Title: What's hidden in my filedrawer and what's in yours? Disclosing Non-published Findings in the Cognitive Science of Religion

Michiel van Elk^{1,2}

¹ Department of Psychology, University of Amsterdam, Amsterdam, the Netherlands

² Amsterdam Brain and Cognition Center, University of Amsterdam, Amsterdam, the Netherlands

Corresponding author:

Michiel van Elk

University of Amsterdam

Department of Psychology

Nieuwe Achtergracht 129B

1018WT Amsterdam

The Netherlands

Phone: +31205256756

E-mail: m.vanelk@uva.nl

Abstract

In this short report I present an overview of different unpublished studies that we conducted in my lab over the past years. Across the different studies we observed consistent effects of our experimental manipulations or variables of interest on self-report measures, but less so on behavioral and neurocognitive measures. For instance, religious people said they were more prosocial but did not donate more money (Study 1 & 2); participants experienced awe but this did not affect their body and self perception (Study 6 & 7); participants had mystical-like experiences but this did not affect the perception of their peripersonal space (Study 8 & 9); and self-reported magical thinking was unrelated to superstitious behavior (Study 11). In other studies, the hypothesized effects did not bear out as expected or were even in an unexpected direction. Participants perceived more agency in threatening pictures and scenarios, but this was not related to their supernatural beliefs (Study 3-5) and a death priming manipulation reduced rather than increased participants' religiosity (Study 10). Opening the filedrawer through the publication of short reports like this one, will hopefully further increase transparency and will help other researchers to learn from our own trials and errors.

Introduction

Recently I was having drinks with colleagues, when someone asked me to estimate how many unpublished studies I could recount in my lab. I came up with a rough estimate of about 40 studies over the past 10 years, which made me realize that this number is quite shocking.

We all know about the filedrawer problem. Many of us have had the frustrating experience that research projects in which we invested a lot of our time and energy will never see the light of day. There are a variety of reasons for this: the results did not bear out as expected; retrospectively there were some serious flaws in the experimental design or a student messed up. For some projects, there is a point of no return: the investments in terms of time and money may have been so extensive, that we want to get the null findings published. I have also had this experience and published my null findings on agency detection (van Elk, Rutjens, van der Pligt, & van Harreveld, 2016), mentalizing (D.L.R. Maij et al., 2017) and compensatory control (van Elk & Lodder, 2018) for instance. But in many cases the effort of getting our null-findings published is simply too costly. We already lost so much time on apparently fruitless projects, that instead of lingering on, we decide to move forward to conduct more exciting and more promising studies. Even uploading studies with non-significant or non-interpretable findings to the psychfiledrawer website may be too cumbersome: a quick glance on the website shows that many studies are incomplete, not up-to-date and it is difficult to reference to these studies.

The advantages of publishing null findings are huge (Ioannidis, 2006; van Assen, van Aert, Nuijten, & Wicherts, 2014). Next to learning from our own trials and errors, publication of null findings can help others to avoid doing similar studies, while encouraging them to use an improved study design. Publishing of null findings also provides a remedy against the replication crisis, which is caused in large part by the selective publishing of results (Baker, 2016). Of course in the past few years more and more people have become aware of these problems, and many initiatives have been taken to improve the field, including the use of open science badges, preregistration and the publication of registered reports (Asendorpf et al., 2013).

Still, in my own lab I have this long list of unpublished findings. As a researcher I don't have the time for writing full empirical research reports about my (series of) null results that are subsequently sent out for peer review. Even the Journal of Articles in Support of the Null Hypothesis requires full-length articles. Next to publishing papers, I am also expected to teach, supervise student projects, obtain grant money, give public lectures, do interviews and so on. So what am I left to do? I could wait until my retirement and by that time publish a complete textbook full of null findings with the ominous title 'The van Elk files: unpublished findings from the Religion Cognition and Behavior lab 2010 – 2050'. Or I could try to find alternative ways of disseminating my work.

It seems the field is in need of a new way of reporting unpublished findings. What we need is a concise description of the studies that were conducted, including a table with summary statistics. Such a concise format would allow other researchers to refer to the results. It also allows flexibility. One could include a link to the Open Science Framework (www.osf.io), on which the preregistration, study materials and data could be made publicly accessible. Other researchers should have the opportunity for contacting the author to obtain more information about the study. Co-workers can be acknowledged, who in this way also receive credits for the work they did.

As far as I am aware, as of yet there is no journal offering this type of article format. But this short report provides a first attempt to showcase what such an article could look like. Below I will outline some of the most prominent and well-documented studies that we conducted over the past years in my lab. All studies are loosely focused on the topic of the cognitive science of religion. They reflect our attempt to find a controlled way of studying religious and spiritual beliefs and experiences in the lab, by using experimental manipulations and neurocognitive measures. Despite our best efforts, many of these studies resulted in null-results, inconsistent findings, or effects on subjective measures (self-report), but not on objective measures (e.g., behavioral or psychophysiological). Still, the insights that we obtained from these studies might prove valuable for other researchers.

An overview of the different studies that are described in this paper is included in Table 1. The relevant summary descriptives and statistics are provided in

Table 2. If available, we published the raw data, analysis scripts and draft papers that were written detailing the specifics of each study on the Open Science Framework. For some studies that were conducted as part of a student research project, it was not possible to obtain the original data and code, in which case I extracted the summary statistics from the report. More detailed information about each of the individual studies reported here, including information about materials and methods is available upon request. In what follows I will first provide a concise overview of the different studies. Then I will reflect on the more general implications and conclusions that can be drawn based on these findings.

Study 1 &2: Priming Prayer

Previous research has suggested that religious priming makes people more prosocial and that this effect is stronger for explicit compared to implicit priming and more pronounced for religious compared to non-religious participants (Shariff, Willard, Andersen, & Norenzayan, 2016). We conducted two online studies that were preregistered on the OSF (<https://osf.io/sxi5k/> and <https://osf.io/gfacx/>). Approximately 200 self-identified religious participants conducted each study – a sample size, which was considered large at the time the study was conducted in 2014. By using a between-subjects design, in the experimental condition participants were instructed to pray to God for a friend in need, while in the control condition they were required to say a nursery rhyme. Following the experimental manipulation participants were given the opportunity to donate some of the money they were about to receive for filling out the survey to a charity. There was no effect of our experimental manipulation on the amount of money that people were willing to donate (see Table 2). But by using an individual differences approach, we established that self-reported religiosity was positively related to self-report measures of prosocial behavior.

This work was done in collaboration with dr. David Maij and Vere Meijer. The data sets, including a coding scheme of the different variables, associated with these studies are available for re-analysis on the OSF (<https://osf.io/sxi5k/files/>).

This study – next to calling into question the efficacy of religious priming as an experimental manipulation (van Elk, Matzke, et al., 2015)– also provides a first

illustration of the viability of an individual difference approach and the centrality of self-report compared to behavioral measures in the psychology of religion.

Study 3: Agency Detection

We conducted 3 studies to investigate whether participants would be more likely to perceive intentionality in pictures of threatening compared to non-threatening phenomena, and in pictures representing animals and natural scenes. This hypothesis follows logically from the theory of the hyperactive agency detection device (HADD), according to which humans show a bias for attributing intentionality – especially in situations signaling potential threats or danger (Barrett, 2000). We used a similar experimental paradigm as in Nieuwboer et al., (2014), which we administered to participants at both a psychic and a Christmas fair (in order to obtain sufficient individual variability in supernatural beliefs). Across the three different studies that we conducted, ($N = 88$, $N = 75$ & $N = 63$ respectively) we found that participants attributed more agency to threatening compared to non-threatening pictures (see Table 2). However, there was no consistent relationship between supernatural beliefs and participants' tendency to over-attribute intentionality to threatening pictures. It could be that the absence of the hypothesized relationship is related to the fact that some of our participants had difficulty understanding the task instructions (i.e., people from different educational backgrounds likely had a differential understanding of the word 'intentionality').

This work was done in collaboration with dr. David Maj and the data sets associated with each of these studies have been published on the OSF (<https://osf.io/s5rph/>).

While the main effect of threat on agency attribution was in line with previous work (Nieuwboer et al., 2014) and our predictions, the lack of a consistent relationship between agency attributions and supernatural beliefs, called into question the hypothesis that a hyperactive agency detection device is associated with these beliefs (for extensive theoretical discussion, see: Van Leeuwen & van Elk, 2019).

Study 4 & 5: Hyperactive Agency Detection in Virtual Reality

In some of our previous studies we failed to find evidence for a central prediction of HADD theory, according to which humans have a bias for inferring agency when being primed with threatening information (Maij, van Schie, & van Elk, 2019). We also failed to confirm a central hypothesis of HADD theory, according to which agency detection is related to supernatural beliefs (see previous section). However, in those studies our experimental manipulations lacked ecological validity, as participants were simply presented with pictures on a screen that had no relation with our agency detection measures. In order to improve the ecological validity of our threat manipulation we used Virtual Reality, in which participants navigated across different virtual worlds.

In a series of one pilot ($N = 35$) and three virtual reality (VR) studies we tested the hypothesis that ambiguous and threatening situations would activate the HADD, resulting in more agency-like experiences. The materials and analysis plans for the different studies have been pre-registered on the OSF (<https://osf.io/jncb3/>). We note that the design of the studies and our findings are similar to recent work from the Religion Cognition & Culture lab at Aarhus University – which was conducted around the same time (Andersen, Pfeiffer, Müller, & Schjoedt, 2019). Participants navigated through a threatening virtual environment (e.g., a haunted house, a dark forest) or a non-threatening virtual environment (e.g., a maze, a bright forest), while auditory (e.g., breaking branch) and audio-visual agent cues (e.g., falling branch) were presented. Participants were instructed to press the button when they perceived the presence of another agent (e.g., another human being or animal) in the virtual scenario.

In the first study (Study 4; $N = 96$) by using a within-subjects design we found that agency cues more often resulted in agency detection in a threatening compared to a non-threatening environment (see Table 2). In the second study (Study 5; $N = 29$), by using a within-subjects design, while keeping the level of ambiguity (i.e., visibility) constant, this effect was non-significant, suggesting that perceptual ambiguity is the driving factor in agency detection. A third study has been conducted ($N = 80$), but the data have not been analyzed, as the involved researcher and programmer moved out of academia. The aim of this study was to assess whether contextual threat (i.e., as induced by watching a horror movie) could increase agent

detection, while keeping the level of ambiguity constant between conditions. The preregistration of this study can be found on the OSF (<https://osf.io/9eb4h>). Given the complexity of the design of the study (i.e., including VR data, movement data, heart rates, subjective ratings, suggestibility and self-report measures), the data has not been uploaded on the OSF, but is available upon request from the author (in combination with a well-documented description of the different variables).

Across all studies, the types of agents that people reported were in line with the contextual manipulation: in the threatening forest participants more often detected wolves and humans; while in the non-threatening forest they more often reported seeing birds and squirrels. There was no relationship between individual differences in supernatural beliefs and agent detection. This work was done in collaboration with dr. David Maij and the virtual scenarios were programmed by Kas 't Veer.

A draft version of the introduction, methods, results and discussion section of these studies is included on the OSF (<https://osf.io/jncb3/files/>).

We suggest that our findings make sense in light of the framework of predictive processing, according to which prior expectations exert a strong top-down influence on bottom-up sensory processing, thereby coloring perception based on contextual information (Andersen, 2019). The predictive processing theory also accounts for the effects of ambiguity on agent attribution, as top-down expectations yield a stronger effect in case of noisy or ambiguous sensory input (van Elk & Aleman, 2017). However, our findings do not line well with HADD theory, as there was no relationship between agency detection and supernatural beliefs in any of the studies (see also: Overview below).

Study 6 & 7: Awe & Self perception

Awe is a complex emotion that is typically elicited by perceptually vast stimuli. In previous studies we found that participants perceive themselves to be smaller during awe experiences (van Elk, Karinen, Specker, Stamkou, & Baas, 2016) and that awe experiences are characterized by a reduced focus on the self (van Elk, Gomez, van der Zwaag, van Schie, & Sauter, 2019). Awe is also considered a spiritual or self-transcendent emotion, as it seems to trigger spiritual intentions (Van Cappellen &

Saroglou, 2012) and spiritual experiences are often considered awe-inducing (Preston & Shin, 2017). However, most studies on awe have used self-report measures, which are prone to all types of demand- and expectancy-effects. In two studies we intended to use EEG to capture the implicit and automatic processes associated with feeling awe in order to investigate whether awe directly affects the perception of one's body and the self.

In the first EEG study (Study 6; $N = 22$) participants were presented with awe-eliciting, positive or neutral control videos and they were instructed to either get fully absorbed in the videos or to count the number of perspective changes (for similar design, see: van Elk et al., 2019). During the presentation of the videos vibrotactile stimuli were presented to assess effects of the emotional experience on the perception of one's body. As expected, participants reported stronger feelings of awe for the awe-videos compared to the control videos (see Table 2) and in the absorption compared to the analytical condition. The peak latency of the N200 somatosensory evoked potential (SEP) was modulated by subjectively experienced awe, as reflected by an interaction between video and condition and an interaction between video and the subjective awe ratings. These findings could suggest that awe affects the perception of one's body, resulting in a reduced focus and awareness of bodily stimuli. However, as this specific finding was not pre-registered and the sample size was small, the results need to be interpreted with caution.

This study was conducted in collaboration with Chris König and a draft version of the paper including the methods and results is available on the OSF (<https://osf.io/ztwfq/files/>).

In the second EEG study (Study 7; $N = 18$) participants were presented with awe, positive and neutral videos, which were followed by the presentation of adjectives related to the self or unrelated to the self. The analysis focused on the N400-response in association with self-related vs. unrelated words (Metzler et al., 2014). Similar to Study 6 we found that our manipulation was effective: participants reported stronger feelings of awe when watching awe compared to control videos (see Table 2). We also found an N400-effect for adjectives that were unrelated compared to related to the self. However, this effect was not modulated as a function of condition (i.e., there was no difference in self-related processing

between awe, positive and neutral conditions). Also, participants did not show an enhanced memory performance for distinguishing between self-related adjectives that were or were not presented during the previous experimental conditions. The absence of an effect could be related to the fact that self-related and unrelated stimuli were only presented following (and not during) the awe-videos. This project was conducted by Marius Braunsdorf.

Both EEG studies thus demonstrate that awe manipulations effectively affect self-report measures of awe, but that it is difficult to capture effects of awe using neurophysiological techniques – a topic that we will return to in the General Discussion.

Study 8 & 9: Self-transcendent Experiences & Peripersonal space

In two studies we assessed the question whether specific experiences that might be ‘deemed’ self-transcendent (Taves & Asprem, 2017), result in the perceived extension of one’s peripersonal space (PPS), i.e., the space directly surrounding the human body within one’s reach (Noel, Pfeiffer, Blanke, & Serino, 2015). This hypothesis builds on the notion that a key characteristic of many self-transcendent experiences is a changed perception of one’s environment, a reduced awareness of space and the feeling of a strong connection with the surrounding world (Hood Jr, 1975).

In a first study (Study 8; $N = 41$) we used a placebo god helmet to induce mystical-like experiences (Maij, van Elk, & Schjoedt, 2019) and we used the audiotactile integration task as a dependent measure of PPS (Teneggi, Canzoneri, di Pellegrino, & Serino, 2013). In line with other studies (Maij, van Elk, et al., 2019) we found that high absorption participants reported more mystical-like experiences in response to the God helmet manipulation as measured using the mysticism scale (see Table 2). However, there was no relation between placebo-induced mystical experiences and the PPS.

This study was conducted by Benedetta Romano and the data can be found on the OSF (<https://osf.io/2u7yc/files/>).

In a second study (Study 9; $N = 36$) we built on previous findings indicating that joint synchronous movements can induce feelings of empathy and prosociality

(Mogan, Fischer, & Bulbulia, 2017). By using a within-subjects design we instructed pairs of male participants via auditory cues to move in synchrony or in an asynchronous fashion (e.g., swinging with the arms). By using self-report measures we established that participants felt closer towards the other (see Table 2), trusted the other more and felt more similar to the other when moving in synchrony compared to moving asynchronously. However, there was no effect of our synchrony manipulation on the PPS measures.

The self-report data can be found on the OSF (<https://osf.io/2u7yc/files/>) and the study was conducted by Olmo van den Akker.

The absence of an effect of our experimental manipulation on PPS in both studies could be related to the dependent measures that were used: as we did not include a sufficient number of ‘catch’ trials, participants already anticipated the vibrotactile touch based on the looming or receding sounds (for improved design of PPS measurement, see: Noel et al., 2015). This anticipatory effect may have obscured any additional effect of our manipulation on PPS perception. In line with our earlier observations, both studies also show that experimental manipulations affect only self-report measures, but not more ‘objective’ behavioral measures – a topic that we will return to in the General Discussion.

Study 10: Terror management

In an online study using a between-subjects design, we tested the hypothesis that death priming would result in higher scores on a religiosity measure. This prediction followed from terror management theory, according to which death anxiety should activate cultural worldview defense systems (Greenberg, Solomon, & Pyszczynski, 1997).

In the death priming condition (Study 10; $N = 119$), participants first completed the after life belief scale (ABS), and subsequently they indicated to what extent they considered themselves to be religious. In the control condition ($N = 116$), participants first answered the religiosity question and then completed the ABS. Contrary to our prediction, participants in the death priming condition had lower scores on the religiosity question than in the control condition (see Table 2). This

effect remained significant after controlling for multiple comparisons (i.e., three other religiosity items were included as well).

The data for this study was collected as part of the so-called testing-week, during which first-year psychology students at the University of Amsterdam were required to complete survey in return for course credits. The data can be found on the OSF (<https://osf.io/ukzdp/files/>).

A possible explanation for the apparent contradictory effect of our death priming manipulation is that the dominant worldview of our student population at the University of Amsterdam was atheism / agnosticism (Lindeman, van Elk, Lipsanen, Marin, & Schjodt, 2019). Making participants think about their death might accordingly bolster the most prevalent worldview beliefs, resulting in a reduced belief in God. I note however that the effect needs to be interpreted with caution – especially in light of recent failed attempts to replicate classical terror management findings using high-powered studies (Rodríguez-Ferreiro, Barberia, González-Guerra, & Vadillo, 2019; Sætrevik & Sjøstad, 2019).

Study 11: Superstitious Thinking in children

At a science museum in Amsterdam we collected data from a large group of children between 5 and 12 years of age and their parents to assess their magical beliefs and superstitious behavior. We conducted different studies, one of which has been published (van Elk, Rutjens, & van der Pligt, 2015).

In the other study (Study 11; $N = 219$) we asked children to shoot a dice three times using a custom made device. By using a between-subjects manipulation we manipulated the feedback after two shots: one group of children was told that they belonged to the best 10% of the day if they would shoot a 5 or 6. The other group of children was instructed that their performance was below the average of the day and that it didn't really matter which number they would throw. As a dependent measure we used the force that children applied to pulling the lever to shoot the dice. We tested the hypothesis that in situations of uncertainty children would show a motivated tendency to engage in superstitious-like behavior, by applying more force to shoot the dice. This hypothesis followed from previous studies in which we found that participants invested more effort (e.g., they spent more time on drawing

a ball; they applied more force when throwing a dice) in high-risk situations (Becker & van der Pligt, 2016). We also measured children's magical beliefs by using the magical thinking questionnaire.

There was no effect of our manipulation on the force that children applied; nor did we observe a relation between children's self-reported magical beliefs and their 'superstitious' pulling behavior. Surprisingly, we also did not observe a relationship between the superstitious beliefs of the parents and the children's self-reported magical thinking (see Table 2).

The data from this study has been collected by Monique Duizer, Laura Dijkhoff, Eva Specker and the data related to self-reported magical thinking and superstition can be found on the OSF (<https://osf.io/cswmk/files/>).

Thus, in this study there was no effect of our experimental manipulation and we did not observe the hypothesized relation between the individual difference measures (which may be related to the low reliability and validity of our scale to measure magical thinking in children). Also, we did not observe reliable effects on the self-report and the behavioral measures that were included in this study.

Overview and Summary

Before reflecting on the general implications, let me try to shortly summarize the main findings from this flurry of studies.

First, in Study 1 and 2 religious priming did not increase the amount of money that people donated – though we found that religiosity was correlated to people's self-reported willingness to donate. The lack of an overall effect of religious priming on prosociality echoes recent findings from two registered reports on this topic (Billingsley, Gomes, & McCullough, 2018; Gomes & McCullough, 2015) – although explicit religious priming seems to increase prosocial behavior selectively among religious participants (Billingsley et al., 2018; Shariff et al., 2016). The absence of an effect of our experimental manipulation in both studies among religious participants could be related to the lack of compliance, as participants completed the study online.

In Study 3A, 3B and 3C we found that participants perceived more intentionality and agency in pictures of threatening phenomena. Also in Study 4 and

5 using a more ecologically valid manipulation, we found that threat increased the detection of agents in a virtual environment. These studies fit well with the logic from evolutionary psychology that humans have an evolved tendency to detect agency – a hair-trigger device that fires in ambiguous and threatening situations (Barrett, 2000). However, in none of the studies did we observe a consistent relationship between agent detection and supernatural beliefs. Thereby these studies add to the growing empirical evidence against HADD theory, which posits that evolved agency detection biases are at the basis of supernatural beliefs. Other theoretical frameworks to account for the emergence of supernatural beliefs seem more plausible in light of the current evidence, including the theory of predictive processing (Andersen, 2019) and the interactive religious experience model (Van Leeuwen & van Elk, 2019).

In order to obtain further insight in the underlying neurocognitive mechanisms of self-transcendent experiences, in study 6 and 7 we used EEG and in study 8 and 9 we used an audio-tactile integration task. Although participants reported feelings of awe, there was no clear effect of awe on somatosensory processing or the processing of self-related adjectives. Also, we did not observe an effect of god-helmet induced mystical experiences on the extension of peripersonal space, nor did moving in synchrony affect the perception of the space directly surrounding one's body. The lack of an effect on these more 'objective' measures could be related to the inefficacy of our experimental manipulations to induce sufficiently strong experiences. For instance, although our videos induced awe as reflected by the self-report measures, the duration was relatively short and the way the videos were presented was non-immersive (i.e., we didn't use a VR environment). Also, the mere act of measuring behavioral and brain responses could have interfered with the experience, thereby working against the experimentally induced experiences. For instance, in the god-helmet study participants were required to respond to tactile vibrations while listening to dynamic white noise stimuli, which could have reduced their ability to get absorbed in the experiences attributed to the helmet. Thus, a more promising avenue for future studies is the use of more powerful and ecologically valid ways to induce mystical-like experiences (e.g., through VR or psychedelics) and to use neuroimaging techniques in a task-free setting (e.g., resting-state analysis).

Inspired by terror-management manipulations we found that priming participants with the afterlife belief scale resulted in lower religiosity scores in Study 10. This unexpected finding could be related to the overall low level of religiosity among our participants. Relatedly, the way in which we primed participants by having them reflect on their beliefs about death and afterlife, could have increased their awareness of their cultural worldview and the belief that life ends when we die. These findings cast a new perspective on terror management theory, suggesting that cultural worldview defenses could also be defined in terms of religious unbelief and atheism. Again, it is important to keep in mind that recent replication attempts have failed to replicate classical TMT findings (Rodríguez-Ferreiro et al., 2019; Sætrevik & Sjøstad, 2019) and that effects often appear inconsistent across different studies (Jonathan Jong; personal communication). It is thus important not to draw strong inferences based on this single study.

Finally, in Study 11 we found no relationship between children's self-reported magical thinking and their superstitious behavior in a dice-throwing task. There was also no relationship between children's and parents' self-reported magical thinking and superstition. Although we have previously established a developmental trend for decreased magical thinking with increased age (van Elk, Rutjens, et al., 2015), this apparently was not reflected in the amount of force that children applied to throw a dice – though previous studies with adults have shown evidence for this 'superstitious effect' (Becker & van der Pligt, 2016).

The critical reader might note that the findings reported here do not provide a final defeater for major theoretical frameworks in the psychology and cognitive science of religion. Absence of evidence is not the same as evidence of absence – as many Bayesians have been keen to point out (Wagenmakers et al., 2018). It should also be acknowledged that some of the studies reported here may have been underpowered – especially when it comes to detecting individual differences. As such, these studies will not provide the definite answer as of whether a specific effect exists or not – especially in light of the observation that many of the effect sizes of critical effects in the psychology of religion tend to be rather small (see for instance: D. L. R. Maij et al., 2017). Failure to find empirical evidence for prominent theoretical frameworks, such as HADD or TMT theory, could be explained by many

different factors (e.g., the design and power of the study; validity of the measures etc.). Complementary approaches, such as the use of cross-cultural data sets and carefully crafted field studies, might be better suited than lab-based studies to test the predictions derived from some of the theories that were discussed in this paper (see also suggestions for future research below).

General Discussion

Now that my filedrawer has finally been opened and some of the dust has been wiped off, what do we learn from this? Was my filedrawer excessively filled with unpublished findings? I don't think so. For instance, in my psychology department I have been the teaching coordinator of our students' thesis projects, handling approximately 100 theses per year. Over the past years I have seen many theses with non-significant findings that I guess are mostly stored deeply in the filedrawer. In fact, many psychology students seem to express surprise in case a thesis project actually bears out as expected, because this is the exception rather than the rule. In fact, we all should feel surprised in case we see our hypothesis confirmed by a statistically significant effect: a p -value smaller than .05 actually reflects the probability of getting the observed data, assuming that the null hypothesis is true (Lakens, 2019). The situation is likely similar at many other psychology departments, as each of our students is expected to jump through the hoop of conducting an empirical research project. But also at scientific conferences or discussions on social media, many colleagues admit to having quite a few studies in their filedrawer.

On a more positive note, first off I believe we are in need of new ways of communicating our scientific (null) findings to a broader audience. The peer review process is key to scientific progress, but at the same time it is slow and laborious. Even despite a recent trend towards more transparency, including preregistration on the OSF and the use of registered reports, many studies still remain unpublished. Journals could organize new sections to shortly describe non-significant or difficult-to-interpret results that might still be of interest to a broader audience. By including a link to the OSF and basic descriptive statistics, these findings in turn could be used to inform meta-analytic studies or for secondary analyses.

Secondly, the studies described above reflect an ongoing challenge to come up with good experimental paradigms and measures to study religious and spiritual beliefs and experiences. When doing research on religion one is always faced with the trade-off between studying authentic religious experiences in an ecologically valid way and the need for tight experimental control. Most of the studies reported here offer highly systematic and controlled manipulations, but at the same time they fail to capture the ‘real stuff’ that psychologists of religion are interested in. Bringing authentic religious practices to the lab (Schjoedt, Stdkilde-Jorgensen, Geertz, & Roepstorff, 2009) or infusing field studies with standardized psychological scales (Luhmann, Nusbaum, & Thisted, 2010) might offer more promising avenues for understanding the mechanisms underlying religion. The VR studies discussed above are good examples in that respect, as they show that in an ecologically valid situation induced threat does indeed increase agency detection, as would be predicted by HADD theory.

Thirdly, there seems to be a common thread in the different studies reported here, in that there is a dissociation between subjective self-report measures (which often showed effects in the expected direction) and more implicit psychophysical or neurocognitive measures. For instance, highly religious people said that they were more prosocial, but they were not more willing to donate than less religious participants. Our awe videos indeed successfully induced awe as measured using a self-report scale, but they did not affect neurocognitive responses to bodily stimuli or to self-related adjectives. Participants reported mystical-like experience with our god-helmet and felt more in union with others when moving in synchrony; however, this did not affect their perception of peripersonal space.

The golden grail in psychology is often to show ‘objective or behavioral evidence’ for a specific effect or experimental manipulation. But we have to face the fact that this is notoriously difficult, e.g., as also evidenced by the large literature on placebo manipulations, which typically affect subjective but not objective measures (Schwarz & Buchel, 2015). The dissociation between self-report on the one hand, and behavioral and neurophysiological measures on the other hand, could indicate that they actually capture different underlying constructs. We need a more refined theory explaining the causal mechanism whereby our latent variable of interest

affects our measurement tools, including both self-report and behavioral measures (Borsboom, Mellenbergh, & van Heerden, 2004).

Self-report measures reflect participants' beliefs, expectations as well as the contextual and social setting in which a study is conducted. The mechanisms whereby people comply with experimental instructions and respond in a socially desirable way, may actually be at the heart of many phenomena that psychologists of religion and spirituality are interested in, such as faith healing, the role of set and setting in psychedelic experiences and the role of religion in self-esteem (Sedikides & Gebauer, 2010) and prosocial behavior (Shariff et al., 2016). Thus, we need to acknowledge that understanding subjective experience is at the heart of the scientific study of religion, as William James already acknowledged (James, 1902). And maybe we should let go of the ambition to publish only papers showing 'more objective' behavioral or neurophysiological effects.

Conclusion

This paper provides a first start to communicate unpublished findings in a more concise and efficient way. Opening up our filedrawer through the publication of short reports and summary statistics, will directly foster scientific progress, by allowing secondary analyses, better informed meta-analyses and more transparent reporting and disclosing of results. It is my hope that many more filedrawer papers will follow, not only in the field of CSR, but in psychology and cognitive science more broadly.

Acknowledgments

The writing of this paper was supported by a Templeton grant (#60663) to MvE. This paper was written during a research fellowship at the Netherlands Institute of Advanced Studies (NIAS), in Amsterdam awarded to MvE.

References

Andersen, M. (2019). Predictive coding in agency detection. *Religion Brain & Behavior*, 9(1), 65-84. doi:10.1080/2153599x.2017.1387170

- Andersen, M., Pfeiffer, T., Müller, S., & Schjoedt, U. (2019). Agency detection in predictive minds: a virtual reality study. *Religion, Brain & Behavior*, 9(1), 52-64.
- Asendorpf, J. B., Conner, M., De Fruyt, F., De Houwer, J., Denissen, J. J. A., Fiedler, K., . . . Wicherts, J. M. (2013). Recommendations for Increasing Replicability in Psychology. *European Journal of Personality*, 27(2), 108-119. doi:10.1002/per.1919
- Baker, M. (2016). 1,500 scientists lift the lid on reproducibility. *Nature News*, 533(7604), 452.
- Barrett, J. L. (2000). Exploring the natural foundations of religion. *Trends in Cognitive Sciences*, 4(1), 29-34. doi:Doi 10.1016/S1364-6613(99)01419-9
- Becker, D., & van der Pligt, J. (2016). Forcing your luck: Goal-striving behavior in chance situations. *Motivation and Emotion*, 40(2), 203-211. doi:10.1007/s11031-015-9527-5
- Billingsley, J., Gomes, C. M., & McCullough, M. E. (2018). Implicit and explicit influences of religious cognition on Dictator Game transfers. *R Soc Open Sci*, 5(8), 170238. doi:10.1098/rsos.170238
- Borsboom, D., Mellenbergh, G. J., & van Heerden, J. (2004). The concept of validity. *Psychol Rev*, 111(4), 1061-1071. doi:10.1037/0033-295X.111.4.1061
- Gomes, C. M., & McCullough, M. E. (2015). The effects of implicit religious primes on dictator game allocations: A preregistered replication experiment. *J Exp Psychol Gen*, 144(6), e94-104. doi:10.1037/xge0000027
- Greenberg, J., Solomon, S., & Pyszczynski, T. (1997). Terror management theory of self-esteem and cultural worldviews: Empirical assessments and conceptual refinements. *Advances in Experimental Social Psychology*, Vol 29, 29, 61-139. doi:Doi 10.1016/S0065-2601(08)60016-7
- Hood Jr, R. W. (1975). The construction and preliminary validation of a measure of reported mystical experience. *Journal for the scientific study of religion*, 14(1), 29-41.
- Ioannidis, J. P. A. (2006). Journals should publish all "null" results and should sparingly publish "positive" results. *Cancer Epidemiology Biomarkers & Prevention*, 15(1), 186-186. doi:Doi 10.1158/1055-9965.Epi-05-0921
- James, W. (1902). *The Varieties of Religious Experience: A Study in Human Nature: Being the Gifford Lectures on Natural Religion Delivered at Edinburgh in 1901-1902*. In: Dover Publications.
- Lakens, D. (2019). The practical alternative to the p-value is the correctly used p-value.
- Lindeman, M., van Elk, M., Lipsanen, J., Marin, P., & Schjoedt, U. (2019). Religious Unbelief in Three Western European Countries: Identifying and Characterizing Unbeliever Types Using Latent Class Analysis. *International Journal for the Psychology of Religion*, 29(3), 184-203. doi:10.1080/10508619.2019.1591140
- Luhrmann, T. M., Nusbaum, H., & Thisted, R. (2010). The Absorption Hypothesis: Learning to Hear God in Evangelical Christianity. *American Anthropologist*, 112(1), 66-78. doi:Doi 10.1111/J.1548-1433.2009.01197.X
- Maij, D. L. R., van Elk, M., & Schjoedt, U. (2019). The role of alcohol in expectancy-driven mystical experiences: a pre-registered field study using placebo brain

- stimulation. *Religion Brain & Behavior*, 9(2), 108-125.
doi:10.1080/2153599x.2017.1403952
- Maij, D. L. R., van Harreveld, F., Gervais, W., Schrag, Y., Mohr, C., & van Elk, M. (2017). Mentalizing skills do not differentiate believers from non-believers, but credibility enhancing displays do. *PLoS One*, 12(8). doi:ARTN e0182764 10.1371/journal.pone.0182764
- Maij, D. L. R., van Harreveld, F., Gervais, W., Schrag, Y., Mohr, C., & van Elk, M. (2017). Mentalizing skills do not differentiate believers from non-believers, but credibility enhancing displays do. *PLoS One*, 12(8), e0182764.
- Maij, D. L. R., van Schie, H. T., & van Elk, M. (2019). The boundary conditions of the hypersensitive agency detection device: an empirical investigation of agency detection in threatening situations. *Religion Brain & Behavior*, 9(1), 23-51. doi:10.1080/2153599x.2017.1362662
- Metzler, S., Theodoridou, A., Aleksandrowicz, A., Muller, M., Obermann, C., Kawohl, W., & Heekeren, K. (2014). Evaluation of trait adjectives and ego pathology in schizophrenia: An N400 study. *Psychiatry Research*, 215(3), 533-539. doi:10.1016/j.psychres.2013.12.025
- Mogan, R., Fischer, R., & Bulbulia, J. A. (2017). To be in synchrony or not? A meta-analysis of synchrony's effects on behavior, perception, cognition and affect. *Journal of Experimental Social Psychology*, 72, 13-20. doi:10.1016/j.jesp.2017.03.009
- Nieuwboer, W., Van Schie, H. T., & Wigboldus, D. (2014). Priming with religion and supernatural agency enhances the attribution of intentionality to natural phenomena. *Journal for the cognitive science of religion*, 2(2), 97-120.
- Noel, J. P., Pfeiffer, C., Blanke, O., & Serino, A. (2015). Peripersonal space as the space of the bodily self. *Cognition*, 144, 49-57. doi:10.1016/j.cognition.2015.07.012
- Preston, J. L., & Shin, F. (2017). Spiritual experiences evoke awe through the small self in both religious and non-religious individuals. *Journal of Experimental Social Psychology*, 70, 212-221. doi:10.1016/j.jesp.2016.11.006
- Rodríguez-Ferreiro, J., Barberia, I., González-Guerra, J., & Vadillo, M. A. (2019). Are we truly special and unique? A replication of Goldenberg et al.(2001). *Royal Society Open Science*, 6(11), 191114.
- Sætrevik, B., & Sjøstad, H. (2019). Failed pre-registered replication of mortality salience effects in traditional and novel measures.
- Schjoedt, U., Stdkilde-Jorgensen, H., Geertz, A. W., & Roepstorff, A. (2009). Highly religious participants recruit areas of social cognition in personal prayer. *Social Cognitive and Affective Neuroscience*, 4(2), 199-207. doi:Doi 10.1093/Scan/Nsn050
- Schwarz, K. A., & Buchel, C. (2015). Cognition and the Placebo Effect - Dissociating Subjective Perception and Actual Performance. *PLoS One*, 10(7). doi:ARTN e0130492 10.1371/journal.pone.0130492
- Sedikides, C., & Gebauer, J. E. (2010). Religiosity as Self-Enhancement: A Meta-Analysis of the Relation Between Socially Desirable Responding and Religiosity. *Personality and Social Psychology Review*, 14(1), 17-36. doi:10.1177/1088868309351002

- Shariff, A. F., Willard, A. K., Andersen, T., & Norenzayan, A. (2016). Religious Priming: A Meta-Analysis With a Focus on Prosociality. *Personality and Social Psychology Review*, 20(1), 27-48. doi:10.1177/1088868314568811
- Taves, A., & Asprem, E. (2017). Experience as event: event cognition and the study of (religious) experiences. *Religion, Brain & Behavior*, 7(1), 43-62.
- Teneggi, C., Canzoneri, E., di Pellegrino, G., & Serino, A. (2013). Social Modulation of Peripersonal Space Boundaries. *Current Biology*, 23(5), 406-411. doi:10.1016/j.cub.2013.01.043
- van Assen, M. A. L. M., van Aert, R. C. M., Nuijten, M. B., & Wicherts, J. M. (2014). Why Publishing Everything Is More Effective than Selective Publishing of Statistically Significant Results. *PLoS One*, 9(1). doi:ARTN e84896 10.1371/journal.pone.0084896
- Van Cappellen, P., & Saroglou, V. (2012). Awe Activates Religious and Spiritual Feelings and Behavioral Intentions. *Psychology of Religion and Spirituality*, 4(3), 223-236. doi:10.1037/a0025986
- van Elk, M., & Aleman, A. (2017). Brain mechanisms in religion and spirituality: An integrative predictive processing framework. *Neuroscience and Biobehavioral Reviews*, 73, 359-378. doi:10.1016/j.neubiorev.2016.12.031
- van Elk, M., Gomez, M. A. A., van der Zwaag, W., van Schie, H. T., & Sauter, D. (2019). The neural correlates of the awe experience: Reduced default mode network activity during feelings of awe. *Human Brain Mapping*, 40(12), 3561-3574. doi:10.1002/hbm.24616
- van Elk, M., Karinen, A., Specker, E., Stamkou, E., & Baas, M. (2016). 'Standing in awe': The effects of awe on body perception and the relation with absorption. *Collabra: Psychology*, 2(1).
- van Elk, M., & Lodder, P. (2018). Experimental manipulations of personal control do not increase illusory pattern perception. *Collabra: Psychology*, 4(1).
- van Elk, M., Matzke, D., Gronau, Q. F., Guan, M., Vandekerckhove, J., & Wagenmakers, E. J. (2015). Meta-analyses are no substitute for registered replications: a skeptical perspective on religious priming. *Frontiers in Psychology*, 6. doi:ARTN 1365 10.3389/fpsyg.2015.01365
- van Elk, M., Rutjens, B. T., & van der Pligt, J. (2015). The development of the illusion of control and sense of agency in 7-to-12-year old children and adults. *Cognition*, 145, 1-12. doi:10.1016/j.cognition.2015.08.004
- van Elk, M., Rutjens, B. T., van der Pligt, J., & van Harreveld, F. (2016). Priming of supernatural agent concepts and agency detection. *Religion Brain & Behavior*, 6(1), 4-33. doi:10.1080/2153599x.2014.933444
- Van Leeuwen, N., & van Elk, M. (2019). Seeking the supernatural: the Interactive Religious Experience Model. *Religion Brain & Behavior*, 9(3), 221-251. doi:10.1080/2153599x.2018.1453529
- Wagenmakers, E. J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Morey, R. D. (2018). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic Bulletin & Review*, 25(1), 35-57. doi:10.3758/s13423-017-1343-3

Table 1. Overview of the design, including the independent variables and the dependent variables of the unpublished studies described in the paper.

Study	Design	IV	DV (as reported here)	OSF link
Study 1	Between-subjects	prayer vs. Nursery rhyme	Amount of money donated	https://osf.io/sx5sk/
Study 2	Between-subjects	prayer vs. Nursery rhyme	Amount of money donated	https://osf.io/gfacw/
Study 3A	Within-subjects	Threatening vs. Non-threatening Pictures	Intentionality	https://osf.io/5srph/
Study 3B	Within-subjects	Threatening vs. Non-threatening Pictures	Intentionality	
Study 3C	Within-subjects	Threatening vs. Non-threatening Pictures	Intentionality	
Study 4	Within –subjects	Threatening vs. Non-threatening forest	Agent detection	https://osf.io/jnck3/
Study 5	Within –subjects	Threatening vs. Non-threatening forest	Agent detection	
Study 6	Within-subjects	Awe vs. positive & Control videos	Awe	https://osf.io/ztwfa/files/
Study 7	Within-subjects	Awe vs. positive & Control videos	Awe	
Study 8	Between-subjects	God-helmet on vs. off	Mystical Experiences	https://osf.io/2u7yc/files/
Study 9	Within-subjects	Moving in synchrony vs. Asynchrony	Rapport	https://osf.io/2u7yc/files/
Study 10	Between-subjects	Death prime	Religiosity	https://osf.io/ukzdp/files/
Study 11	Between-subjects	Low vs. high success	Magical Thinking Feedback	https://osf.io/cswmk/files/

Table 2: Overview of descriptive statistics for the different studies.

	N	DV	Mean C1	Mean C2	Test statistics
Study 1	188 (91/97)	\$ money donated	18.90 (.74)	19.13 (.63)	$t(186) = -.24, p = .80$
Study 2	115 (55 / 60)	\$ money donated	4.07 (.46)	3.63 (.44)	$t(113) = .69, p = .40$
Study 3A	88	intentionality	81.87 (1.62)	48.27 (3.73)	$F(1,87) = 78.34, p < .001, \eta^2 = .47$
Study 3B	75	intentionality	70.04 (2.68)	17.51 (2.59)	$F(1,74) = 210.34, p < .001, \eta^2 = .74$
Study 3C	63	intentionality	73.10 (2.75)	41.36 (3.83)	$F(1,60) = 53.56, p < .001, \eta^2 = .47$
Study 4	96	agent detection	2.70 (.26)	7.40 (.67)	$F(1, 94) = 28.97, p < .001, \eta^2 = .24$
Study 5	29	agent detection	5.66 (.81)	6.55 (.87)	$F(1,28) = 2.76, p = .108, \eta^2 = .09$
Study 6	22	Awe	63.94 (11.02)	-20.26 (10.29)	$F(2, 24) = 66.15, p = .00, \eta^2 = .78$
				-57.48 (9.80)	
Study 7	18	Awe	100.07 (33.98)	15.46 (34.47)	$F(2, 34) = 24.56, p < 0.005, \eta^2 = 0.41$
				-77.42 (36.36)	
Study 8	41 (23/18)	Mystical Experiences	Correlation Absorption & Mysticism $r = .358, p = .022$		
Study 9	36	Rapport	3.69 (.30)	3.00 (.26)	$F(1, 35) = 9.86, p = .003, \eta^2 = .22$
Study 10	235 (119 / 116)	Religiosity	1.91 (.11)	1.51 (.11)	$F(1, 233) = 6.95, p = .009, \eta^2 = .03$
Study 11	219	Magical Thinking	Correlation with parents' superstition $r = -.01, p = .89$		