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### God

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## God: Do I have your attention?

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### ABSTRACT

Religion is commonly defined as a set of rules, developed as part of a culture. Here we provide evidence that practice in following these rules systematically changes the way people attend to visual stimuli, as indicated by the individual sizes of the global precedence effect (better performance to global than to local features). We show that this effect is significantly reduced in Calvinism, a religion emphasizing individual responsibility, and increased in Catholicism and Judaism, religions emphasizing social solidarity. We also show that this effect is long-lasting (still affecting baptized atheists) and that its size systematically varies as a function of the amount and strictness of religious practices. These findings suggest that religious practice induces particular cognitive-control styles that induce chronic, directional biases in the control of visual attention.

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## 1. Introduction

One way or another, religion plays an important role in our lives—be it as active believers, as targets or victims of religiously motivated actions, or as interested observers of conflicts nurtured by differing religious convictions. Here we provide evidence that this impact may be more fundamental than commonly assumed, namely, that religious practice may affect basic perceptual processes in such a way that followers of different religions literally see the same things differently.

Religion is commonly defined as a set of (implicit and/or explicit) rules, developed as part of a culture, which gives

followers the experience that their life is meaningful. It can be considered a sort of framework that shapes a follower's life and thoughts, and determines the way he or she creates and formulates beliefs, and experiences rules and feelings (Lindbeck, 1984). That cultural experience in a broader sense might affect our perception and attention has been suggested by studies on cultural differences. For instance, Masuda and Nisbett (2001) observed that people growing up in Asian cultures exhibit a more holistic perceptual style (i.e., are more responsive to the global than to local features of visual objects or scenes) than people growing up in the North-American culture. Westerners seem to focus on salient objects while East Asians attend more to the relationships between objects and background elements or context (Nisbett & Masuda, 2003; Nisbett & Miyamoto, 2005). This fits with the observation that East Asians allocate their attention more broadly than Americans do (Boduroglu, Shah, & Nisbett, 2009) and

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provides converging evidence for the claim of Witkin and colleagues (1954) that social interdependence is associated with a more holistic processing style.

Researchers attribute these differences to culturally guided learning experience. The idea is that Western cultures often emphasize the individual and individual goals and needs, whereas Eastern Asian cultures emphasize the importance of the group and the social embedding (Nisbett & Miyamoto, 2005). These different foci are likely to be transmitted to new members of the culture through cultural learning, that is, by providing selective reward for responses and actions that reflect culturally important values. This view is consistent with evidence that holistic and analytic perceptual styles can be experimentally induced by having people perform tasks that draw attention to either personal interdependence (by letting the participants marking relational pronouns as “our” and “we”) or independence (by having them to circle pronouns referring to the self as “my” and “I”) (Kühnen & Oyserman, 2002). Electrophysiological findings suggest that a bias to attend to the global context versus local details affects the processing of visual features rather early in the processing stream. In particular, after marking independent pronouns, participants produced an enlarged P1 amplitude to local than global targets in a global–local task (where they had to react to large shapes made of small shapes; see Navon, 1977) at lateral occipital electrodes (i.e., in the visual cortex), whereas marking interdependent pronouns had the opposite effect (Lin, Lin, & Han, 2008).

Even though culture is certainly an important determinant of interindividual differences, cultural context is very hard to capture and to define, which makes investigations that go beyond the available, rather coarse comparisons between Eastern and Western cultures extremely difficult. For instance, many inter-cultural comparisons of what are considered “Western” and “Eastern-Asian” cultures have evaluated US Americans in relation to Japanese. US Americans are composed of various cultural and national backgrounds, ranging from countries with particularly individualistic cultures, like the United Kingdom and the Netherlands, to countries with a particularly strong emphasis on collectivism, such as Greece and Mexico (cf., Hofstede, 2001). Japan, in contrast, is one of the Asian countries with the most individualistic culture. Thus it seems difficult to capture the essence of a culture by studying citizens of a particular country (which often live and represent different cultures) and to generalize from one country to its regional neighbors (e.g., to China, which is considered much more collectivistic than Japan; cf., Hofstede, 2001; Oyserman, Coon & Kemmelmeier, 2002). In the absence of an unequivocal and straightforward definition of what a culture is and what it implies, it is difficult to derive clear-cut predictions of how culture might affect human cognition.

Social systems that seem to be better suited for that purpose are religious systems or, for short, religions. Religions are typically rather well pre- and described in (often sacred) writings (notwithstanding important exceptions, as Buddhism) and relived in specific, widely shared practices and rituals; even different streams and subgroups can often be straightforwardly identified and defined rela-

tive to each other. Very recently, McCullough and Willoughby (2009) argued that, because religious people have considerable practice in learning and following rules, they are less likely to commit crimes in general. That is, the fact that individuals receive training in following rules may generalize beyond the particular rules being practiced. Along the same lines, Hommel and Colzato (in press) have speculated that religious training may induce particular cognitive-control strategies and establish default control parameters that generalize to situations that have no bearing for religious beliefs. For instance, continuously focusing on the individual rather than the social context might induce a chronic attentional-control bias towards local, and away from global features of people’s behavior, events, and objects.

Preliminary evidence suggesting that religion affects attention and perception of their followers has been provided by Colzato, van den Wildenberg, and Hommel (2008). This study compared Dutch neo-Calvinists (followers) and atheists (non followers) brought up and living in the same country (the Netherlands, where the dominant culture is influenced by Calvinism) with respect to their attentional biases. Colzato et al. employed the same global–local task (Navon, 1977) that was used in many cultural studies and presented participants with a large rectangle or square made of either smaller rectangles or squares. Participants were to react to either the global or the local shape in different blocks of trials. Both neo-Calvinists and atheists recognized the global shape faster than the local shapes, thus producing the well-known global precedence effect (i.e., people see the forest before the trees; Navon, 1977). However, Calvinists showed a significantly less pronounced global precedence effect than atheists.

As Colzato et al. pointed out, Dutch neo-Calvinism is based on the concept of *sphere sovereignty* propagated by the former Dutch Prime Minister Abraham Kuyper (Bratt, 1998). This concept emphasizes that each sphere or sector of life has its own responsibilities and authority, and stands equal to other spheres. Other sectors than one’s own are not to be judged or considered, but basically to be left alone. The widespread application of this concept has led to a profound segregation (“pillarization”) of Dutch society and established the idea that, in a nutshell, everyone should “mind his or her own business”. Among other things, this idea of segregation as strength has led to a rather liberal policy regarding drug use, abortion, or euthanasia, but it also provided the theoretical basis for Apartheid ideology in South Africa (Boesak, 1984). To teach children and other new members of the neo-Calvinist tradition the “rules of the game”, so Colzato et al. (2008) speculated, selective reward must have provided for behavior that reflects appropriate application of those rules. This, among other things may have led neo-Calvinists to chronically bias local attention, compared to the atheists.

The observations of Colzato et al. (2008) provide preliminary evidence that following a set of religious rules might indeed systematically change the way people attend to and process visual events. At the same time, they fail to demonstrate that this bias really is chronic, strictly tied to rule-following practice, and really reflecting the particular

religious practice being followed rather than religiousness in general. The present two studies aimed at filling this theoretical gap. To test whether the hypothetical religion-induced bias is indeed chronic, we studied how long-lasting religion-related differences in processing global versus local features are and whether they continue to exist in the absence of practice, as in the case of baptized atheists—people who were regularly baptized but stopped believing during puberty. To test whether the bias may be modulated by the strictness to religious rules, we also tested whether the effect of religion on visual attention is proportional to the strength of belief, as expressed in different variants of neo-Calvinism. Finally, we tested the specificity of the religion-related attentional bias by comparing Roman Catholics in Italy (where the dominant culture is penetrated by Catholicism) and Orthodox Jews in Israel (where the dominant culture is instead permeated by Judaism), with seculars growing up in the same cultures. Given that in Roman Catholicism and Judaism the rules have a much stronger emphasis on social solidarity than in neo-Calvinism (which emphasizes individual responsibility instead; see Cohen & Hill, 2007), we expected that Catholics and Orthodox Jews would show a greater global precedence effect than seculars do.

## 2. Study 1

The purpose of Study 1 was twofold. First, we investigated how long-lasting the effect of religion on visual attention is by comparing Dutch conservative neo-Calvinists, baptized atheists (formerly conservative Calvinists), and “true” (i.e., non-baptized) atheists, brought up in the same country and in the same cultural setting, with respect to the way they attend to and process global and local features of visual stimuli (as diagnosed by the global–local task (Navon, 1977)). If religious practice would really induce a chronic attentional bias, one would expect at least some after-effect of such practice in baptized atheists. Accordingly, we expected a significantly less pronounced

global precedence effect in baptized than in non-baptized atheists. Second, we investigated whether this reduction of the global precedence effect is proportional to the strength of belief, that is, to the amount of religious practice. To do so, we compared the conservative neo-Calvinists and non-baptized atheists with liberal neo-Calvinists from a religious community that follows less strict religious rules than conservative neo-Calvinists do. If the attentional bias is a function of the amount and strictness of religious practice, the global precedence effect should be less pronounced in conservative than in Liberal Calvinists.

### 2.1. Methods

#### 2.1.1. Participants

We tested 72 young healthy adults, who participated for partial fulfillment of course credit or a financial reward. They constituted four experimental groups with 18 participants each: Conservative Calvinists (all members of the “Gereformeerde Gemeenten” of the Calvinistic corps of Leiden University), Liberal Calvinists (all members of the “Gereformeerde Vrijgemaakt” Church of Gouda), atheists (non-baptized) and baptized atheists (former members of the “Gereformeerde Gemeenten” Church). All participants were matched for ethnicity (100% Caucasian), Culture (100% Dutch), age, sex, and IQ (measured by Raven’s Standard Progressive Matrices)—see Table 1 for demographic data and religious behavior. All groups were educated in the Netherlands following the same educational style and institutional type (VWO), and reported similar social–economic background. Written informed consent was obtained from all participants after the nature of the study was explained to them; the protocol and the remuneration arrangements of 10 Euro was approved by the institutional review board (Leiden University, Institute for Psychological Research).

#### 2.1.2. Apparatus and stimuli

Responses were made by pressing the “Z” or “?” of the QWERTY computer keyboard with the left and right index

**Table 1**

Demographic characteristics and religious behavior of participants, and performance on globally and locally defined targets in Study 1. Standard errors are presented in parentheses.

Variables (SD)	Conservative Calvinists	Liberal Calvinists	Baptized atheists	Atheists
Sample N (M:F)	18 (8:10)	18 (9:9)	18 (8:10)	18 (7:11)
Age (years)	21.2 (2.6)	21.7 (3.7)	22.4 (3.0)	22.1 (3.3)
Raven IQ	112.7 (3.6)	112.9 (3.85)	112.3 (4.2)	114.7 (3.4)
Baptized (or similar)**	18 (0)	18 (0)	18 (0)	0 (0)
Daily prayers**	5.6 (1.5)	3.7 (2.1)	0 (0)	0 (0)
Weekly church visit**	2.0 (0)	1.8 (0.4)	0 (0)	0 (0)
Age of leaving church	0 (0)	0 (0)	15.3 (1.5)	0 (0)
Global targets				
Reaction times (ms)	355 (10.5)	344 (10.5)	362 (10.5)	350 (10.5)
Error rates (%)	5.9 (1.7)	5.9 (1.7)	4.6 (1.7)	6.1 (1.7)
Local targets				
Reaction times (ms)	411 (10.9)	418 (10.9)	421 (10.9)	443 (10.9)
Error rates (%)	8.7 (1.7)	10.2 (1.7)	9.7 (1.7)	10.4 (1.7)
Global precedence				
Reaction times (ms)**	56	74	59	93
Error rates (%)	2.8	4.3	5.1	4.3

<sup>\*</sup>*p* < 0.05.

<sup>\*\*</sup>*p* < 0.01.

finger, respectively. The target stimuli were adopted from Huizinga, Dolan, and Van der Molen (2006), and consisted of geometric figures. Larger (global) rectangles or squares consisted of smaller (local) rectangles or squares. Global stimuli (i.e., squares or rectangles;  $93 \times 93$  pixels or  $93 \times 189$  pixels respectively) were composed of many smaller “local” stimuli (i.e., squares or rectangles;  $21 \times 21$  pixels or  $8 \times 46$  pixels respectively). The space between the local elements of a stimulus was 3 pixels. A global square consisted of 16 small squares or eight small rectangles; a global rectangle consisted of 32 small squares or 16 small rectangles.

### 2.1.3. Task and procedure

Participants responded to randomly presented rectangles or squares by pressing a left or right response button, respectively. They responded to the global shape in one block and to the local in another; block order was randomized and each block comprised of 30 practice trials and 100 experimental trials. A cue indicated to which dimension (global or local) the participants should respond. Cues that signaled the global (local) dimension consisted of a large (small) square, presented at one side of the target stimulus, and a large (small) rectangle, presented at the other side of the target stimulus. The color of cues and target was red. They remained on the screen until a response was given or 3500 ms had passed. The time interval between presentation of the cue and of the target stimulus was 500 ms. The interval between the response and the presentation of the cue was fixed at 1000 ms.

All participants were tested individually and completed the intelligence test and the global–local task. Individual IQ was determined by means of a 30-min reasoning-based intelligence test (Raven’s Standard Progressive Matrices: SPM, Raven, Court, & Raven, 1988). The SPM assesses the individual’s ability to create perceptual relations and to reason by analogy independent of language and formal schooling; it is a standard, widely-used test to measure Spearman’s  $g$  factor and of fluid intelligence in particular.

### 2.2. Statistical analysis

Univariate ANOVAs were performed to test age and IQ differences between the groups. Following Colzato et al. (2008) and Huizinga et al. (2006), median reaction times and square root error percentages were analyzed by means of ANOVAs using Target Level (global vs. local) as within- and Group as between-participants factor. We only considered data from where local and global information differed. A significance level of  $p = .05$  was adopted for all tests.

### 2.3. Results and Discussion

No significant group differences were obtained for age, intelligence, or sex,  $F(3, 71) < 1$ . The reaction time analysis showed a main effect of Target Level,  $F(1, 68) = 331.57$ ,  $p < .0001$ ,  $MSE = 331.568$ ,  $\eta_p^2 = 0.89$ , which was modified by Group,  $F(3, 68) = 7.75$ ,  $p < .0001$ ,  $MSE = 331.568$ ,  $\eta_p^2 = 0.25$ . All groups showed a significant main effect of Target Level,  $F(1, 17) = 155.96$ ,  $p < .0001$ ,  $MSE = 504.772$ ,  $\eta_p^2 = 0.90$ ;  $F(1, 17) = 135.14$ ,  $p < .0001$ ,  $MSE = 231.792$ ,

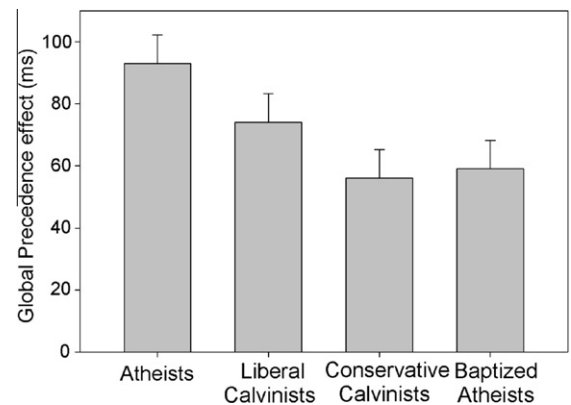


Fig. 1. Mean global precedence effect for atheists, Liberal Calvinists, Conservative Calvinists and baptized atheists. Vertical capped lines atop bars indicate standard error of the mean.

$\eta_p^2 = 0.89$ ;  $F(1, 17) = 138.54$ ,  $p < .0001$ ,  $MSE = 209.838$ ,  $\eta_p^2 = 0.89$ ;  $F(1, 17) = 127.70$ ,  $p < .0001$ ,  $MSE = 379.871$ ,  $\eta_p^2 = 0.88$ , for atheists, baptized atheists, Conservative Calvinists and Liberal Calvinists, respectively. For all groups the main effect indicated global precedence (Navon, 1977): Global targets were responded to faster than local targets. Moreover, the size of this effect varied with Group. Replicating earlier findings (Colzato et al., 2008), Conservative Calvinists showed the smallest global precedence effect, followed by Liberal Calvinists, baptized atheists and atheists (see Table 1 and Fig. 1).

$t$ -Tests for the obtained global precedence effects showed that baptized atheists differed significantly from atheists (34 ms),  $t(34) = 3.81$ ,  $p < .001$ , but not from Conservative Calvinists (3 ms),  $t(34) = -.32$ ,  $p > .05$ , or Liberal Calvinists,  $t(34) = -1.74$ ,  $p > .05$ . Interestingly, Liberal Calvinists showed a significantly larger precedence effect than Conservative Calvinists did (18 ms),  $t(34) = -2.05$ ,  $p < .05$ , and a significantly smaller effect than atheists (19 ms),  $t(34) = 2.03$ ,  $p < .05$ . Error percentages did not reveal any reliable effect,  $F(1, 68) < 1$ .

As expected, our findings suggest that the effect of religion is not a temporary by-product of ongoing religious practice but a long-lasting, chronic bias of visual attention. Interestingly, the performance of baptized atheists was not reliably different from Conservative Calvinists, suggesting that more than seven years of non-practice were insufficient to even reduce the acquired bias. Our observations also suggest that attentional biases are a (probably continuous) function of the amount and strictness of religious practices.

### 3. Study 2

Up to now all observations regarding the relationship between religion and attention demonstrate a reduction of the global precedence effect. This might suggest that religious practice necessarily emphasizes attention to details, perhaps because believers are trained to distinguish between superficially similar situations that however call for the application of different rules suggested by their



belief. Another possibility is that other type of religions, which are related to different set of rules, may bias attention and perception in different directions. If the type of bias acquired would really reflect the rules expressed in, and learned by means of the particular type of practice, it should be possible to demonstrate an increased precedence effect for religions that emphasize the community and the social context rather than the individual. To share this emphasis, so we would argue, requires attentional training that takes global features into account. This “rule” should induce stronger support of the global features of stimuli and, thus, lead to a stronger precedence effect.

Two religions that put much more emphasis on the social solidarity and context than Calvinism (and other Protestant religions) does are Roman Catholicism (cf., John Paul, 1987) and Judaism (Hart, 2000). This different emphasis is obvious from the most basic practice of living these religions: Whereas Protestant believers are encouraged and actually expected to engage in direct dialog with God (a process that Luther aimed to facilitate by translating the Bible from Latin), Catholics and Jews mainly communicate with God more indirectly, through socially shared prayers and religious rituals guided by dedicated mediators (priests, rabbis). Numerous authors since de Tocqueville (1835) and Weber (1930) have considered that the much stronger emphasis on individualism in Protestant religions have systematically biased both individual cognition and political preference, which among other things is likely to have shaped the political constitution of the United States of America and facilitated the emergence of capitalism (Bellah, Madsen, Sullivan, Swidler, & Tipton, 1985). Other authors have emphasized, and provided empirical evidence that Catholicism and Judaism propagate collectivism. For instance, Farias and Lalljee (2008) found that Roman Catholics adopt a more collectivistic outlook than atheist/agnostic participants on a battery of social–psychological measures, including values, self-concepts, and individualism/collectivism scales. Along the same lines, strongly religious (Jewish) high school students in Israel have been shown to score higher on several collectivism measures than their secular fellow students (Ichilov, 2005; Sagy, Orr, & Bar-On, 1999).

Direct comparisons across religions have provided more evidence for systematic cognitive differences between Protestants on the one hand and Catholics and Jews on the other. For instance, Protestants see their membership to their religion as an “assent”, whereas Catholics and Jews see their religious identity as due to biological descent (i.e., they are Catholics or Jews because their parents were) (Cohen & Hill, 2007). Moreover, Protestants have a decidedly internal locus of control (Sue & Sue, 1990) and consider their belief the major means to control destiny (Falicov, 2001), while Catholics have an external locus of control and tend to see God, fate, or destiny being in charge for their life. With respect to Allport and Ross’ (1967) motivational approach, the religious motivation of Protestants can be characterized more as “intrinsic” (“I try hard to carry my religion over into all my other dealings in life”), whereas the religious practice of Catholics and Jews is more “extrinsically” motivated (“it doesn’t matter so much what I believe as long as I lead a moral life”, Cohen & Hill,

2007). In other words, Protestantism is more affecting one’s internal thoughts while Catholicism and Judaism seem to target the social implications of one’s actions. The latter is likely to require the consideration of a broader range of stimuli (e.g., other people and their responses) for the control of appropriate action—a broader attentional focus that is. Indeed, Dershowitz (1971) found that Orthodox Jewish boys were more field dependent than were secular Jewish boys, who in turn were more field dependent than Protestant boys. With respect to the global–local task employed in Study 1, there are thus reasons to expect that Catholics and Jews would show a greater global precedence effect than secular participants from an otherwise comparable cultural context.

As Dutch culture is penetrated by Calvinism, so are Italian and Israeli cultures permeated by Catholicism and Judaism—which is why we conducted our second study in Italy and Israel, respectively. To test whether other religions, which are related to different set of rules, may bias attention and perception in different direction (increasing instead of decreasing the size of the global precedence effect), we compared Roman Catholics in Italy and Orthodox Jews in Israel, with culture–matched seculars. Given that in Roman Catholicism and Judaism the rules have a much stronger emphasis on social solidarity than neo-Calvinism has, we expected Catholics and Orthodox Jews to show a greater global precedence effect than seculars.

### 3.1. Methods

Seventy-two young healthy adults (36 Italians tested in Bologna, Italy, and 36 Israelis tested in Beer-Sheva, Israel) were compensated for their collaboration and constituted the four groups of 18 participants each: Italian Roman Catholics and Italian Seculars (people who grew up in a laic environment) and Israeli Orthodox Jews and Israeli Seculars. As in Study 1, all participants were matched for ethnicity, culture, age, and IQ—see Table 2 for demographic data and religious behavior. All Italian and Israeli participants were educated in the country they lived in, were exposed to the same educational style and institutional type, and reported similar social–economical background. Written informed consent was obtained from all participants after the nature of the study was explained to them; the protocol and the remuneration arrangements of five Euro (Italian participants) and of 40 Shekels (Israeli participants) or course credits were approved by the respective institutional review board. The remaining procedure was as Study 1.

### 3.2. Results and discussion

#### 3.2.1. Roman Catholics vs. Seculars

No significant group differences were obtained for age,  $t = -0.89$ ,  $p > .05$ , or intelligence,  $t = 1.53$ ,  $p > .05$ . The reaction time analysis showed a main effect of Target Level,  $F(1, 34) = 42.86$ ,  $p < .0001$ ,  $MSE = 871.985$ ,  $\eta_p^2 = 0.56$ , indicating that participants responded faster to global than local targets. This effect was modified by Group,  $F(1, 34) = 5.42$ ,  $p < .05$ ,  $MSE = 871.985$ ,  $\eta_p^2 = 0.14$ . As expected, Roman Catholics exhibited a more pronounced

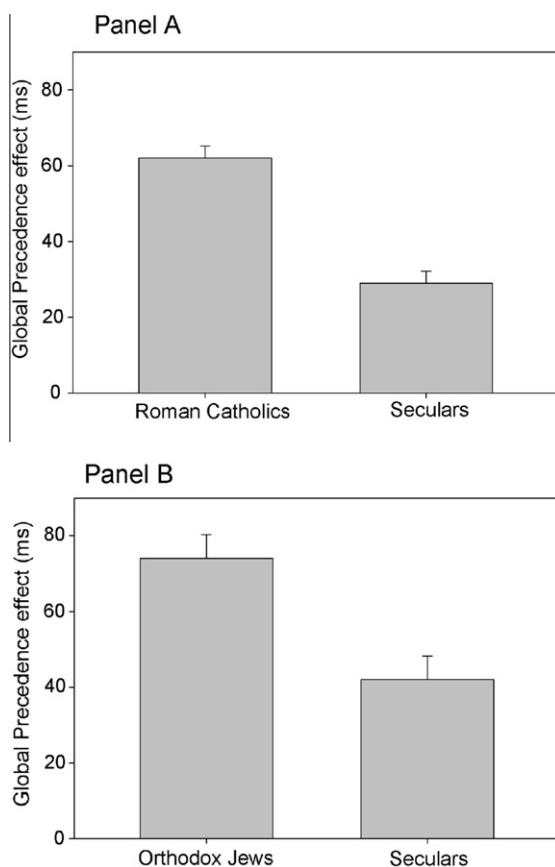
**Table 2**

Demographic characteristics and religious behavior of participants, and performance on globally and locally defined targets in Study 2. Standard errors are presented in parentheses.

Variables (SD)	Italian		Israeli	
	Roman Catholics	Seculars	Orthodox Jews	Seculars
Sample N (M:F)	18 (2:16)	18 (5:13)	18 (9:9)	18 (9:9)
Age (years)	20.3 (1.1)	20.3 (1.2)	23.4 (2.1)	24.2 (1.6)
Raven IQ	110.7 (5.2)	113.9 (5.7)	109.6 (4.8)	112.8 (4.6)
Baptized (Yes:No)*	18:0	14:4		
Communion (Yes:No)**	18:0	0:18		
Daily prays**	0.5 (0.5)	0 (0)	1.7 (0.9)	0 (0)
Kosher food (Yes:No)**			18:0	0:18
Weekly church/synagogue visits**	1.0 (0)	0 (0)	3.0 (2.9)	0 (0)
<i>Global targets</i>				
Reaction times (ms)	474 (21.9)	542 (21.9)	378 (12.5)	356 (12.5)
Error rates (%)	3.8 (1.0)	4.2 (1.0)	14.1 (3.3)	10.6 (3.3)
<i>Local targets</i>				
Reaction times (ms)	536 (18.7)	571 (18.7)	452 (12.3)	398 (12.3)
Error rates (%)	3.9 (0.9)	3.6 (0.9)	11.0 (2.0)	13.4 (2.0)
<i>Global precedence</i>				
Reaction times (ms)**	62	29	74	42
Error rates (%)	0.1	-0.6	-3.1	2.8

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .



**Fig. 2.** Mean global precedence effect for Roman Catholics and Seculars (Panel A) and Orthodox Jews and Seculars (Panel B). Vertical capped lines atop bars indicate standard error of the mean.

global precedence effect than Seculars (see Table 2 and Fig. 2). Error percentages did not reveal any reliable effect,  $F_s(1, 34) < 1$ .

### 3.2.2. Orthodox Jews vs. Seculars

No significant group differences were obtained for age,  $t = -1.40$ ,  $p > .05$ , or intelligence,  $t = 1.60$ ,  $p > .05$ . The reaction time analysis showed a main effect of Target Level,  $F(1, 34) = 94.52$ ,  $p < .0001$ ,  $MSE = 647.993$ ,  $\eta_p^2 = 0.73$ , indicating a global precedence. This effect was modified by Group,  $F(1, 34) = 7.56$ ,  $p < .001$ ,  $MSE = 647.993$ ,  $\eta_p^2 = 0.18$ . As is the case of Roman Catholics, Orthodox Jews exhibited a more pronounced global precedence effect than Seculars (see Table 2 and Fig. 2). Error percentages did not reveal any reliable effect,  $F_s(1, 34) < 1$ .

The finding that Roman Catholics and Orthodox Jews show a larger global precedence effect than seculars demonstrates that religion does not necessarily reduce the effect but seems to modulate its size depending on the type of religious practice.

## 4. General discussion

Our findings show that members of different religions, and atheists, differ specifically and systematically in the way they attend to the global and local features of visual stimuli. This effect of religion on visual attention is relatively long-lasting, a matter of degree, and it reflects the specific religious practice and type of religious set of rules by either reducing or increasing the global precedence effect. It goes without saying that Calvinism, Catholicism and Judaism differ in many ways and many of those differences may be responsible for the observed variation in the size of the global precedence effect. And yet, we would argue that the emphasis on individual responsibility (which

translates in stronger emphasis of local features in the processing of events) versus social solidarity (which translates in stronger emphasis of global features in the processing of events) is a particularly salient difference that strongly shapes the behavior of the respective members of these religious communities. If so, it makes sense to assume that continuously producing this behavior leads to the acquisition of particular cognitive-control styles and corresponding control parameters that generalize to attentional control in religion-unrelated tasks and circumstances (Colzato et al., 2008; Hommel & Colzato, *in press*). Moreover, as the groups we investigated were matched for sex, IQ, age, educational style, cultural background, and socio-economic situation we can rule out an account of our results in these terms. Particularly important was the matching of the age range and educational style: the global precedence effect seems to be unrelated to general intelligence but does change with age (Huizinga et al., 2006).

Given the correlational nature of the observed relationship between religion and attentional bias, it is important to consider the mechanism underlying this relationship. Many researchers have favored a unidirectional causal model of the link between religion and cognition. For instance, Oyserman et al. (2002) review a number of authors that have attributed North American individualism to the (mainly) Protestant background of USA's founding fathers (and mothers). This suggests that religion is shaping one's mind and, considering our present findings, might also bias one's attentional preferences. As we have argued, meeting the expectations of one's religious community requires behavior that reflects or at least obeys the rules of the respective religion. Doing so is likely to induce a bias towards cognitive-control parameters that produce the wanted behavior. In the case of attentional control this might imply parameter values related to a rather local focus with Protestants but values related to a rather global focus with Catholics and Jews. These biases towards particular value ranges might become chronic and therefore affect cognitive control even under circumstances that are not related to religious practice.

Other scenarios are possible, however. For instance, one may argue that Calvinism is more attractive for people with a more local attentional bias while Catholicism and Judaism for people with a more global bias. If so, our findings may reflect mere self-selection. However, people commonly join religious groups long before such biases become obvious (often by birth, following family traditions, certainly in Italy and Israel), which seems to undermine this possibility. Moreover, the wider implication would be that the distribution of different religions across the world is a function of pre-existing personality characteristics of their members, which does not seem to fit with historical facts. For instance, the scattered distribution and frequent regional switches between different religions in countries like Germany are a mere reflection of laws that required inhabitants to share the current religion of their current sovereign.

A somewhat more realistic possibility would be an interaction between or co-evolution of traditional cognitive preferences and religion. Even with rather strongly or-

ganized religions like Catholicism, the concrete religious practice is often colored by local habits and pre-religious or pagan traditions—such as the introduction of the Christmas tree in Catholic and Protestant practice. If we assume that these habits and traditions are reflecting the cognitive mindsets of the local people, religious practice and cognitive mindsets might have co-developed, so that religion would be more an expression of a particular mindset rather than a logically independent cause in the classical sense.

A further theoretical alternative would be that both religious practice and cognitive biases are a function of a third, not yet identified factor. Even though we did control for the arguably most obvious factors, there is no way to rule out other contributions. Even though we can only speculate what factors that might be, a recent study suggests at least one interesting candidate. As demonstrated by Ijzerman and Semin (2009), people feel closer to each other when being exposed to a warmer temperature, be it by a hot (as opposed to cold) drink or by sitting in a room with higher temperature. Interestingly, Italy and Israel are notoriously “warm” countries, conditions that in view of Ijzerman and Semin's observation might propagate both more collectivistic religions, like Roman Catholicism and Judaism, and behavior that takes other people more into consideration (thus inducing a broader attentional focus).

Taken altogether, our findings are important and have implications for at least two different levels of analysis. First, our observations can be taken to suggest that religious practice has a measurable and long-lasting impact on attentional processes. There is no reason to assume that this kind of impact is restricted to religiously inspired practice. As implied by Nisbett and Miyamoto (2005), any kind of practice that reflects particular rules may have the same potential of inducing systematic biases. This fits with the already mentioned findings on the impact of Western vs. East Asian culture on attentional processes, even though we emphasize that in almost all of the relevant studies religion was not controlled.

Second, our findings raise a number of wider implications that relate to the role of belief systems in interpersonal and inter-cultural conflict. Our study was not focused on, and did not reveal any biases towards particular issues and contents, even though they certainly exist. However, even a rather abstract bias such as towards local vs. global attributes of a perceived event is likely to cause diverging perceptions, interpretations and, eventually, conclusions. Very likely, this divergence stands in the way of effective communication between people with different religious background, especially if we consider that religion may impact many more control parameters than investigated here. As long as we do not have a clear understanding of what parameters are affected and exactly how this shapes our cognitive processes, it is difficult to believe that existing and future misunderstandings can be resolved or avoided. Accordingly, we consider the present research as only one of many necessary steps towards a better integration of the different (e.g., cognitive, social, and cross-cultural) levels of analyses of human behavior.



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