this issue before re-uploading your manuscript files, you are welcome to email me at [aoholcombe@gmail.com](mailto:aoholcombe@gmail.com)

Please ensure that your revised files adhere to our author guidelines, and that the files are fully copyedited/proofed prior to upload. Please also ensure that all copyright permissions have been obtained. This is the last opportunity for major editing, therefore please fully check your file prior to re-submission.

If you have any questions or difficulties during this process, please contact the editorial office at [editorialoffice@collabra.org](mailto:editorialoffice@collabra.org).

We hope you can submit your revision within the next six weeks. If you cannot make this deadline, please let us know as early as possible.

Sincerely,  
Alex Holcombe

**Author Response**  
Apr 27, 2022

Hi Alex,  
  
Thanks for this. I agree that it is important to acknowledge students where they make a significant contribution to the work. However, in this case I do not think it is appropriate. This is an experiment I was already planning to run and so used it as a teaching tool for one of our modules where students write a short research report. Whilst they prepared an ethics application for the experiment as part of this learning experience, they did not design the experiment, create the materials, or write any of the manuscript. They were given access to the data to analyse but the analysis reported in the manuscript was performed by myself.  
  
Please let me know if you are happy for me to go ahead and make the final submission.  
  
Best wishes,  
  
Arran

**Editor Response**

Apr 27, 2022

Hi Arran,  
That makes sense. Thanks for the explanation. Please proceed.

**Editor Final Decision:** Accept

May 1, 2022

Dear Dr. Reader,

Thank you for your responsiveness to the concerns raised. I am happy to say that your paper is now officially accepted for publication in Collabra: Psychology. Congratulations on this excellent work, I think it will make an important contribution to the literature and I look forward to seeing it published! I hope your experiences with Collabra: Psychology have been positive and that you will continue to consider it as an outlet for your work.

As there are no further reviewer revisions to make, you do not have to complete any tasks at this point.

You will be receiving separate correspondence regarding any production and technical comments, data deposits, as well as publication charges. We work with the Copyright Clearance Center to process any applicable APC charges. Please note that your APC transaction must be completed before your article gets published.

You will have an opportunity to check the page proofs before we publish your article. Thank you again for publishing in Collabra: Psychology.

Sincerely,  
Alex Holcombe