



Reports

Activating Christian religious concepts increases intolerance of ambiguity and judgment certainty



Christina Sagioglou^{a,*}, Matthias Forstmann^{b,1}

^a Institut für Psychologie, Universität Innsbruck, Maximilianstraße 2, Gebäude C, 6020 Innsbruck, Austria

^b University of Cologne, Department Psychologie, Sozialpsychologie I, Richard-Strauss-Str. 2, 50931 Köln, Germany

HIGHLIGHTS

- Exposure to Christian religious concepts increases intolerance of ambiguity.
- Semantically activating these concepts fosters people's dislike of ambiguity.
- Priming religion evokes a preference for non-ambiguous vs. ambiguous visual stimuli.
- This ambiguity intolerance manifests in increased certainty about social judgments.
- Ecological validity of the effects found is established through a field study.

ARTICLE INFO

Article history:

Received 14 November 2012

Revised 26 March 2013

Available online 12 May 2013

Keywords:

Religion

Contextual priming

Ambiguity intolerance

Judgement certainty

Social judgement

ABSTRACT

How does living in a society in which one is frequently exposed to reminders of its Christian foundations shape one's basic cognitions and behaviors? Following contextual priming logic, being exposed to Christian religious content should render associated norms accessible. One prototypical Christian norm is the reliance on dichotomous moral categories such as right vs. wrong (virtuous vs. sinful). If Christian primes indeed activate this normative structure, it should manifest itself in an increased ambiguity intolerance. We tested this reasoning in five studies. Specifically, we demonstrated that semantically activating Christian concepts increases self-reported ambiguity intolerance (Study 1), preference for a non-ambiguous (vs. ambiguous) visual stimulus (Study 2), as well as judgment certainty as means to reduce experienced ambiguity (Studies 3a & 3b). Finally, we extended our laboratory findings to real-life environments by showing that individuals exposed to a cathedral (vs. a place with civic buildings) reported increased ambiguity intolerance (Study 4).

© 2013 Elsevier Inc. All rights reserved.

Introduction

Religion is a universal and natural phenomenon (Bloom, 2007). According to recent statistics, only about 11.6% of the world's population is nonreligious – that is, atheistic or agnostic – opposed to more than 30% of affiliated Christians (Turner, 2012). Reminders of religion are similarly ubiquitous. In Western societies, church towers loom over nearly every town or village, cross necklaces are frequently worn as lucky charms, and football players on national television dramatically thank God for helping them score. But how does living in a society in which reminders of our Christian foundations are omnipresent shape our basic cognitions, emotions, and behaviors?

Given the strong prevalence of religion worldwide, experimental research investigating the psychological underpinnings and consequences

of religion and faith is relatively scarce. This neglect can be attributed to two primary reasons. First, religion used to be a taboo topic with great potential to offend and was thus oftentimes not accepted as an appropriate matter of scientific inquiry (e.g., Bloom, 2012; Dennett, 2006; Sedikides, 2010). In the past decade, however, contemporaneously with a rise of literature critically discussing organized religion and spirituality (e.g., Harris, 2004; Hitchens, 2007), experimental research on religion has been extensively resumed. A second reason lies within the limitations of the experimental paradigm itself. In order to research religion, one may, for example, compare two societies whose members differ in their level of religiosity. However, beyond the fact that these societies most likely also differ on several other dimensions, one will have a hard time finding a society entirely void of any religious influence. Alternatively, one may consider experimentally manipulating participants' levels of religious belief in a laboratory setting, which would raise both technical and ethical concerns. But with the use of classic priming procedures, it has become possible to experimentally isolate the effects of thinking consciously or unconsciously about religion on people's cognitions and behaviors. Building on the assumption that religious concepts

* Corresponding author.

E-mail addresses: Christina.Sagioglou@uibk.ac.at (C. Sagioglou), Matthias.Forstmann@uni-koeln.de (M. Forstmann).

¹ Both authors contributed equally.

are chronically accessible in believers (cf., Higgins, King, & Mavin, 1982), this approach has been employed in a great number of contemporary studies of religious belief. The most prominent domain of this research is prosocial behavior (see Galen, 2012, for a review). For example, priming religion was shown to promote generosity (Shariff & Norenzayan, 2007), helping behavior (Pichon & Saroglou, 2009), altruism (Saroglou, Pichon, Trompette, Verschuere, & Dernelle, 2005) and honesty (Randolph-Seng & Nielsen, 2007). Although a great body of research confirms this positive link between religion and morality, there are some contradictory findings. Under certain conditions, religion seems to have detrimental effects on prosociality in form of decreased willingness to help if the target is an illegal immigrant (Pichon & Saroglou, 2009), increased prejudice towards African Americans (Johnson, Rowatt, & LaBouff, 2010), or greater retaliation (Saroglou, Corneille, & Van Cappellen, 2009). In addition, individual differences such as submissiveness (Saroglou, Corneille, & Van Cappellen, 2009; Van Cappellen, Corneille, Cols, & Saroglou, 2011) or expressed belief in God (Dijksterhuis, Preston, Wegner, & Aarts, 2008) at times seem to moderate religion priming effects.

A seminal set of studies by Rutchick (2010) strongly suggests that processing religious stimuli in a natural environment can likewise fundamentally affect our behavior. Analyses of data from US elections revealed that voting in churches increases the likelihood of voting for a conservative candidate or of supporting conservative amendments. Moreover, Rutchick (2010) experimentally showed that these decisions most likely emerge from an activation of traditional Christian values. Yet, as becomes apparent from the reported findings, much of the experimental research on religion focuses on effects on higher-order cognitions (e.g., stereotypical thoughts) and behaviors (e.g., voting), but less so examines effects on basic cognitive processes. In this research, we therefore sought to investigate how thinking about religion alters basic information processing. Specifically, we were interested in examining fundamental cognitive styles fostered by accessibility of Christian concepts. In the following, the empirical and hypothetical consequences of religion priming are further discussed, focusing on the relation between religion and intolerance of ambiguity.

Religion and intolerance of ambiguity

The construct of ambiguity intolerance was introduced in the context of research on the authoritarian personality (Frenkel-Brunswick, 1949) and can broadly be defined as the tendency to experience ambiguous stimuli as disconcerting (Budner, 1962). A variety of specifications are offered in the literature, many of which relate ambiguity intolerance to rigid, “definite” thinking styles (e.g., Frenkel-Brunswick, 1949). In fact, ambiguity intolerance was shown to reliably correlate with rigidity measures and other interrelated variables such as authoritarianism, ethnocentrism, church attendance and magical thinking (Adorno, Frenkel-Brunswick, Levinson, & Sanford, 1950; Block & Block, 1951; Keinan, 1994; MacDonald, 1970). It is reasonable to assume that we constantly find ourselves confronted with at least some degree of ambiguity. Per definition, any instance of probability, contradiction, or vagueness is somewhat ambiguous, which are all characteristics we are likely to encounter on a daily basis in various situations. If these situations evoke a discomfort, it is apparent that this can have far-reaching consequences for a person’s behavior (cf., Norton, 1975).

But how does ambiguity intolerance relate to religion? Correlational findings link religion to a variety of cognitive styles such as rigidity, dogmatism, authoritarianism, or social distance (see Wulff, 1997). Specifically, church attendance as one aspect of religiosity is strongly correlated with cognitive rigidity and ambiguity intolerance (MacDonald, 1970). A more specific hint at this relation is provided by Duriez (2003), who found that religious belief is associated with a higher need for order, structure and predictability. Moreover, he found that the more literal a person takes religious teachings, the

more discomfort that person feels towards ambiguity and the more closed-minded that person is. Indeed, a close inspection of Christian scripture will quickly reveal that a literal understanding may promote thinking in dichotomous moral categories, as the teachings – originally intended to govern social life – provide clear differentiation of “right” from “wrong” and “good” from “bad” (Hogg, Adelman, & Blagg, 2010). Of course, most religious people do not hold fundamentalist views and tend to interpret religious content symbolically rather than literally (see Wulff, 1997). Also, Christian religious scripture does not solely contain dichotomous statements about moral behavior. However, one prototypical characteristic of Christian morality seems to be the two-tier distinction between “virtuous” and “sinful” behaviors (cf., Hogg et al., 2010; Silberman, 2005). Thus, one can expect this normative structure to be primarily associated with Christianity, rather than the nuanced moral discourse one may encounter upon in-depth bible analysis.

But is it conceivable that such norms can even be activated in individuals who never practiced them? Previous research has effectively demonstrated that this is the case. In a series of studies, Aarts and Dijksterhuis (2003) showed that mental activation of situational norms and subsequent behavior occur entirely independent of previous experience with these norms. No matter whether or not participants had often visited a library, they all lowered their voice upon seeing the picture of a library (Aarts & Dijksterhuis, 2003). Knowledge about norms is thus sufficient to influence behavior, a notion highly congruent with findings of religion priming effects that do not depend on experience with religious practices or spirituality (e.g., Johnson et al., 2010; Randolph-Seng & Nielsen, 2007).

This procedural logic of contextual priming on the one hand and the prototypical “right-versus-wrong” nature of Christian teachings on the other hand formed the basis of our predictions. We reasoned that if activation of religious content would indeed render associated norms accessible, people should assimilate to these norms. Specifically, we hypothesized that the Christian norm of “good” (virtue, heaven) versus “bad” (sin, hell) would become cognitively accessible upon exposing people to Christian content and would subsequently shift a person’s cognitive style towards a greater intolerance of ambiguity—a concept closely related to rigid, categorical thinking (cf., MacDonald, 1970). We decided to test this with immediate as well as indirect measures of ambiguity intolerance.

In the first three experiments, we investigated the cognitive and behavioral consequences of semantically activating Christian concepts. Specifically, we examined how priming religion affects self-reported ambiguity intolerance (Study 1), preference for an ambiguous vs. non-ambiguous piece of art (Study 2), as well as judgment certainty after the evaluation of ambiguous stimuli (Studies 3a & 3b). Finally, we extended our laboratory findings to real-life situations by testing how the presence of reminders of Christianity affects self-reported ambiguity intolerance (Study 4).

Study 1: religion priming and intolerance of ambiguity

Method

Participants and design

Sixty-four English-speaking participants (38 females; $M_{Age} = 33.83$ years, $SD = 13.36$) recruited from Amazon Mechanical Turk (MTurk) completed the study in exchange for modest monetary compensation (see Buhrmester, Kwang, & Gosling, 2011 for a discussion of MTurk data quality). They were randomly assigned to either a religion or a neutral priming condition.

Materials and procedure

Ostensibly to assess word comprehension, participants first completed a scrambled sentences priming procedure (Srull & Wyer, 1979). All participants constructed ten 4-word sentences from 5-word sets (e.g., *seven to Tim church went* → *Tim went to church*).

In the religion priming condition, five sets contained religion-related words (*faith, church, heaven, prayer, and divine*), which were intended to semantically activate the concept of religion. The remaining five, and all ten sets in the control condition, were neutral and did not prime any specific concept.

Afterwards, participants responded to MacDonald's (1970) 20-item Revised Scale of Ambiguity Tolerance (AT-20). The scale derived from the 16-item Rydell and Rosen (1966) measure, which MacDonald extended by four items to improve reliability. MacDonald (1970) assents to Budner's (1962) definition of ambiguity intolerance and further states that the individual high in ambiguity tolerance seeks out and enjoys ambiguity and tends to perform well on ambiguous tasks. To increase variability, we altered the dichotomous answer option to a 7-point scale ranging from 1 (not at all) to 7 (very much) and instructed participants to indicate how much they agreed with each of the statements (e.g., "There is a right way and a wrong way to do almost everything."). We calculated a mean score of ambiguity intolerance (Cronbach's $\alpha = .76$), with higher values representing higher levels of ambiguity intolerance. Internal consistency of the original measure was reported at similar levels ($KR-20 = .73$; MacDonald, 1970).

To assess trait religiousness of our sample, we added a 5-item religiousness questionnaire ($\alpha = .87$) to the neutral priming condition, including questions pertaining to participants' spirituality and frequency of church attendance (e.g., "How important are your religious or spiritual beliefs for what you do every day?").

Results and discussion

Confirming our hypothesis, participants in the religion priming condition reported significantly higher levels of ambiguity intolerance ($M = 4.55, SD = .65$) than did participants in the neutral priming condition ($M = 4.15, SD = .70$), $t(62) = 2.326, p = .023, d = .58$.

Specifically, these results demonstrate that semantically processing Christian religious stimuli leads people to experience higher intolerance of ambiguity. This means, for example, to generally perceive less ambiguity (e.g., "Practically every problem has a solution.") and to feel greater discomfort upon encountering ambiguity (e.g., "It bothers me when I am unable to follow another person's train of thought.").

Additionally, in line with our reasoning, trait religiousness significantly correlated with ambiguity intolerance in the neutral priming condition, $r(26) = .41, p = .032, r^2 = .17$.

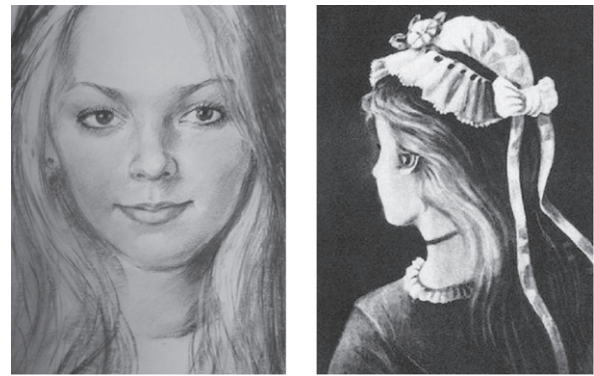
Study 2: religion priming and esthetic judgment

Next, we tested whether this increased ambiguity intolerance would reach beyond self-reported dislike for ambiguous situations and manifest itself on a perceptual level in form of a decreased liking of an ambiguous visual stimulus. Norton (1975) found that ambiguity intolerance predicts esthetic judgment in that individuals high in ambiguity intolerance preferred poems they perceived to be complete and "healthy", whereas the individual low in ambiguity intolerance preferred poems that were "unusual" and open to interpretation. We thus hypothesized that ambiguity intolerance as evoked by a religion priming would similarly elicit a greater dislike of an ambiguous piece of art, but would not affect judgments of a non-ambiguous piece of art.

Method

Participants and design

Forty-nine English-speaking participants (37 females; $M_{Age} = 29.29, SD = 7.83$) were recruited via MTurk. They were randomly assigned to a 2 (priming condition: religion vs. neutral) \times 2 (type of picture: ambiguous vs. non-ambiguous) mixed-factorial design,



Non-ambiguous drawing

Ambiguous drawing

Fig. 1. Drawings used as the dependent measure (Study 2).

with the former factor manipulated between participants and the latter manipulated within participants.

Materials and procedure

The priming procedure was identical to that in Study 1. We then presented two black-and-white pencil drawings of female faces, one ambiguous, the other non-ambiguous, both devoid of religious references (see Fig. 1). The ambiguous drawing had been pretested to differ significantly in ambiguity ($M = 5.32, SD = 1.74$) from the non-ambiguous drawing ($M = 2.69, SD = 1.57, t(156) = 12.33, p < .001$).² Participants rated how much they liked each drawing on a scale from 1 (not at all) to 7 (very much).

Results and discussion

A 2 (priming condition) \times 2 (type of drawing) ANOVA on ratings of the drawings revealed the predicted interaction, $F(1,47) = 3.90, p = .054, \eta_p^2 = .08$ (see Fig. 2). Simple effects tests revealed that religion-primed participants liked the ambiguous drawing significantly less ($M = 3.88, SD = 1.66$) than did participants in the control condition ($M = 4.83, SD = 1.34$), $t(47) = -2.17, p = .035, d = -.62$, whereas the rating of the non-ambiguous drawing did not differ between experimental conditions, $p > .72$. Furthermore, participants primed with religion clearly preferred the non-ambiguous ($M = 5.19, SD = 1.17$) drawing to the ambiguous one ($M = 3.88, SD = 1.66$), $t(25) = 3.94, p = .001, d = .795$, whereas the control group showed a weaker, only marginally significant preference, $p = .061$. The results demonstrate that cognitive accessibility of religious content indeed directs subsequent esthetic judgment.

Study 3: religion priming and judgment certainty

How do people deal with encountered ambiguity? Shaffer and Hendrick (1974) found that although a general sensitivity to inconsistencies is universal, the consequences of perceiving these inconsistencies crucially differ between low and high ambiguity tolerant individuals. Specifically, low tolerant participants were oversensitive to the aversive consequences of inconsistencies and thus experienced greater discomfort than participants high in tolerance. In our Study 2, for example, the pretest suggests that everyone notices the ambiguity

² It should be noted, however, that despite the obvious differences in ambiguity, both pictures also differ on multiple other dimensions. Yet, in an additional pretest (ambiguous picture: $n = 23$; non-ambiguous picture: $n = 22$) we found that the women in both pictures did not differ on attractiveness, likeability, sympathy, compassion, closeness, similarity, and familiarity, nor did the pictures differ on overall calmness, friendliness, familiarity, similarity, warmth, and closeness (all ps ns.).

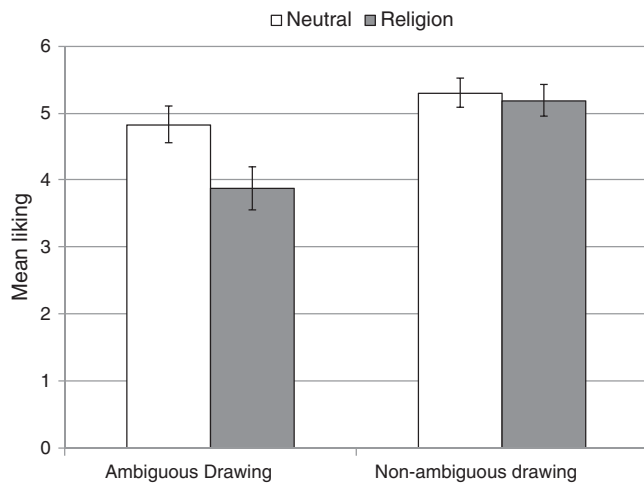


Fig. 2. Ratings of the ambiguous and non-ambiguous drawing (Study 2) as a function of priming condition, with higher values representing greater liking. Error bars indicate standard errors of the mean.

of the drawing, but only for those intolerant of ambiguity did this result in lower ratings.

We therefore reasoned that increased ambiguity intolerance – a feeling of discomfort upon noticing inconsistencies – should encourage people to carry out behaviors aimed at reducing it. This reasoning is comparable to the one applied to the indirect measure of cognitive dissonance, where behaviors aimed at reducing dissonance are taken as evidence for the antecedent experience of it (Shaffer & Hendrick, 1974). Specifically, we hypothesized that priming religion would result in more judgment certainty regarding an ambiguous stimulus as a means to lower the experienced ambiguity. Study 3 tested this notion on a German university student sample.

Study 3a

Method

Participants and design

Forty-six German-speaking students (31 females; $M_{Age} = 24.11$, $SD = 2.26$) recruited from a pool for online data-collection were given the chance to win a gift certificate by enrolling in a lottery. They were randomly assigned to either a religion or a neutral priming condition. One participant was excluded from further analyses because he did not complete the priming procedure. Removing this participant did not affect the significance of the results.

Materials and procedure

The priming procedure was identical to that used in Studies 1 and 2. Subsequently, we presented a series of images of emotionally ambiguous facial expressions taken from Young et al. (1997). Each of these images was comprised of two interpolated (“morphed”) photographs each displaying an enactment of one of the six universal emotions by Ekman and Friesen (1976). We presented perfectly ambiguous facial expressions, that is, 50:50 proportioned interpolations of two emotions each (see Fig. 3). Out of the 15 possible combinations, we selected 10³ for our experiment.

First, participants were asked to label the displayed emotion by forced choice between the two constituting emotions (*What would*

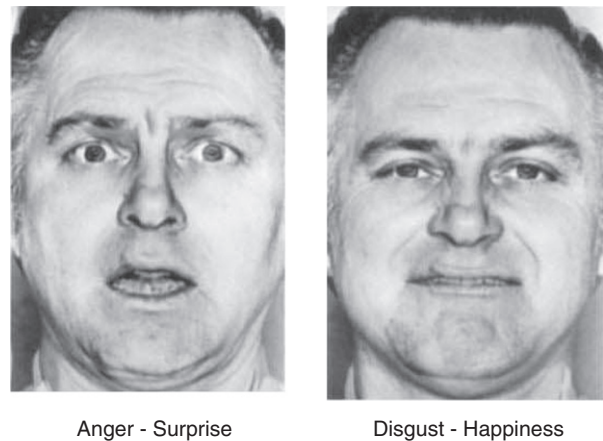


Fig. 3. Two examples of the interpolated emotion prototypes taken from Young et al. (1997) used as ambiguous target stimuli (Studies 3a and 3b).

you say, which is the predominant emotion this person experiences?). Second, they indicated how certain they felt regarding the correctness of their judgment on a scale from 1 (not at all) to 7 (very) (*How certain are you regarding this judgment?*). We predicted that although there was effectively no correct or incorrect response, participants primed with religion would feel more certain about the correctness of their judgment in order to lower experienced discomfort. We calculated a mean score for the 10 certainty items ($\alpha = .60$), with higher values indicating more judgment certainty.

Results and discussion

Supporting our hypothesis, participants in the religion priming condition were significantly more certain about their judgments ($M = 5.13$, $SD = .51$) than were participants in the neutral priming condition ($M = 4.75$; $SD = .67$), $t(43) = 2.139$, $p = .038$, $d = .64$, demonstrating that cognitive activation of religion indeed encourages people to reduce perceived ambiguity.

Study 3b

In Study 3b, our goal was to conceptually replicate as well as theoretically extend the previously reported findings by implementing a new control condition and by demonstrating the effect with US participants. Independent of specific contents, religion is a social phenomenon—a fact that itself may account for some of the effects observed. For instance, a person necessarily is either affiliated to an organized religion or not, and may either approve or disapprove of such an affiliation. Yet, so far, we only tested our experimental conditions against control conditions in which no specific concept was activated. It is, however, necessary to rule out that the effects reported in the previous studies were simply caused by the activation of a social construct, specifically one that is related to group affiliation. We therefore decided to test our religion priming against a sports priming condition (e.g., Randolph-Seng & Nielsen, 2007)—a concept people are likely to have comparably clear-cut opinions about. Similar to religion, sports is a ubiquitous cultural phenomenon, and for many people an integral part of their daily lives. And as with religion, some people like to engage in sportive activities in private, in organized clubs, or – be it deliberately or regretfully – not at all. We hypothesized that – if the previously observed increased ambiguity intolerance was in fact due to activation of religious thinking styles – participants in the religion priming condition would feel more certain about their judgments than would participants in the sports priming condition.

³ One morph was of insufficient quality (see Young et al., 1997, p. 280). From the remaining 14, 10 were randomly selected. No effects were found by emotion displayed.



Cathedral Square



Civic Square

Fig. 4. Locations that served as the contextual priming (Study 4).

Method

Participants and design

Fifty-nine English-speaking participants (34 females; $M_{\text{Age}} = 28.83$, $SD = 9.14$) recruited from MTurk were randomly assigned to either a religion or a sports priming condition (critical words: *ball, sportive, hockey, baseball, and stadium*).

Materials and procedure

The procedure was the same as in Study 3a, except that the control group unscrambled five sentences related to sports. We again calculated a mean certainty score ($\alpha = .83$) with higher values indicating higher levels of judgment certainty.

Results and discussion

In line with our hypothesis, participants in the religion priming condition ($M = 5.46$, $SD = .70$) indeed felt significantly more certain about their judgment than did participants in the sports priming condition ($M = 5.06$, $SD = .80$), $t(57) = 2.08$, $p = .042$, $d = .54$. This suggests that our findings cannot be explained by a mere activation of a social construct related to group affiliation, but lends further support to the assumption that priming religion activates related normative behavior.

Study 4: field study

The previous studies revealed a causal relationship between semantically activating Christian religious concepts and increased ambiguity intolerance. In a final study, we wanted to establish ecological validity of this effect by testing it in a common, real-world environment. Abundant research suggests that situational cues crucially impact our behavior. Berger, Meredith, and Wheeler (2008) analyzed past election data and found that people who voted in a school building were more likely to support an education funding initiative. Similar to Rutchick (2010), they demonstrated that this influence emerges from contextual priming processes. Likewise, earlier priming experiments have established a firm link between environmental cues and automatically elicited normative behavior in that scenting cleanser lead people to keep their environment cleaner (Holland, Hendriks, & Aarts, 2005) or that activating the elderly stereotype lead people to walk slower (Bargh, Chen, & Burrows, 1996). Based on this research, we decided to assess ambiguity intolerance at a location with mostly Christian religious architecture versus a location with solely civic buildings.

Method

Participants and design

Eighty-one German-speaking participants (34 females; $M_{\text{Age}} = 34.09$, $SD = 13.39$) were approached at either the cathedral square (*Domplatz*) or a square with civic buildings only (*Sparkassenplatz*), both of which are located in the center of Innsbruck, Austria (see Fig. 4). The two locations served as our situational context priming conditions (religious vs. neutral). The study was conducted on a single day during the same hours, which granted equal external conditions for both locations.

Materials and procedure

Our response measure was an 11-item questionnaire of ambiguity intolerance, which we had constructed from diverse scales⁴ in order to arrive at a German-language questionnaire containing short and readily comprehensible statements. Participants again rated their agreement with each statement on a 7-point scale (e.g., “I avoid problems that may have more than one solution.”, “I like ambiguous situations.”, “Nothing gets accomplished in this world unless you stick to some basic rules.”).

We concluded our survey with a 2-item religiosity index to assure that our cathedral sample would not be more religious than our civic square sample. Specifically, we asked participants how often in one year they attend religious services (open answer) and how important religiosity or spirituality is for their everyday-life (7-point scale). Similar to Study 1, we predicted that activation of Christian religious content by the presence of a cathedral would lead to increased ambiguity intolerance. We calculated a mean score with higher values indicating higher levels of intolerance. As is a problem with many measures of ambiguity intolerance (Norton, 1975), internal consistency of the scale ($\alpha = .64$) was found to be at the lower end of the acceptable range.

Results and discussion

Analyses of the religiosity items revealed that there was no difference in religiosity between people at both places. Participants at the cathedral square reported attending religious services as often ($M = 5.5$, $SD = 10.91$) as did participants at the civic square ($M = 3.9$, $SD = 8.18$), $t(76) = .72$, $p = .47$, $d = 0.17$. Accordingly, the subjective importance of religiosity was also not rated differently at

⁴ Composition of our scale: Norton (1975)—items 1, 3, 6, 25, 51, 60, of which four are also part of the AT-20; Budner (1962)—item 9; Kruglanski, Webster, and Klem (1993)—item 21; Radant and Dalbert (2003)—items 3, 20, 21.

the cathedral square ($M = 2.84$, $SD = 1.64$) compared to the civic square ($M = 2.7$, $SD = 1.63$), $t(78) = .366$, $p = .72$, $d = 0.09$.

A test of our hypothesis revealed that participants approached at the cathedral indeed reported significantly more ambiguity intolerance ($M = 4.29$, $SD = .79$) than did participants approached at the civic square ($M = 3.89$, $SD = .77$), $t(79) = 2.310$, $p = .023$, $d = .51$. These results underline the external validity of our findings by demonstrating that exposure to a common religious stimulus such as a church alters how people feel about and react to ambiguous information.

General discussion

The reported experiments provide converging evidence for the notion that processing Christian religious stimuli causally influences a person's reaction to ambiguous information. It was consistently shown that thinking about religion as induced by semantic and contextual priming increased participants' intolerance of ambiguity. It was further demonstrated that this pertains to a variety of behaviors relevant in multiple daily-life situations, such as esthetic and social judgment. Specifically, cognitive accessibility of Christian concepts elicited a dislike for an ambiguous visual stimulus and increased certainty about judgments of ambiguous faces. Considering that both perception and social judgment form the basis of human interaction, it is plausible that the cognitive effects of rendering Christian religious concepts accessible reach far beyond the measures examined in this research.

There are a few factors that lend particular strength to this research. First of all, our findings feature extensive ecological validity. We demonstrated that the effect of Christian religious priming is not limited to an online-study setting, but that it also occurred on a cathedral square in the center of a medium-sized city. Thus, even in a natural, busy environment, the presence of a Christian religious building amply affected ambiguity intolerance levels. In addition, we recruited samples from three different cultures, namely the United States, Germany, and Austria. Although Christianity is the dominant religion in all three countries, they vary markedly in their level of religiosity. The United States, for example, are considerably more religious than Germany and Austria, by all common measures including religious belief, religious affiliation, church attendance, spirituality and importance of religion for one's life (e.g., Gallup, 2011; Infratest dimap, 2011). Further, although a similar percentage of the population of Austria and Germany believe there is a god (around 50%), there are notably more atheists in Germany than in Austria, that is, people who do not believe in any supernatural entity at all (25% vs. 5%; European Commission, 2005). We thereby provide a first hint towards the validity of our findings across differentially Christian cultures, which is consistent with previous findings (e.g., Johnson et al., 2010) that religion priming effects occur independent of pre-existing levels of religiosity. It further implies that practical experience is not primarily relevant, but that culturally transmitted religious knowledge forms cognitive associations strong enough to direct behavior.

Apart from the ecological and cross-cultural validity, the worldwide prevalence of religious symbols further points to the relevance of this research. Considering a far-reaching incidence and long history of organized religion, it is not surprising that religious architectural buildings and other symbols are common in almost all cultures worldwide. For example, there are more than 2000 Christian churches alone in New York City or more than 45,000 Christian churches in Germany. To investigate the current psychological impact of exposure to these symbols is thus of crucial importance. While the present research finds influences on spontaneously indicated preferences and judgments, Rutchick's (2010) findings demonstrate that even rational and conscious behaviors such as voting are influenced by exposure to religious symbols.

A question that follows from our results concerns the potential higher-order consequences of ambiguity intolerance. Looking at the dimensions that composite ambiguity intolerance scales, we see that individuals high in ambiguity intolerance state to prefer things they know to anything new, or to feel uncomfortable when not knowing what to expect. Considering further that ambiguity intolerance is linked to ethnocentrism (Block & Block, 1951) and cognitive rigidity (e.g., MacDonald, 1970), it seems plausible to assume that increased ambiguity intolerance is one cognitive route by which religion priming leads to prejudice (Johnson et al., 2010). Indeed, recent research lends strong support to this assumption showing that cognitive rigidity/flexibility is one mediating path by which religiosity is linked to negative attitudes towards racial and value-violating outgroups (Johnson Shen, Yelderman, Haggard, & Rowatt, 2013) and that closed-mindedness partially mediates between religious fundamentalism and prejudice towards value violators (Brandt & Reyna, 2010). Yet, although increased ambiguity intolerance may have these negative outcomes, the accompanying increases in judgment certainty may also help people structure the world, reduce experience of fear, and thereby contribute to individual and collective well-being. Ambiguity intolerance may thus show parallels to the two-edged sword of cognitive heuristics, that aid dynamic decision making in some instances, but lead to biases in others.

Further promising research efforts could lie in the exploration of other religions. Considering that this research was conducted in predominantly Christian cultures, the question arises whether the current findings also pertain to other religions. Correlational data suggests that this might be the case, as ambiguity intolerance was found to correlate with religiosity in Indian Muslims and Hindus (Hassan & Khalique, 1981). Related to this is the question regarding the actual cognitive processes that lead from religious content activation to ambiguity intolerance. Here, it was postulated that a dichotomous mindset is created by moral dichotomies prototypically associated with Christianity. Following this reasoning, religions that are associated with similar concepts should be more prone to this effect. However, although different control priming conditions were implemented, alternative mechanisms cannot be ruled out and should be investigated in future research endeavors. For example, it is conceivable that religion evokes a dichotomous mindset because of the opinion a person may hold about religion (e.g., strong approval vs. disapproval). As we do not directly measure activated cognitions after religion priming, for example via a lexical decision task, we cannot ultimately rule out alternative pathways to ambiguity intolerance.

Advancing experimental research demonstrates that even in a natural, complex environment while people are involved in multiple interactions, religious symbols emit measurable influence on our cognitions and behavior. Recent research (e.g., Johnson Shen et al., 2013) and theorizing (Bloom, 2012; Galen, 2012) have immensely contributed to explaining the contradictory behavior religion priming has elicited. We hope to further contribute to a better understanding of religion priming effects by exploring fundamental cognitive changes in both a controlled and natural environment. Certainly, more research is needed to find out which cognitive processes are set in motion by being reminded of religion and how they relate to the multitude of existing findings in the field.

Acknowledgments

Christina Sagioglou and Matthias Forstmann contributed equally to this research. This research was partly funded by a Leibniz Award of the German Science Foundation (DFG) to Thomas Mussweiler.

References

- Aarts, H., & Dijksterhuis, A. (2003). The silence of the library: Environment, situational norm, and social behavior. *Journal of Personality and Social Psychology*, 84, 18–28.

- Adorno, T. W., Frenkel-Brunswik, E., Levinson, D. J., & Sanford, R. N. (1950). *The authoritarian personality*. Oxford, England: Harpers.
- Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology*, 71, 230–244.
- Berger, J., Meredith, M., & Wheeler, S. C. (2008). Contextual priming: Where people vote affects how they vote. *Proceedings of the National Academy of Sciences*, 105, 8846–8849.
- Block, J., & Block, J. (1951). An investigation of the relationship between intolerance of ambiguity and ethnocentrism. *Journal of Personality*, 19, 303–311.
- Bloom, P. (2007). Religion is natural. *Developmental Science*, 10, 147–151.
- Bloom, P. (2012). Religion, morality, evolution. *Annual Review of Psychology*, 63, 179–199.
- Brandt, M. J., & Reyna, C. (2010). The role of prejudice and the need for closure in religious fundamentalism. *Personality and Social Psychology Bulletin*, 36, 715–725.
- Budner, S. (1962). Intolerance of ambiguity as a personality variable. *Journal of Personality*, 30, 29–50.
- Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's mechanical Turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science*, 6, 3–5.
- Dennett, D. C. (2006). *Breaking the spell: Religion as a natural phenomenon*. New York: Viking.
- Dijksterhuis, A., Preston, J., Wegner, D. M., & Aarts, H. (2008). Effects of subliminal priming of self and God on self-attribution of authorship for events. *Journal of Experimental Social Psychology*, 44, 2–9.
- Duriez, B. (2003). Vivisectioning the religious mind: Religiosity and motivated social cognition. *Mental Health, Religion and Culture*, 6, 79–86.
- Ekman, P., & Friesen, W. V. (1976). *Pictures of facial affect*. Palo Alto, CA: Consulting Psychologists Press.
- European Commission (2005). *Social values, science and technology*. Special Eurobarometer (Retrieved September 16, 2012 from http://ec.europa.eu/public_opinion/archives/ebs/ebs_225_report_en.pdf).
- Frenkel-Brunswik, E. (1949). Intolerance of ambiguity as an emotional and perceptual personality variable. *Journal of Personality*, 18, 108–143.
- Galen, L. W. (2012). Does religious belief promote prosociality? A critical examination. *Psychological Bulletin*, 138, 876–906.
- Gallup (2011). More than 9 in 10 Americans continue to believe in God. Retrieved September 26, 2012 from <http://www.gallup.com/poll/147887/Americans-Continue-Believe-God.aspx>
- Harris, S. (2004). *The end of faith: Religion, terror, and the future of reason*. New York: WW Norton.
- Hassan, M. K., & Khalique, A. (1981). Religiosity and its correlates in college students. *Journal of Psychological Researches*, 25, 129–136.
- Higgins, E. T., King, G. A., & Mavin, G. H. (1982). Individual construct accessibility and subjective impressions and recall. *Journal of Personality and Social Psychology*, 43, 35–47.
- Hitchens, C. (2007). *God is not great: How religion poisons everything*. New York: Twelve.
- Hogg, M. A., Adelman, J. R., & Blagg, R. D. (2010). Religion in the face of uncertainty: An uncertainty-identity theory account of religiousness. *Personality and Social Psychology Review*, 14, 72–83.
- Holland, R. W., Hendriks, M., & Aarts, H. (2005). Smells like clean spirit: Nonconscious effects of scent on cognition and behavior. *Psychological Science*, 16, 689–693.
- Infratest dimap (2011). Glauben Sie an einen Gott? Retrieved August 31, 2012 from <http://de.statista.com/statistik/daten/studie/169072/umfrage/glaube-an-gott-in-deutschland/>
- Johnson Shen, M., Yelderman, L. A., Haggard, M. C., & Rowatt, W. C. (2013). Disentangling the belief in God and cognitive rigidity/flexibility components of religiosity to predict racial and value-violating prejudice: A Post-Critical Belief Scale analysis. *Personality and Individual Differences*, 54, 389–395.
- Johnson, M. K., Rowatt, W. C., & LaBouff, J. (2010). Priming Christian religious concepts increases racial prejudice. *Social Psychological and Personality Science*, 1, 119–126.
- Keinan, G. (1994). Effects of stress and tolerance of ambiguity on magical thinking. *Journal of Personality and Social Psychology*, 67, 48–55.
- Kruglanski, A. W., Webster, D. M., & Klem, A. (1993). Motivated resistance and openness to persuasion in the presence or absence of prior information. *Journal of Personality and Social Psychology*, 65, 861–876.
- MacDonald, A. P. (1970). Revised scale for ambiguity tolerance: Reliability and validity. *Psychological Reports*, 26, 791–798.
- Norton, R. W. (1975). Measurement of ambiguity tolerance. *Journal of Personality Assessment*, 39, 607–619.
- Pichon, I., & Saroglou, V. (2009). Religion and helping: Impact of target, thinking styles and just-world beliefs. *Archive for the Psychology of Religion*, 31, 215–236.
- Radant, M., & Dalbert, C. (2003). Zur Dimensionalität der Ambiguitätstoleranz. *Paper presented at the 7. DPPD-Tagung der Deutschen Gesellschaft für Psychologie, Halle*.
- Randolph-Seng, B., & Nielsen, M. E. (2007). Honesty: One effect of primed religious representations. *International Journal for the Psychology of Religion*, 17, 303–315.
- Rutchick, A. M. (2010). Deus ex machina: The influence of polling place on voting behavior. *Political Psychology*, 31, 209–225.
- Rydell, S. T., & Rosen, E. (1966). Measurement and some correlates of need-cognition. *Psychological Reports*, 19, 139–165.
- Saroglou, V., Corneille, O., & Van Cappellen, P. (2009). "Speak, Lord, your servant is listening": Religious priming activates submissive thoughts and behaviors. *International Journal for the Psychology of Religion*, 19, 143–154.
- Saroglou, V., Pichon, I., Trompette, L., Verschuere, M., & Dernelle, R. (2005). Prosocial behavior and religion: New evidence based on projective measures and peer ratings. *Journal for the Scientific Study of Religion*, 44, 323–348.
- Sedikides, C. (2010). Why does religiosity persist? *Personality and Social Psychology Review*, 14, 3–6.
- Shaffer, D. R., & Hendrick, C. (1974). Dogmatism and tolerance for ambiguity as determinants of differential reactions to cognitive inconsistency. *Journal of Personality and Social Psychology*, 29, 601–608.
- Shariff, A. F., & Norenzayan, A. (2007). God is watching you priming God concepts increases prosocial behavior in an anonymous economic game. *Psychological Science*, 18, 803–809.
- Silberman, I. (2005). Religion as a meaning system: Implications for the new millennium. *Journal of Social Issues*, 61, 641–663.
- Srull, T. K., & Wyer, R. S. (1979). The role of category accessibility in the interpretation of information about persons: Some determinants and implications. *Journal of Personality and Social Psychology*, 37, 1660–1672.
- Turner, D. J. (2012). Religion: Year in review 2010. *Britannica book of the year, 2011. Encyclopedia Britannica online* (Retrieved from <http://www.britannica.com/EBchecked/topic/1731588/religion-Year-In-Review-2010>).
- Van Cappellen, P., Corneille, O., Cols, S., & Saroglou, V. (2011). Beyond mere compliance to authority figures: Religious priming increases conformity to informational influence among submissive people. *International Journal for the Psychology of Religion*, 21, 97–105.
- Wulff, D. H. (1997). *Psychology of religion: Classic and contemporary*. New York: Wiley.
- Young, A. W., Rowland, D., Calder, A. J., Etcoff, N. L., Seth, A., & Perrett, D. I. (1997). Facial expression megamix: Tests of dimensional and category accounts of emotion recognition. *Cognition*, 63, 271–313.