

## **Introduction**

The manuscript “Revisiting the positive association between loneliness and anthropomorphism with an extension to belief in free will: Replication and extensions of Epley et al. (2008)” proposes a close replication of the study “Creating social connection through inferential reproduction: Loneliness and perceived agency in gadgets, gods, and greyhounds” by Epley et al., (2008). The study design in the proposed manuscript is based on the correlational study (study 1) described Epley et al., (2008), but also includes outcome variables from study 2 and study 3 from that same paper. Additionally, it extends the research by adding a potential second predictor (belief in free will) and two additional outcome variables (anthropomorphism of supernatural beings, perceived controllability of gadgets).

Overall, the manuscript is very well written, and I believe the proposed method for replicating the target article, while at the same time implementing the proposed extensions, is well thought-through and scientifically sound. I do have three recommendations/points of concern for the current version of the manuscript. These include the arguments for replicating this specific article, the free will belief extension, and the planned sample size. Below, I address my thoughts and recommendations in detail. I hope the authors find my recommendations helpful in the development of the manuscript and study design.

### **Arguments for replicating Epley et al. (2008)**

In the current manuscript, the authors provide several reasons for a new replication of Epley et al. (2008), including the high impact of the original paper and the mixed results of previous replications. The manuscript then mentions two replications in specific (Open Science Collaboration, 2015; Bartz et al., 2016) and highlights the limitations of these replications. I think the argument for replicating the original study can be strengthened by citing a few more empirical studies on the link between loneliness and anthropomorphism (not necessarily replication studies) that yield null or mixed results. Also, I did wonder if another replication is preferable to a meta-analysis of the existing literature on the connection between loneliness and anthropomorphism (given that the original study was cited 700+ times). I recommend the authors to cite more studies here and to briefly elaborate on their choice of a replication vs. a meta-analysis.

### **Free will belief extension**

I think the rationale behind the extension on ‘belief in free will’ as a predicting factor of anthropomorphism is in need of a little more explanation and support by scientific literature. Specifically, I am not sure whether I am fully convinced by the argument that thinking of free will as a uniquely human trait will “be associated with a subjectively sharper contrast between humans and non-humans and predict weaker anthropomorphism” (p.5). This is because the very definition of anthropomorphism is to attribute such humanlike characteristics to non-human objects. Other studies on anthropomorphism (Eyssel et al., 2011, Eyssel & Reich, 2013) have used the attribution of traits that are thought to be uniquely human or that reflect human nature (Haslam et al., 2008) as an indicator of anthropomorphism. These studies have reported significant effects of some of the factors described in the Three Factor Theory (Epley et al., 2007) on the attribution of these traits. I therefore wonder whether regarding free will to be a uniquely human trait will, as the authors claim, indeed hinder the attribution of humanlike traits to non-human objects and would like to see more literature in support of this claim.

Additionally, I wondered whether it is possible that belief in free relates differently to

some outcomes than others. Specifically, studies have already shown a positive association between religiosity and belief in free will, as belief in free will is a core concept in some religions (Carey & Paulhus, 2013). A significant correlation between belief in free will and the belief in supernatural beings as measured in the proposed study might therefore also not necessarily be evidence of anthropomorphism. Perhaps the authors could elaborate briefly on this possibility in the manuscript.

Finally, the authors hypothesize that belief in free will has unique predictive power. However, the authors also argue that “there is some evidence that belief in free will is positively associated with prosocial behaviors, dispositional gratitude, and importantly, sense of belongingness [...] and as such, negatively associated with the tendency to anthropomorphize” (p.5/6), which would suggest that the belief in free will might actually be associated with anthropomorphism indirectly, through a decrease in chronic loneliness. I therefore suggest that the authors clarify their claims that belief in free will uniquely predicts anthropomorphism. Alternatively, they could also choose to frame this extension as exploratory work (since the authors also do not have a specific prediction of the direction of the effect), which would mean that they would not formulate in the manuscript that they believe that this variable will have unique predictive power.

### **Oversampling**

The authors have conducted a power analysis based on effects reported in previous research on the association between loneliness and anthropomorphism (Bartz et al., 2016). This analysis resulted in a required sample size of 439 participants. The authors however state that they plan on recruiting 1000 participants given their budget and the fact that they would like to be able to detect small samples.

I would actually advise against oversampling by that much, as to not unnecessarily burden participants without gaining a lot of predictive power (I have received this exact comment by reviewers in studies where I too oversampled by around 300 participants, based on my available budget). It seems that the power analysis that resulted in a required sample size of 439 participants was already based on a rather small effect ( $f^2 = .029$ ). Of course, some oversampling will be required to compensate for failed attention checks. The authors might want to consider setting their targeted sample size at around  $n=500$ . With the budget they save, they could run a follow-up study that could corroborate/clarify possible unexpected effects they might encounter in their replication.

### **Conclusion**

Overall, I think the design of the study is described very clearly in the manuscript, and the proposed methodology of the study is scientifically sound. Though I would ask the authors to pay a little more attention to the rationale behind the free will belief extension, I think the other extensions they propose (anthropomorphism of supernatural agents, perceived controllability of gadgets) make a lot of sense. The concerns I addressed above should be easily addressed in a new version of the manuscript.

### **Review written by**

Marieke Wieringa, MSc | PhD candidate

Behavioural Science Institute (BSI) | Radboud University

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