Past Its Prime?
A Methodological Overview and Critique of Religious Priming Research in Social Psychology

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Social psychologists have frequently used priming methodologies to explore how religion can impact behaviour. Despite this, no consensus currently exists on whether religious priming effects are replicable or consistently observed across a range of spiritual beliefs. Moreover, mixed evidence highlights possible methodological shortcomings within the priming literature as well as theoretical ambiguity regarding the contents of different primes. The current article examines four types of religious priming methodologies that are frequently used in social-psychological research (explicit, implicit, subliminal, and contextual) and critically inspects the current landscape of the religious priming literature. We highlight theoretical issues and suggest methodological improvements that should facilitate a clearer understanding of when and how religion influences human behaviour.

With the birth and development of religious priming studies over the past few decades, psychologists have sought to understand and clarify the role of religion in human behaviour – a challenging endeavor previously reserved for philosophers and theologians. Regrettably, however, the current state of the field concerning priming research in general is quite chaotic. Recent replication failures of "classic" behavioural priming effects (e.g., Chabris *et al.* 2019; Doyen *et al.* 2012; O'Donnell *et al.* 2018; Shanks *et al.* 2013) and highly publicized discussions regarding "Questionable Research Practices" (John *et al.* 2012; Kerr 1998) have understandably cast doubts on many conclusions derived from published priming research, especially in social psychology. Germane to the present discussion, although a series of meta-analyses of religious priming studies yielded small-to-moderate effects (Shariff *et al.* 2016), other analyses using alternative methods for correcting publication bias (van Elk *et al.* 2015) and recent replication attempts that did not find significant priming effects (e.g., Gomes and McCullough 2015; Verschuere *et al.* 2018)

cumulatively suggest that certain forms of religious priming effects may not differ statistically from zero. Thus, like a short-lived fad, experimental priming manipulations of religion that seemed promising at first and quickly became influential may now be "past their prime" and on the way to being forgotten and abandoned.

With priming becoming "the poster child" of the replication crisis (Kahneman 2012), researchers invested in religious priming should ask themselves: Do we cut our losses and walk away? Or do we continue forward and risk finding nothing? The goal of this article is to inspect the current landscape of religious priming research in social psychology by 1) revisiting various types of priming methodologies, 2) identifying theoretical and methodological concerns, and 3) suggesting ways that future research might be improved. We briefly describe the advantages of experimentation and provide an overview of common religious priming techniques. We then discuss the current state of the field and highlight methodological refinements that might be employed to generate more robust conclusions.

Methodological overview

Socrates, Dostoevsky, Christopher Hitchens, and many great minds have pondered the relationship between religion and morality. To date, the question is still not settled. As one example of why, correlational evidence on the religion-morality link is mixed. Religiosity is correlated with self-reported positive endeavors such as forgiveness (Fehr *et al.* 2010), blood donations (Gillum and Masters 2010), and voluntarism (Ruiter and De Graaff 2010), as well as observable prosocial behaviour toward coreligionists (Henrich, Ensminger *et al.* 2010; Purzycki *et al.* 2016, 2018). However, other studies have found no relationship between dispositional religiosity and cooperative behaviour (Ahmed and Salas 2009; Eckel and Grossman 2004) or self-reported (im)moral actions (Hofmann *et al.* 2014).

Beyond the mixed findings, other issues with correlational research are evident. Although informative, correlational research designs limit researchers' ability to draw causal inferences and cannot easily test directionality of effects or rule out third variables that may cause both religiosity and prosociality. That is, it is difficult for correlational studies to do more than document an association between religion and prosocial behaviour or, based on this association, advance an argument that religion may be sufficient at times for bringing prosociality about. This is particularly true because the alternative hypothesis that prosociality drives religiosity is also reasonable. Other issues include that religious people have a greater tendency to respond in socially desirable ways than non-religious people (Gervais and Norenzayan 2012; Sedikides and Gebauer 2010), believers may overestimate their religious

commitment (e.g., exaggerated church attendance; Hadaway *et al.* 1998), and non-believers may socially refrain from identifying as atheists (Gervais and Najle 2018). For these reasons, survey research may be poorly positioned to detect any true relationship between religion and morality (or related variables).

One set of techniques that overcomes some limitations of correlational methods and can demonstrate a causal role of religious beliefs on moral (and non-moral) behaviour, if it exists, are experimental designs that utilize religious priming. Here, "religious priming" refers broadly to the activation of mental concepts through both overt and subtle cues of religion, which can be used to measure the effect of religious cognition on judgment and behaviour in subsequent tasks (Bargh and Chartrand 2000). Although some priming studies treat religious (dis)belief as an outcome variable, such as experiments eliciting analytical thinking (Gervais and Norenzayan 2012) or manipulating agency detection (see Van Leeuwen and van Elk 2019), we focus our discussion on social psychological experiments manipulating saliency of religious beliefs/concepts.

In laboratories, researchers have primed religion by asking participants to complete tasks involving active reflections, subtle reminders, subliminal word or image presentations, or contextual cues of religious concepts (e.g., Aveyard 2014; Kupor *et al.* 2015; also see Table 1). Priming tasks are typically followed by a second task often disguised as unrelated to the priming task, which then measures outcomes of interest while religious concepts are readily accessible or activated without awareness in participants' minds. Critically, by comparing observed differences in dependent measures for people who have been primed with religious (vs. non-religious) concepts or have not received an experimental manipulation, researchers can attempt to infer any causal effect of the primes on behaviour.

Despite the potential artificiality of experimentally inducing religious thoughts, even unconsciously, some forms of this tool have ecological validity. Believers and non-believers alike might have conversations about spirituality, hear news about religious groups, see religious icons, pass by religious buildings, or be exposed to religious music during holiday seasons, and these experiences may occur without reflective awareness. Randomized controlled experiments − based on the assumption that there are no systematic differences within or between different groups at the outset of experiments (Mill 1965) − can capitalize on the types of incidental exposures to religion that occur in the real world and translate them into tests of whether religion impacts behaviour. That is, because researchers cannot randomly assign religious identities to participants, religious priming can be an important tool to demonstrate the causal impact of religion on various psychological outcomes

(Willard *et al*. 2016).

Below, we provide a methodological overview of four common types of religious priming: explicit, implicit, subliminal, and contextual. Table 1 provides a summary of the typical characteristics of each method. Explicit and implicit religious priming both typically involve semantic cues; subliminal and contextual priming may be semantic or non-semantic. In explicit, implicit, and contextual priming, participants can consciously perceive priming stimuli (e.g., reading religious text, solving puzzles, hearing Adhan). On the other hand, subliminal priming involves presentation of stimuli outside of perceptual awareness (e.g., very rapid image presentations). Finally, in explicit priming, participants are aware that the priming task involves religion − although they are probably unable to guess how it is expected to influence their behaviour − whereas implicit, subliminal, and contextual primes are usually argued to leave participants oblivious to religious cues.

Explicit priming

Many activities within religious traditions (e.g., Islamic call to prayer, the Torah reading) dictate explicit proscriptions and prescriptions to guide daily behaviours. Even for those who do not identify as particularly religious, explicit reminders of religious values might spontaneously be made salient through wedding vows, funeral ceremonies, or "What Would Jesus Do?" bumper-sticker messages. Similar to these overt cues of religious concepts, explicit priming involves directly prompting participants to think about specific religious ideas. For example, participants may be asked to read passages from sacred texts or other excerpts with religious content (e.g., Laurin, Kay *et al*. 2012, Studies 4-5; Yilmaz and Bahçekapili 2016, Study 2), write an essay about a religious passage (e.g., DeBono *et al*. 2016), or memorize Biblical verses (e.g., Johnson *et al*. 2015). A simple recall task, such as asking participants to list the Ten Commandments, may also be used to evoke thoughts of religion (Mazar *et al*. 2008, Study 1). In each of these procedures, comparison conditions involve similar tasks that are unrelated to religion (e.g., reading about linguistics, memorizing inspirational but non-religious quotes, listing ten book titles). These studies have shown that explicitly reminding participants of religious concepts can affect subsequent behaviour (e.g., cheating, helping, resisting temptation). Critically, randomly assigning people to religious prime (vs. neutral) groups helps ensure that any differences in outcome variables can be attributed to the experimental manipulations.

Another way in which researchers explicitly prime religion is by strategically embedding demographic questionnaires that assess participants' religiosity within an experiment. For example, Laurin, Shariff *et al*. (2012, Studies 2−3) manipulated the salience of belief in God by administering a question-

	Explicit	Implicit	Subliminal	Contextual
Can participants perceive the priming stimuli?	Yes	Yes	No	Yes
Are participants aware of how the prime may be influencing their behaviour?	Maybe	No	No	No
Priming Stimuli Examples	• Sacred texts • Demographics • Essay-Writing	• Scrambled Sentence Tasks • Subtle presentation	• Lexical Decision Tasks • Rapidly presented images	• Experiment locations • Holiday (vs. secular) music
Advantages	• High customizability (flexible manipulations) • Relatively easy to create new stimuli	• Participant engagement • Hypothesis-guessing is less likely	• Hypothesis-guessing is unlikely	• Hypothesis-guessing is less likely • Naturalistic settings • (Possibly) stronger effects
Challenges	• Hypothesis-guessing (demand effects)	• Less flexibility for semantic stimuli • (Possibly) smaller effects	• Less flexibility for semantic stimuli • More resources needed (pretesting stimuli, special program, etc.) • Multiple trials = longer study durations • (Possibly) smaller effects	• Difficult to coordinate field experiments • Limited choice of locations • More potential for confounds/interruptions (e.g., bystanders)
Example References	• DeBono et al. 2016 • Mazar et al. 2008 • Johnson et al. 2015	• Benjamin et al. 2016 • Chan et al. 2014, Studies 2-3	• Pichon et al. 2007 • McKay et al. 2011 • Rutchick 2010, Study 5	• Ahmed & Salas 2013 • Aveyard 2014, Study 2 • Xygalatas 2013

Table 1: Summary of the four common types of priming method.

naire to participants before or after they played a game involving punishment. Because participants' beliefs predicted their level of punishment only when made salient prior to playing the game, a causal inference between belief in God and punishment behaviour was drawn. Using a similar technique, researchers have manipulated the saliency of beliefs by simply asking questions (or not) about religious identification prior to an experimental task, demonstrating reductions in hostility after threat and enhanced forgiveness among those reminded of their religious belief systems (Nieuwboer *et al.* 2016; Schumann *et al.* 2014, Studies 1−7).

Implicit priming

Scrambled Sentence Task

An implicit religious priming methodology pioneered by Shariff and Norenzayan (2007; adapted from Srull and Wyer 1979) is the Scrambled Sentence Task. Participants are given several sets of five words. For each set, they are asked to create a meaningful sentence by dropping one word and rearranging the remaining four words. For example, "fall was worried she always" would become "she was always worried" (see Figure 1). Participants are usually given ten scrambled sentences where five of them are shared across conditions and the other five are systematically varied. The sentences in a religious prime condition might contain target words such as "spirit," "divine," "God," "sacred," and "prophet." Researchers have similarly primed secular concepts by embedding target words such as "civic," "jury," "court," "police," and "contract" (Shariff and Norenzayan 2007, Study 2).

A number of religious priming studies have used the Scrambled Sentence Task. People who unscrambled sentences containing religious words were more cooperative with anonymous strangers in various economic games (Ahmed and Hammarstedt 2011; Ahmed and Salas 2011; Shariff and Norenzayan 2007), and cheated less (Randolph-Seng and Nielsen 2007). In addition to these findings regarding prosocial behaviour, priming religion using the Scramble Sentence Task has been shown to lead to greater self-control, task persistence, intolerance of ambiguity, resistance of temptation, and risk-taking intentions in non-moral domains (Kupor *et al.* 2015, Studies 1a-1c; Laurin, Kay *et al.* 2012, Studies 1−3; Rounding *et al.* 2012; Sagioglou and Forstmann 2013, Studies 1−3; Toburen and Meier 2010). Nonetheless, we caution readers about using this methodology (see Methodological Concerns section).

Subtle reminders of religion

Aside from the Scrambled Sentence Task, several other noteworthy implicit priming methods have been used. For example, primes such as word-search

puzzles (Pichon *et al.* 2007, Study 2), magazine ads about "The Sacred Houses of God" vs. "The Stately Houses of Government" (Wu and Cutright 2018, Study 1c), and a stack of papers with the phrase "Nature of God" vs "Nature of Water" placed near participants' working area (Chan *et al.* 2014, Study 2) can serve as subtle reminders of religion. Another subtle manipulation uses "God" in non-religious statements as casual idioms. For example, Kupor *et al.* (2015, Study 2) manipulated the salience of God by presenting an online ad that stated, "God knows what you're missing!" or "You don't know what you're missing!" This method makes the prime less conspicuous by embedding religious words in non-religious contexts.
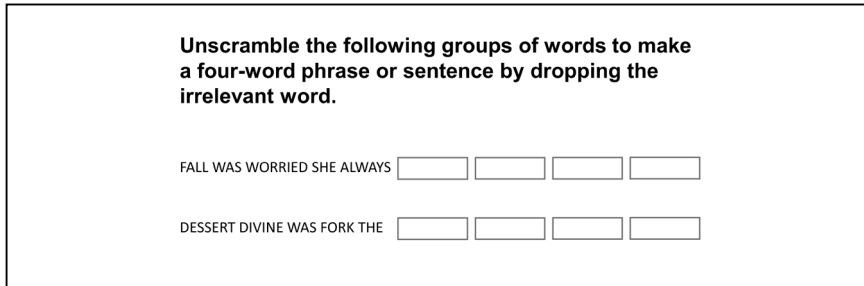

Unscramble the following groups of words to make a four-word phrase or sentence by dropping the irrelevant word.

FALL WAS WORRIED SHE ALWAYS ☐ ☐ ☐ ☐

DESSERT DIVINE WAS FORK THE ☐ ☐ ☐ ☐

Figure 1: Scrambled Sentence Task of a neutral sentence (top) and priming sentence (bottom)

Subliminal priming

Subliminal priming is designed to test the influence of exposure to a stimulus presented below the threshold for conscious perception on subsequent task (Kouider and Dehaene 2007). Stimuli are usually made subliminal by the joint use of brief presentations and "masking" techniques. To the extent that presenting religious words or images outside of conscious awareness increases accessibility of related ideas, researchers can test the automatic influence of religious concepts on behaviour when participants are unaware of the nature of the stimuli to which they have been exposed.

In one interesting example of subliminal priming (Rutchick 2010, Study 5), participants viewed a series of images consisting of colored panels that appeared for one second and were asked to classify them based on the number of panels they contained. Unbeknownst to participants, each image was immediately preceded by a priming image that appeared for 30 milliseconds (ms). Participants were randomly assigned to be subliminally exposed to either ecclesiastical images (e.g., crucifix) or control neutral images (e.g., abstract paintings). In this case, the researchers were interested in whether a very rapid exposure to religious images influenced the way Christians and non-Christians awarded money to people seeking compensation for abortion pills.

In more typical subliminal religious priming experiments, primes are words. Participants might be asked to look at a fixation point appearing in the middle of a computer monitor for 500–1000ms. This is followed, in order, by a forward mask (~500ms), a prime (<60ms), and a backward mask that overwrites the prime (~500ms). Masks may be a string of Xs or fragmented letters (Abrams 2008). Similar to the Scrambled Sentence Task, words such as "divine," or "holy" are used as primes in religious prime conditions; in comparison conditions, primes are neutral words such as "water" or "tractor." Researchers may include additional comparison conditions of theoretical interest (e.g., McKay *et al.* 2011). In addition, researchers frequently ensure that the priming words are carefully matched for valence, length, and lexical frequency to avoid confounds.

Subliminal primes such as these can be disguised as part of Lexical Decision Tasks, in which participants are asked to quickly classify different letter strings ("targets") as words or non-words. In between-participant designs, different groups of people are exposed to different sets of subliminally-presented prime words (e.g., "miracle" and "God" versus "meeting" and "Dad") before seeing the targets, which are all neutral words or their anagrams (see Figure 2). Here, participants may think that researchers are interested in their classification performance, but the actual dependent variables are post-task behaviours that are expected to vary as a function of subliminal priming. For example, after being subliminally primed with positive religious words, people took more charity pamphlets (Pichon *et al.* 2007, Study 1) and behaved in submissive ways (Saroglou *et al.* 2009, Study 2).
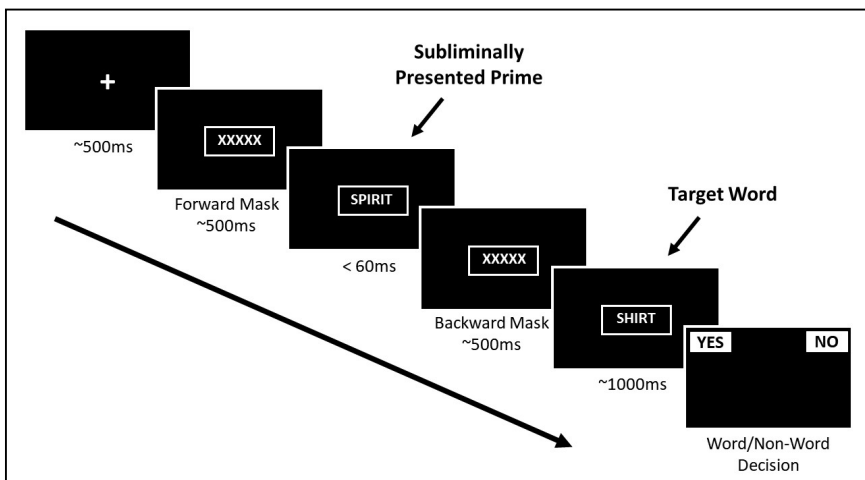

Figure 2: Sequence of events during a typical Lexical Decision Task using subliminal priming.

In within-participant versions of this paradigm, all participants are exposed to both religious and neutral primes, but targets are sometimes neutral and sometimes related to a construct of interest (e.g., Saroglou *et al.* 2009, Study 1). In these cases, the main dependent variable is whether people are faster to classify words related to the construct of interest (e.g., submission) when they are preceded by a religious prime relative to a neutral prime. Regardless of the specific design, from participants' perspectives, Lexical Decision Tasks appear to be measuring something other than what they are actually measuring, and participants are unaware that they have been viewing subliminally-presented primes.[1]

Contextual priming

For researchers interested in how religious situations (rather than religious dispositions or exposure to religious concepts) influence behaviour, contextual priming is a unique tool that often has a higher degree of ecological validity than other forms of priming paradigms. Although few studies have used contextual priming, meta-analytic evidence suggests that it may be more effective than other priming techniques (Shariff *et al.* 2016). Contextual religious priming is accomplished by examining or manipulating an experiment's location (e.g., chapel vs. government building), varying or measuring the time or day that an experiment takes place (e.g., during prayer calls, Sunday), or by manipulating other environmental cues (e.g., background music) during a study. These methods are particularly useful when researchers use experimental designs by randomly assigning participants to different experimental conditions because it allows researchers to control most aspects of a research study while using naturally occurring religious contexts as stimuli. For this reason, although quasi-experimental field studies using contextual primes (e.g., Duhaime 2015; LaBouff *et al.* 2012; Sagioglou and Forstmann 2013, Study 4) provide valuable evidence for the real-world effects of religion on behaviour, we focus our discussions specifically on field *experiments*.

Location

On a variety of measures, students who are randomly assigned to complete an experimental task in a university chapel respond differently from those whose decisions are made in an academic building (e.g., Ahmed and Salas 2013; Rutchick 2010, Study 4; Wu and Cutright 2018, Study 1a). Additionally, Xygalatas (2013) found that Mauritian Hindus who were randomly assigned

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1   Researchers have also used the Lexical Decision Tasks to present supraliminal primes as targets. For example, each trial may start with a prime word (e.g., "God") where participants are asked to classify it as a word or non-word, followed by another judgment task involving agency detection (see van Elk *et al.* 2016, Studies 2–4).

to play an economic game in a temple were more cooperative than those who played in a restaurant. Xygalatas *et al.* (2016) also found a similar effect of contextual religious priming on prosocial donations in a within-participants experiment, where all participants were tested in three distinct locations: A Catholic church, Hindu temple, and restaurant (for comparison). To make sure that which location was used first did not influence the results of this experiment, the ordering of locations was counterbalanced across participants.

Although varying testing locations is a simple method with the benefit of closely resembling naturally occurring religious experiences, it also involves many potentially confounding variables, making it less "clean" than other designs where experimental conditions differ only on one variable of interest. Thus, contextual priming requires careful planning to ensure control of elements of an experiment that can reasonably be controlled (e.g., collecting data on the same days/times; limiting the number of uninvolved bystanders). Testing locations should also be similar in size and spatial arrangements (e.g., statues, staff-only areas) to rule out alternative explanations based on these features.

Music

Aside from location, researchers have used background auditory cues to prime religion. For example, Aveyard (2014, Study 2) conducted an experiment in the United Arab Emirates in which the priming task was disguised as a study about driving. All participants listened to an audio recording of busy traffic, but in one condition, the Islamic call to prayer was included in the background. In another condition, the call to prayer was omitted. In other studies, researchers have used "Ave Maria" and "Silent Night" to induce religious salience (Lang *et al.* 2016; Wu and Cutright 2018, Study 1b). As with any experiment, it is important to control for potentially confounding variables. For example, music clips should be the same length and should be similar in timbre, tempo, and emotional quality across conditions.

Theoretical quibbles

Do religious primes mean the same thing to everyone?

When using religious priming methods, researchers are mostly interested in how the religious concepts instantiated by priming procedures affect behaviour (Willard *et al.* 2016). In this sense, priming methods are merely tools that accomplish the goal of making participants think about God or other religious concepts, even if they are unaware they are doing so. However, what is on a non-believer's mind when God or religious concepts in which they do not believe are activated? Likely, non-believers' knowledge about God mostly reflects general cultural conceptions of God and little else. Perhaps,

mere knowledge of culturally-constructed stereotypes is sufficient for primes to "work," even if particular beliefs are not endorsed (Devine 1989). However, Shariff *et al.*'s (2016) meta-analysis has revealed that in the prosociality domain, religious priming effects are close to zero among non-religious participants.

Are primes failing to activate religious concepts for non-believers or are concepts activated but represented in a different way than for believers? Although culture may also shape believers' ideas about God/religion, their thinking about these concepts is almost certainly more idiosyncratic. Knowing *about* someone is quite different from *knowing* that person. If the knowledge that is activated through religious priming is qualitatively different for believers and non-believers, then it is difficult to tease out exactly what primes are activating and whether it is the content of the primes or preexisting beliefs that are driving subsequent changes in behaviour.

When participants are given explicit prompts such as "please take some time to write about the role of God" (Wu and Cutright 2018), it is unclear whether the writing task primes socioculturally constructed concepts of God that are shared by believers and non-believers alike or the task uniquely activates personal, existing beliefs for religious adherents. Even for believers, some people may conceptualize God abstractly (e.g., God is love) while others may have experiential or personal perceptions of God (e.g., God spoke to *me*). Furthermore, although asking participants to contemplate certain religious concepts (e.g., divine retribution) may be easy using explicit priming methods, if the concepts are incompatible or inconsistent with their existing beliefs (e.g., God is forgiving), participants may engage in defending their view instead of reflecting on the intended priming concept (Watanabe and Laurent 2017).

Implicit, subliminal, and contextual primes also make the same concerns even more problematic because participants are frequently not expected to (a) know they have been exposed to the concepts, and/or (b) understand the influence of primes on their behaviour. Epistemologically and empirically disentangling whether religious priming activates a concept versus belief in the concept is a challenging task that researchers should address to interpret the effects of primes and their implications for causal inferences regarding the impact of religion on behaviour. One way to resolve this issue may be to use open-ended prompts, which allow researchers to analyze the contents of participants' qualitative responses. Not only would it help confirm the success of manipulations, but it could provide insight into whether believers and non-believers are affected in different ways by the same prime. Even though people may not know why they act as they do (Nisbett and Wilson 1977), asking about their mental processes represents at least a starting place.

What exactly is religious cognition?

Given the multifaceted nature of religion, another outstanding question is: what is religious cognition? This question needs to be addressed before any determination can be made regarding why thinking about religion sometimes, but not always, promotes prosocial giving and sometimes even increases anti-social behaviour (e.g., Ginges *et al.* 2009). One possibility is that considering religion activates a number of distinct but associated psychological constructs, with each aspect of spiritual thought having a unique influence on behaviour (Ritter and Preston 2013). Although work has begun to examine the substantial complexity in how people view God, religion, and spirituality (e.g., Shariff and Norenzayan 2011; Sharp *et al.* 2017), an important next step is to uncover which aspect(s) of this complexity drives specific actions. More nuanced treatment of religious cognition may help explain why, for example, Protestants and Catholics respond differently to the same primes of Christianity (Benjamin *et al.* 2016; Preston and Ritter 2013).

To be fair, an important goal of people who study the cognitive science of religion is to investigate general, cross-religious, and foundational claims about religious phenomena (Xygalatas 2014). However, treating religion as a unitary construct conflates important conceptual distinctions and obscures the interpretation of priming effects. Although the majority of past research using the techniques reviewed above presumably activated religion in a "broad" sense, specific aspects of religion could be studied using the same paradigms. Some researchers have attempted this by explicitly priming universal love vs. one true religion ideas (Hoffmann *et al.* 2019) or examining different characteristics of God (Johnson *et al.* 2013).

Finally, it is important to recognize that religion is a social phenomenon. Although some religious activities may be performed in solitude (e.g., private prayer), most religious conversations, experiences, and rituals involve groups of individuals (e.g., family, community). Given the communal nature of religion, it is questionable whether experimentally inducing religious thinking bereft of social context has much to offer for theory-building. Examining effects of religious priming on group decision-making may further shed light on religion's role in group cohesion and intergroup aggression.

Methodological concerns and improvements

Is the jury still out?

Do religious priming studies provide converging evidence for how religious concepts affect behaviour or attitudes? Although meta-analytic work by Shariff *et al.* (2016) suggests the existence of an overall effect, recent replication attempts of some experiments included in this meta-analysis have shown

contradictory results. For example, Shariff and Norenzayan's (2007) finding that religious priming using the Scrambled Sentence Task increases financial generosity was not observed in high-powered, pre-registered direct replications (Billingsley *et al.*, 2018; Gomes and McCullough 2015). Benjamin *et al.* (2016) also did not observe any effects of religious primes on prosocial behaviour in dictator games, even though they used the same Scrambled Sentence Task. Similarly, in a study using Arabic rather than English, Aveyard (2014, Study 1) used the same task and did not observe differences in cheating behaviour. In addition, Gervais *et al.* (2020) conducted two large-sample preregistered direct replications of Kupor *et al.* (2015, Studies 1a–1b) and concluded that reminders of God (via a sentence-unscramble task) did not increase non-moral risk-taking. Given the methodological superiority of recent studies (e.g., larger sample sizes), it seems as though the Scrambled Sentence Task is not a reliable tool for priming religion.

Other inconsistent findings in the literature are noteworthy. For example, Parra *et al.* (2016) observed that for participants in Ghana, visually priming religious concepts *reduced* transfers in dictator games. Also, subliminal religious primes increased costly punishment for people with a prior history of donation to religious organizations (McKay *et al.* 2011), but participants who were explicitly reminded of their belief punished *less* than control participants (Laurin, Shariff *et al.* 2012). Recent efforts to extend these findings to the punishment of immoral (as opposed to simply unfair) targets have similarly yielded inconsistent results (O'Lone and McKay 2016; Watanabe and Laurent 2019). Moreover, although students in Mazar *et al.*'s (2008) experiment cheated less after recalling the Ten Commandments, this effect was not observed in large-scale registered replication efforts involving 25 labs across multiple countries (Verschuere *et al.* 2018).

Inconsistent findings are also prevalent for variables other than prosociality. For example, a finding of increased risk-taking inclination after explicit religious priming (Kupor *et al.* 2015, Study 3) did not emerge in Brulin *et al.* (2018, Study 2); in fact, an opposite effect was observed in their Swedish sample such that religious priming *reduced* risk-taking. Additionally, although historical and correlational evidence documenting negative attitudes toward science among religious Americans seems fairly robust (e.g., 1925 Scopes Trial; McPhetres and Zuckerman 2018), this trend was not observed using various religious priming methods (see McPhetres *et al.* 2020, Studies 1-3b).

Null effects are difficult to interpret because they do not necessarily mean that no effect exists, but simply that no evidence for an effect was found. Moreover, priming is highly sensitive to variations in experimental features, participants, and cultural contexts (Cesario 2014), and moderators such as these can lead to failures to find true effects if other sources of variability are

not systematically controlled. The studies mentioned above also remind us that incongruent results can be obtained when using different priming techniques and that even when priming stimuli are identical, results can differ depending on how outcome variables are measured. As in all domains of research, it is important to identify and consider potential moderating variables to explain when and why effects sometimes differ. Mixed findings for studies investigating similar questions using similar paradigms may be due to variability in choices that researchers make in designing and conducting their studies, hence, adding complications to drawing broader conclusions about the presence of "real" priming effects. Finally, although overt priming techniques seem to yield somewhat larger effect sizes relative to more subtle forms of priming (Willard *et al.* 2016), more studies with increased methodological rigor are needed before reaching definitive conclusions. Below, we highlight several methodological improvements that should be considered to keep the field moving forward.

The credibility revolution in psychology

Science is self-correcting, and psychological science in particular is rapidly improving through self-scrutiny. Although the "credibility revolution" (Spellman 2015; Vazire 2018) is still a work-in-progress, many psychologists have adopted policies that emphasize transparency and methodological rigor (e.g., van't Veer and Giner-Sorolla 2016). As a start, although small sample sizes are not a problem unique to the religious priming literature, future studies should recruit larger sample sizes (Simmons *et al.* 2011). Given the danger of underpowered studies combined with questionable research practices in producing inflated false positive rates (Bakker *et al.* 2012, Ioannidis 2005), sample sizes should also be informed by *a priori* power analyses. For example, based on the effect-size estimate reported in Shariff *et al.* (2016), if prosocial behaviour is used as a dependent variable, regardless of priming method, van Elk *et al.* (2015) suggest that at least 766 participants are needed to detect a small effect with 80% statistical power for a between-participant design. Likewise, based on Billingsley *et al.*'s (2018) estimate, if explicit priming is used and samples consist of religious individuals, 620 participants are needed to achieve the same statistical power when Dictator Games serve as a dependent measure.

Data sharing and preregistration of new studies (e.g., Nosek and Lakens 2014; van't Veer and Giner-Sorolla 2016) are also good ideas. Although neither of these eliminate questionable research practices or publication biases, preregistrations can help with problems like post-hoc hypothesizing or data dredging (Kerr 1998), which can have adverse consequences for theory development. Similarly, open sharing of data and stimulus materials can help

researchers confirm or disconfirm others' work effectively. Together, these practices will promote the field's commitment to transparency, help ensure the credibility of findings that emerge, and facilitate cumulative growth of the research collective.

Direct replications: demanded but unincentivized

Sound research is replicable, and repeating experimental procedures (i.e., direct replications) can clarify the truth claims of an original effect (Open Science Collaboration 2012). Since the "replication crisis," improvements have been made to encourage direct replications (e.g., journals advocating registered reports), but there are notable obstacles. Even without hostility or malpractice, neither replicators nor original authors are incentivized for directly replicating prior work. Arguably, researchers should be motivated to pursue truth, qua truth; however, publication of impactful and novel findings is tied to professional success, including but not limited to hiring, salary, tenure, and grant decisions (Nosek *et al.* 2012).

There is little incentive for researchers to attempt to falsify their own hypotheses, so a natural tension exists between authors and replicators. Failed replications that can potentially damage reputations threaten authors even though failures to replicate do not necessarily mean that the original findings were incorrect (Kahneman 2014; Stroebe 2019). For early-career researchers, possible consequences of conducting replications may be intimidating, and concentrating on novel work might seem more beneficial, particularly given limited resources and time to gain status in the field. One solution may be to increase adversarial collaborations—where different research groups put feelings aside and work together to pursue the truth. However, this may be easier said than done. For this reason, we appreciate recent direct replication efforts involving effective communications between replicators and original authors (e.g., Gervais *et al.* 2020; Billingsley *et al.* 2018). We would like to see more endeavors similar to the Many Labs Project (e.g., Verschuere *et al.* 2008), where independent and diverse research groups cooperatively attempt to directly replicate a set of religious priming effects.

Hypothesis-guessing: limit or confirm

When participants suspect that researchers are investigating the relationship between religion and prosociality, they may guess at what the researchers are trying to find. Hypothesis-guessing is problematic because it can influence people's responses to confirm or disconfirm researcher expectations, leading to the possibility of null effects at best and spurious findings at worst. The likelihood of this may increase when people – such as psychology undergraduates and workers of crowdsourcing platforms – have participated in multiple experiments and may be actively *trying* to guess what researchers are

investigating. This issue is probably largest for studies using explicit primes. For example, participants who are asked about their religious affiliations or are prompted to think about religious concepts may behave in ways that are not very representative of how they would naturally behave in other contexts. Even implicit primes can cue participants to the nature of a study, although this may depend on the subtlety of the primes and people's natural curiosity or level of suspicion about research.

Although clever experimental manipulations and subliminal primes guard against this, other approaches can be taken. One useful method is having participants complete a "funnel debriefing" (e.g., Ferguson and Bargh 2004; Randolph-Seng and Nielsen 2007) that allows for assessment of hypothesis-guessing without inadvertently revealing the purpose of the study. For example, a researcher can begin with broad questions ("Did anything about this study seem strange?") and in stages, ask more pointed questions ("What do you think the researchers were expecting to find?" or "Do you recall having seen any religious words in the word classification task?"). Awareness probes such as these (e.g., Gomes and McCullough 2015) can allow researchers to test whether including the data from people who appear to have correctly guessed the nature of a study influences the results.

Spiritual diversity

Lastly, increasing the spiritual diversity of samples and primed concepts is a worthwhile goal, as this will increase the generalizability of religious priming effects. To date, religious priming research has relied overwhelmingly on data from adherents of Abrahamic religions. This limitation is problematic if conclusions from research on certain religions conducted in limited places (e.g., WEIRD samples) are used to explain causal mechanisms for how religion evolved and spread around the world (Henrich, Heine *et al.* 2010). Although efforts aimed at sample diversification are beginning to emerge (e.g., Clobert *et al.* 2015; White *et al.* 2019; Xygalatas *et al.* 2016), collaborations with anthropologists and religion scholars should be productive, especially in testing the effects of cross-religious priming. Closely related to this, greater care should be taken to examine the effects of priming on the large and growing number of people who do not identify as religious (non-believers, agnostics, atheists, or spiritual but not religious people). Typically, people from these diverse categories of "not religious" have been treated statistically and conceptually as a relatively homogenous group. However, this assumption may not be justified and should be empirically examined. For instance, a recent Pew Research Center survey revealed that atheists and agnostics are more knowledgeable about religion than those in the "nothing in particular" group (Fahmy 2019).

Conclusion

Skepticism is foundational to the scientific method, and as with any program of research—particularly in areas where results are frequently inconsistent and difficult to replicate—drawing firm conclusions about religious priming studies requires a high standard of evidence. Using experimental designs that reflect the complexity and diversity of religion, continually refining religious priming techniques, sharing methods and data, and conducting collaborative large-scale direct replications are all challenging yet necessary steps that will increase the field's overall confidence in the causal effects of religion on behaviour. The ambitious quest to understand religion has taken many paths, and it seems that social psychologists invested in religious priming research may have to travel a particularly long and rocky road and overcome hazards along the way. Possibly, improvements in all of the areas we have outlined here will keep the cart moving down that road, granting insight into the social functions of religion—a time-honored mystery that continues to unite (and divide) humanity.

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