

The divided mind of a disbeliever: Intuitive beliefs about nature as purposefully created among different groups of non-religious adults



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ABSTRACT

Do non-religious adults – despite their explicit disavowal of religious beliefs – have a tacit tendency to view nature as purposefully created by some being? This question was explored in three online studies using a speeded judgment procedure, which assessed disbelievers in two different Western cultures (United States and Finland). Despite strong performance on control trials, across all three studies non-religious individuals displayed a default bias to increasingly judge pictures of natural phenomena as “purposefully made by some being” under processing constraints. Personal beliefs in the supernatural agency of nature (“Gaia beliefs”) consistently predicted this tendency. However, beliefs in nature as purposefully made by some being persisted even when such secular agency beliefs were controlled. These results suggest that the tendency to view nature as designed is rooted in evolved cognitive biases as well as cultural socialization.

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1. Introduction

The idea that some being or beings created the universe and natural order recurs in different religions across cultures (e.g., Leeming, 2010; Leeming & Leeming, 1994; Long, 1963; Sproul, 1979). However, these ideas are not restricted to ancient mythologies and formal religious doctrines. Previous studies have shown that, although young children can learn naturalistic explanations of natural phenomena (e.g., Kelemen, Emmons, Schillaci, & Ganea, 2014), when both scientific and religious explanations are present, younger children more commonly rely on religious frameworks (Evans, 2001). The attraction of a religious framework does not vanish later on; adults cross-culturally prefer mixing religious beliefs together with scientific

conceptions instead of abandoning their beliefs in supernatural agents altogether (see Evans, 2001, 2008; Legare, Evans, Rosengren, & Harris, 2012). Even when they fully accept a scientific explanatory framework and abandon explicitly religious ideas, adults very commonly misunderstand natural processes or scientific explanations in terms of agentive forces (e.g., Blancke, Schellens, Soetaert, Van Keer, & Braeckman, 2014; Kelemen, 2012; Moore et al., 2002). For example, instead of understanding the purely causal-mechanistic nature of natural selection, adults commonly construe evolution as Nature’s helpful response to animals’ wants or needs (see e.g., Gregory, 2009; Kelemen, 2012).

Disagreements exist as to how people’s recurrent and persistent construal of nature as intentionally designed is best explained. One proposal traces the tendency back to cultural discourse, socialization and religious doctrines (e.g., Alters & Nelson, 2002; Miller, Scott, & Okamoto, 2006; see also Corriveau, Chen, & Harris, 2014; Harris &

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Koenig, 2006). The other argues for a significant role of natural, early-developing cognitive tendencies that endure throughout life at a more implicit and automatic level of processing (e.g., Barrett, 2004, 2012; Bering, 2006; Emmons & Kelemen, 2014; Hood, 2009; Kelemen, 2004).

Positions that place causal weight on cultural exposure contend that the tendency to construe natural phenomena as intentional in origin becomes automatized and internalized over time as a result of repeated exposure to and familiarization with creationist cultural discourse. In consequence, ideas about *purposefully made* nature are thought to persist and recur due to the cross-cultural ubiquity of Christian or Abrahamic theistic cultural discourse, a form of discourse that is particularly influential and prominent in the United States (e.g., McCalla, 2007; Müller et al., 2006; Numbers, 2006; Scott, 1997). What follows from this position is a prediction that robust tendencies to explain the origins of the environment by reference to supernatural agents and their actions should be largely restricted to those individuals whose socialization has led them to explicitly endorse beliefs in God or gods. Support for this hypothesis is potentially found in results from implicit priming studies that show, for example, that while the behavior of God-believers is affected by implicit God primes, the behavior of low believers or non-believers is not. For example, tacit exposure to concepts such as “God” and “divine” increases religious but not secular individuals’ tendencies to act generously (Shariff & Norenzayan, 2007), to perceive social surveillance (Gervais & Norenzayan, 2013), and to sense that they are not the author of their own actions (Dijksterhuis, Preston, Wegner, & Aarts, 2008; see Gervais, Willard, Norenzayan, & Henrich, 2011 for further discussion).

This focus on cultural exposure contrasts with views arguing for the “naturalness of religion”, which instead place emphasis on intuitive, automatic contributions to religious cognitive processing (e.g., Barrett, 2000, 2004, 2012; Bloom, 2007; Evans, 2001; Hood, 2009; Kelemen, 2004). This alternative perspective does not deny the role of cultural discourse in establishing and transmitting the religious beliefs of a specific tradition or in inducing commitment to, and reflective faith in, particular religious representations. However, rather than focusing on unidirectional influences of culture on individuals’ minds, this theory takes into account inherent aspects of human cognition when explaining why beliefs in supernatural agents and related ideas remain culturally successful (see Sperber, 1996). Adopting a dual process model of cognitive processing (e.g., J. St. B. T. Evans, 2003, 2008; Kahneman, 2003, 2011; Stanovich, 1999, 2004), several researchers have argued that given the existence of reliably early-developing cognitive abilities and tendencies to reason about intentional agents and purposefully designed objects, all individuals continue to possess heightened implicit receptivity to religious ideas throughout life (e.g., Barrett, 2004; Baumard & Boyer, 2013; Bloom, 2007; Evans, 2001; Hood, 2009; Kelemen, 2004). This view, therefore, predicts that, regardless of their explicit, reflective disavowal of belief in supernatural agents, at a non-reflective level of processing, people enduringly remain “intuitive theists” (Kelemen, 2004).

To date, much of the empirical support for this view comes from studies exploring both children’s and adults’ tendency to form purpose-based explanations about natural phenomena. Even though children distinguish artifacts from natural entities (see e.g., Gelman, 1988; Gelman & Kremer, 1991; Keil, 1989), their construal of these different ontological classes nevertheless shows some overlap. For example, across cultures, it has been found that children tend to indiscriminately explain both artifacts and natural phenomena by reference to putative purposes and intended design, instead of explaining natural entities in terms of physical causes (DiYanni & Kelemen, 2004; Kelemen, 1999a, 1999b, 1999c, 2003; Kelemen & DiYanni, 2005). Importantly, empirical studies have also shown that, in line with the dual process model, this broad tendency to explain natural phenomena by reference to purpose remains active later in life. Adults with low levels of scientific schooling, or whose semantic knowledge has been fragmented by Alzheimer’s disease, explicitly display promiscuous teleological reasoning (Casler & Kelemen, 2008; Lombrozo, Kelemen, & Zaitchik, 2007). This bias appears to persist as an automatic cognitive default even among well-educated adults and despite countervailing reflective ideas. For example, professional scientists will endorse scientifically unwarranted teleological explanations when their ability to access their reflective knowledge is impaired by responding at speed (Kelemen & Rosset, 2009; Kelemen, Rottman, & Seston, 2013; Rottman et al., 2015). Finally, although adults who believe in God hold stronger teleological beliefs than those who do not, evidence of implicit teleological beliefs (about life events) has been found even among non-believers (Banerjee & Bloom, 2014; Heywood & Bering, 2013).

Until now, however, it has remained empirically untested whether, in addition to purpose-based teleological intuitions, adults also maintain even richer intuitive tendencies to view natural phenomena as purposefully created. The current set of three studies addressed this gap by exploring whether people default to judging natural phenomena as purposefully made when they do not have time to reflect, by adapting previously used speeded response methods (see e.g., Goldberg & Thompson-Schill, 2009; Kelemen & Rosset, 2009; Kelemen et al., 2013). In order to provide the strongest test of the cultural exposure vs. dual process hypotheses, we particularly focused on non-religious adults’ intuitions about creation. Specifically, while both hypotheses predict that religious believers would have higher baseline tendencies to endorse creation than disbelievers, the cultural exposure hypothesis differs from the dual processing hypothesis by predicting that only religious believers are more likely to endorse notions of purposeful creation when responding at speed. The logic is that because ideas about creation are more practiced and familiar to religious believers, such ideas are therefore more available when processing is taxed. By contrast, the dual process hypothesis proposes that even though non-religious adults have practiced denying ideas about creation in their reflective reasoning, they will also show a heightened tendency to understand natural phenomena as intentionally made when their natural cognitive biases are revealed by responding at speed.

To more fully explore these competing hypotheses, we tested different samples of non-religious participants in each of the three studies. In Study 1, we began with a general sample of North American adults. In Study 2, we moved to an even stronger test by recruiting members of North American atheist organizations and explicitly testing them in the context of their membership in this cultural minority group. Finally, in Study 3, we controlled for the possible effects of ambient North American cultural religiosity (e.g., Putnam & Campbell, 2010; Smith, 2013), by repeating the study with non-religious adults in Finland where disbelief in some higher power, God or gods is socially more accepted. It should be noted that throughout these studies, when analyzing people's "creation endorsement", we are referring to a general tendency to think of natural phenomena as purposefully made by some kind of agentive being, and not to "creationist beliefs", which are an example of explicit religious beliefs in a divinity and occur in reference to a particular formal religious doctrine (e.g., Numbers, 2006).

2. Study 1

2.1. Materials and methods

2.1.1. Participants

The participants were 352 North American adults (65% female; mean age = 32, $SD = 13$) who were recruited via the online market place Amazon Mechanical Turk (AMT), which has been shown to be a reliable sampling method (see more e.g., Buhrmester, Kwang, & Gosling, 2011; Mason & Suri, 2012). All participants were native English speaking residents of the United States or Canada and met inclusion criteria described below. Most participants had at least some college education (88%). There were 225 participants who were categorized as "religious" because they rated themselves 3 (indicating they were unsure or indecisive about their beliefs) or higher on a five-point scale (1 = strongly disagree and 5 = strongly agree) measuring their belief that some kind of higher power, God or gods exists ($M = 4.40$, $SD = .76$). There were 127 participants who were categorized as "non-religious" because they rated themselves 2 or lower on the same five-point scale, ($M = 1.28$, $SD = .45$).¹ As in all studies reported here, analyses included participants who completed over 50% of the test items and passed at least 75% of the control items in each condition. An additional 166 participants did not meet these inclusion criteria (primarily in speeded conditions due to the added cognitive load). This number is in line with previous studies using complex online methodology (Oppenheimer, Meyvis, & Davidenko, 2009; see also Holden, Dennie, & Hicks, 2013; Kelley, 2010). All analyses were also run with the entire sample, including these dropped participants, and the same patterns

of results were found. Participants were randomly assigned to one of four conditions, described below, in the Speeded Creation task: speeded being-made group ($n = 93$), unspeeded being-made group ($n = 131$), speeded human-made control group ($n = 52$) or unspeeded human-made control group ($n = 76$).

2.1.2. Procedure

2.1.2.1. Speeded Creation task. The Speeded Creation task was a picture-based procedure devised to measure adults' automatic and reflective tendencies to endorse natural phenomena as purposefully made by some being, which is referred to as 'creation endorsement' from this point onwards. The method was based on the speeded sentence judgment task in Kelemen and Rosset (2009; also Kelemen et al., 2013; see also Eidson & Coley, 2014; Finucane, Alhakami, Slovic, & Johnson, 2000; Goldberg & Thompson-Schill, 2009; Rosset, 2008; Svedholm & Lindeman, 2012). Participants were randomly assigned either to a speeded or an unspeeded condition. In both conditions, participants were sequentially presented with 120 pictures (40 test trials, 80 control/cognitive load trials) in random order on a computer. Participants were asked to judge whether "any being purposefully made the thing in the picture" and respond "yes" or "no" by pressing relevant response keys on a computer keyboard. Clarification about the meaning of the phrase "some being" was provided in the task instructions as follows: "It is important for you to note that by using the term *being* we are deliberately non-specific. For us, *being* might refer to any kind of being who makes things deliberately." (See Appendix A for the full instructions).

Test trial items were 40 photographs of living and non-living natural phenomena (e.g. giraffe, maple tree, tiger's paw, mountain, stalagmite, hurricane). All pictures of living things depicted adult or full-grown organisms. The 80 control/cognitive load trials consisted of three types and were included to track participants' understanding of the instructions, their abilities to respond at speed, as well as response biases and strategies that were likely to occur given non-religious participants' potentially high motivations to "beat the task" by adopting strategies intended to protect against ever endorsing religious-sounding answers: "No-bias control" trials (10 items) were included to control for and monitor participants' potential bias to deny creation for all items. To interfere with this potential response set, no-bias controls were 10 photographs of different kinds of artifacts (e.g., balloon, cello, scissors) which, as unequivocal examples of items that are "purposefully made by some being", should always have yielded "yes" responses regardless of condition or personal atheist beliefs. Because we hypothesized that participants' creation endorsement would increase under speed – resulting in a significant number of test trials that might potentially elicit a "yes" response under speeded conditions – we also included "yes-bias control" trials (60 items) to create a testing context in which "no" was a high frequency response option. In these trials, participants saw different kinds of colorful geometrical shapes and were specifically instructed: "When you see a geometrical shape, always press NO." This kind of parallel task was adopted for yes-bias control items because, under the dual processing

¹ This division into "religious" and "non-religious" was not intended to fully represent the range of various reflective identities that individuals may have in reference to religious belief. Rather, the dichotomy was used to specifically compare disbelievers to all others, because the purpose of the present study was to assess whether disbelievers have an automatic tendency to assess the origin of natural phenomena as purposefully made.

account, there is no item category that is unambiguously interpretable as not created. These trials also served to monitor participants' attentiveness and understanding of the instructions.

Finally, "cognitive load control" trials (10 items) were included to increase the complexity of the task and prevent participants from adopting another low-level strategy for "beating the task" which became apparent during pilot testing. The strategy was a superficial category-based approach of perceptually scanning for artifacts and answering "yes" and scanning for non-human-made objects and answering "no". To foil this strategy, cognitive load trials involved human-made artifactual representations of living things, specifically cartoon characters (e.g., Eeyore, Spiderman) (see [Ganea, Ma, & DeLoache, 2011](#); [Preissler & Bloom, 2007](#) for understanding of symbolic media). These trials, therefore, paralleled test trials of natural entities except that they were human-made caricatures that, as artifacts, were "purposefully made by some being" but were sufficiently ambiguous to interfere with participants using an attentionally-undemanding category-based heuristic throughout the whole task. High levels of inaccurate "no" responses to cognitive load trials were informative as to the degree of participants' engagement and difficulty with the task as well as the level of their motivation to avoid answering "yes" on test trials.

Participants in the speeded condition had a maximum of 865 ms to respond and were instructed to respond as quickly as possible. The response time was defined based on the average response time for pilot participants in a separate pretest. Participants in the unspeeded condition were allowed to proceed in the task at their own pace and were instructed to think about their answers long and carefully. In both conditions, participants began the experiment by responding to eight practice items that presented examples of each picture category. In the main task, pictures were then presented in five blocks of 24 pictures. Each block contained a proportional number of pictures from each category (8 test items, 2 no-bias controls, 12 yes-bias controls and 2 cognitive load items), presented in random order. Programming of the task was done by using MySQL, PHP and JavaScript with the CakePHP framework, which enabled the blocks to preload before the participant saw any items so that the speed of participants' internet connection, browser or computer did not affect the standardized timing of the speeded condition.

2.1.2.2. Human-made group. In addition to the being-made group, a second set of participants was randomly assigned to a speeded or unspeeded human-made group. This group was designed as a control to disambiguate being-made group results by clarifying whether they derived from participants having a "yes" bias, or a general inability to negate intentional agency regardless of origin ([Rosset, 2008](#); [Rosset & Rottman, 2014](#)). The procedure for the human-made group was identical to the being-made group except that participants were asked to assess whether a *human* had purposefully made the things in the pictures. High similarity between the being-made and human-made groups on test item endorsement would suggest these biases. Low levels of test item endorsement in the

human-made group, both under speeded and unspeeded conditions, would serve as an indicator that neither bias was involved.

2.1.2.3. Individual differences measures. After the main task, participants completed measures of their personal beliefs as well as the eight questions on Galapagos finch diversity from the Conceptual Inventory of Natural Selection (CINS; [Anderson, Fisher, & Norman, 2002](#)). These assessments were included to explore how individuals' explicit personal beliefs and scientific understanding of natural mechanisms related to their tendencies to endorse creation in the Speeded Creation task.

With regard to their personal beliefs, participants used a five-level Likert scale (1 = strongly disagree and 5 = strongly agree) to rate their explicit agreement with ten statements about their belief in a higher power, God, gods, or beliefs in a creator God, as well as their "Gaia" beliefs in the intrinsic agency of nature and the Earth (e.g., "Nature is a powerful being", "Earth is alive", "Nature responds to the needs of animals and helps them survive"; see [Table 3](#)). These items were adapted from a "Gaia measure" that has previously been found to be related to adults' teleological ideas about natural phenomena ([Kelemen, 2012](#); [Kelemen et al., 2013](#)).

Participants' beliefs in Gaia forces of intrinsic creative agency were measured in addition to their belief in a higher power, God or gods, because these kinds of agentive ideas recur commonly both in non-Western cultures and also in Western religiosity outside of the traditional Abrahamic context (e.g., [Davy, 2008](#); [Leeming & Leeming, 1994](#)). Furthermore, beliefs in Nature and the Earth as purposefully-behaving agents, as well as misconceptions about evolution and natural selection as purposeful processes, recur commonly among adults who do not necessarily identify these beliefs as supernatural and do not identify themselves as religious. Even though they may use secular or scientific terminology, these conceptions can be understood to represent supernatural reasoning in a culturally non-religious context; they fail to describe an actual physical-causal mechanism behind Nature's behavior and instead invoke the idea of a being who is able to purposefully create natural phenomena. (See [Blancke et al., 2014](#); [Gregory, 2009](#); [Kelemen, 2012](#); [Moore et al., 2002](#)). In consequence, it seemed possible that, in addition to explicit formal religious beliefs in a higher power/God/gods, informal beliefs in Nature's and Earth's agentive powers might also strengthen creation endorsement on the Speeded Creation task, just as they do in the context of teleological reasoning ([Kelemen et al., 2013](#)).

2.2. Results

2.2.1. Speeded Creation task

Across both conditions, 'yes' responses on test items were coded as 1 and 'no' responses were coded as 0 to yield a proportional mean test item endorsement score between 0 and 1, with higher scores reflecting higher creation endorsement. Control and cognitive load items were coded to yield proportional mean inaccuracy scores between 0 and 1, with higher scores reflecting greater inaccuracy.

First, we examined test item endorsement across the demographic categories. There were no significant differences between females and males, or between higher educated and lower educated participants. However, participants older than the median age of the sample (28 years) endorsed test items more than younger participants. Thus, age was included as a control in the subsequent analysis. Our main analysis explored whether the pattern of test item endorsement significantly varied between the speeded and unspeeded conditions and, in particular, whether this occurred among non-religious individuals in the being-made group but not the human-made control group. We therefore conducted a 2 (Speed: speeded vs. unspeeded) \times 2 (Belief: religious vs. non-religious) \times 2 (Type: being-made vs. human-made) \times 2 (Age: younger vs. older) ANOVA on test item endorsement. This analysis revealed, again, that older participants endorsed test items more ($M = 46\%$, $SD = 44\%$) than younger ($M = 33\%$, $SD = 39\%$) ($F(1, 334) = 4.30$, $p < .05$, $\eta^2 = .01$), but also that participants' test item endorsement was significantly higher in the being-made group ($M = 55\%$, $SD = 43\%$) than the human-made group ($M = 11\%$, $SD = 22\%$; $F(1, 334) = 110.92$, $p < .001$, $\eta^2 = .25$) and that endorsement of test items was higher among religious participants ($M = 49\%$, $SD = 44\%$) than non-religious participants ($M = 22\%$, $SD = 32\%$; $F(1, 334) = 32.48$, $p < .001$, $\eta^2 = .09$). However, a Belief by Type interaction effect was also found ($F(1, 334) = 17.62$, $p < .001$, $\eta^2 = .05$), indicating that the influence of religiosity was specific to the being-made group; religious and non-religious participants in the human-made group did not differ in their tendencies to reject human involvement in the creation of natural phenomena.

With respect to the effects of speeded responding, across being-made and human-made groups, participants were generally more likely to endorse natural phenomena as "purposefully made" when speeded ($M = 44\%$, $SD = 41\%$) rather than unspeeded ($M = 36\%$, $SD = 43\%$; $F(1, 334) = 6.98$, $p < .01$, $\eta^2 = .02$). However, a marginal Speed by Type interaction, ($F(1, 334) = 3.84$, $p = .051$, $\eta^2 = .01$), revealed that this effect was more pronounced in the being-made group ($M_{diff} = 10\%$); speeded and unspeeded participants in the human-made group, on the other hand, differed only slightly in test item endorsement ($M_{diff} = 1\%$). In sum, under speeded conditions, participants tended to default to a view of nature as "purposefully made by some being" whether they were religious or non-religious. Moreover, this pattern did not reflect indiscriminate endorsement of just any kind of intentional creation. Participants did not automatically judge nature as made by a human even under speeded conditions. (See Fig. 1 for the specific test item endorsement proportion means in the being-made and human-made groups.)

To further confirm that participants' tendency to default to test item endorsement under speed in the being-made group did not simply result from overall confusion or general response sets, we conducted a 2 (Speed: unspeeded vs. speeded) \times 4 (Item Type: test items vs. no-bias controls vs. yes-bias controls vs. cognitive load items) \times 2 (Belief: religious vs. non-religious) repeated-measures ANOVA on test item endorsement and inaccurate control item performance in the being-made group.

This analysis revealed that participants were not confused by the instructions or using a low-level response strategy: While there was an overall effect of speeded responding on task performance ($F(1, 219) = 29.99$, $p < .001$, $\eta^2 = .12$), participants responded very differently to test vs. control items ($F(1.46, 319.372) = 209.02$, $p < .001$, $\eta^2 = .49$) and an Item Type by Speed interaction, $F(1.46, 319.372) = 3.86$, $p < .05$, $\eta^2 = .02$) indicated that speeded effects differed across item types. Specifically, both religious and non-religious participants were more likely to endorse test items than inaccurately answer cognitive load items, no-bias controls or yes-bias controls (Table 1).

As expected, accuracy on the more challenging cognitive load trials was significantly lower than in the other two control trial types, particularly under speeded conditions. Participants therefore found responding to cognitive load items (i.e. cartoon characters) less straightforward than, for example, responding to no-bias controls (i.e. artifacts). Specifically, in addition to being interpreted as human-made drawings, the cognitive load items were likely also seen as real-world referents of natural kinds (e.g., Ganea et al., 2011; Preissler & Bloom, 2007), prompting increased no-responses from individuals who were motivated to negate ideas about purposeful creation of nature. Indeed, while all item types differed by speed, the influence of speed on cognitive load trial accuracy ($M_{diff} = 10\%$) was marked and approximated the effect of speed on test trial endorsement ($M_{diff} = 10\%$) – a pattern that clearly indicates that, as hoped, participants could not rely on low-level strategies and truly experienced cognitive load in our procedure.

Moreover, a global "yes" bias was not the source of the speeded effect on test items given that an indiscriminate "yes" bias was not found in control item performance (no-bias controls $M_{diff} = 5\%$; yes-bias controls $M_{diff} = 1\%$). A significant main effect of Beliefs, ($F(1, 219) = 35.68$, $p < .001$, $\eta^2 = .14$), subsumed by a significant interaction between Item type and Beliefs, ($F(1.46, 319.372) = 52.90$, $p < .001$, $\eta^2 = .20$), further confirmed our a priori prediction that non-religious participants were particularly likely to attempt to adopt a general response strategy that would help them "beat the task" and avoid possible creation endorsement on test items. Namely, non-religious participants' results revealed a particular difficulty in no-bias controls (non-religious: $M = 6\%$, $SD = 8\%$; religious: $M = 3\%$, $SD = 6\%$) and cognitive load items (non-religious: $M = 18\%$, $SD = 26\%$; religious: $M = 9\%$, $SD = 19\%$) – both items that involved responding "yes". It is particularly interesting that even though non-religious participants showed a lower level of creation endorsement of test items ($M = 30\%$, $SD = 36\%$) in comparison to religious participants ($M = 70\%$, $SD = 39\%$), their test item endorsement (i.e. responding "yes"), along with that of religious participants, was significantly higher than inaccuracy in any other item category (see Table 1).

Lastly, to assess whether the effects on test item endorsement were solely carried by responses to living things, potentially because participants focused on individuals' capacities for intentional biological reproduction rather than on whether living and non-living natural categories were purposefully created, we conducted a 2 (Test Item Type: living nature vs. non-living nature) \times 2 (Speed:

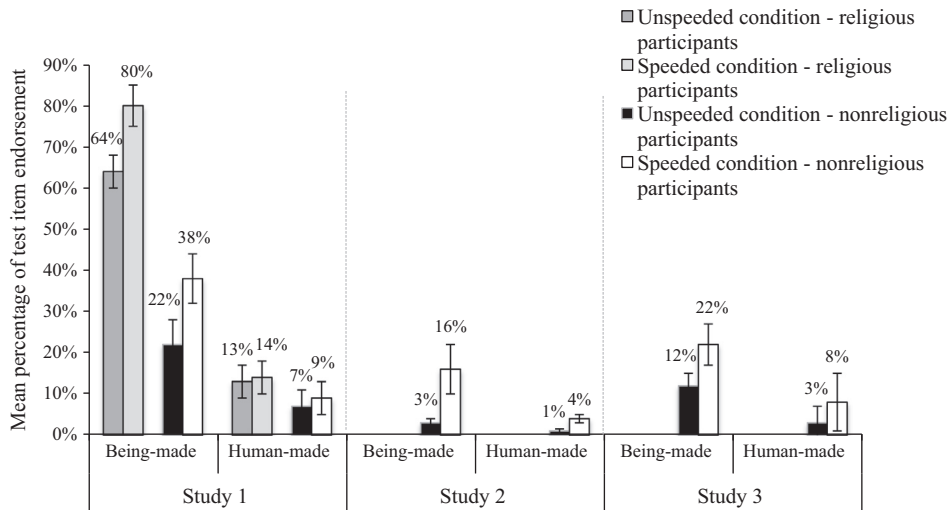


Fig. 1. Test item endorsement proportion mean scores in being-made and human-made groups by religious and non-religious participants in Study 1, Study 2 and Study 3.

Table 1

Test item endorsement and control and cognitive load item inaccuracy proportional mean scores (SD) by religiosity and speed in being-made groups in all studies.

	Study 1			Study 2			Study 3			
	Unspeeded		Total	Speeded		Total	Unspeeded	Speeded		
	Religious	Nonreligious		Religious	Nonreligious		Nonreligious	Nonreligious		
Test items	64 (41)	22 (35)	51 (44)	80 (33)	38 (35)	61 (40)	3 (9)	16 (31)	12 (23)	22 (30)
No-bias controls	2 (5)	2 (5)	2 (5)	5 (7)	9 (9)	7 (8)	2 (4)	9 (8)	1 (4)	6 (9)
Yes-bias controls	2 (4)	1 (4)	2 (4)	4 (4)	2 (3)	3 (4)	1 (4)	1 (3)	0.5 (1)	2 (4)
Cognitive load items	6 (18)	12 (27)	8 (22)	13 (20)	23 (24)	18 (22)	3 (9)	17 (21)	4 (15)	11 (13)

unspeeded vs. speeded) \times 2 (Beliefs: religious vs. non-religious) repeated-measures ANOVA. This analysis did not reveal any significant interactions, indicating that, among religious and non-religious participants, speeded effects on test item endorsement were not limited to living things but driven by both living and non-living natural entities (for the full results see [Appendix B](#)).

2.2.2. Predictors of creation endorsement

In addition, we hoped to clarify which types of explicit personal beliefs predicted creation endorsement. Correlations between individual difference measures and test item endorsements within the Speeded Creation being-made group (see [Table 2](#)), revealed that many of the ten personal beliefs were correlated with each other. Before conducting regression analyses, a factor analysis was therefore conducted to explore whether items loaded together due to one or more common underlying factors (e.g., a God belief).

Principal components analysis with Varimax (orthogonal) rotation revealed two discriminable factors. The first factor was a 4-item “God factor” tapping beliefs that made explicit reference to ‘God’ or ‘religion’, and, in the Western cultural context would be understood as explicitly religious (e.g., “I believe in the existence of some kind of higher power/ God/ gods”). Cronbach’s alpha indicated that this factor demonstrated good internal consistency, $\alpha = .89$.

The second factor was a 5-item “Gaia factor” tapping non-doctrinal beliefs that did not make any explicit references to religious agents (higher power, God, gods) but described nature’s and the Earth’s immanent agency (e.g. “I believe Nature is a powerful being”, “I believe that the Earth is alive”, “I believe that Nature responds to the needs of animals and helps them survive”). This factor also demonstrated good internal consistency, $\alpha = .78$. (See [Table 3](#).)

To explore the influence of these factors as well as the influence of scientific knowledge on performance by both groups in the Speeded Creation task, we regressed participants’ creation endorsement in the being-made group and human-made control group onto mean God and Gaia factor scores and CINS scores while controlling for Speed. In the being-made group, creation endorsement was predicted by Speed and by both the God and Gaia factors, $R^2 = .430$, $F(4, 218) = 41.13$, $p < .001$. By contrast no significant predictors were found in the human-made group (see [Table 4](#)).

2.3. Discussion

Results from Study 1 revealed that even though religious participants’ baseline tendency to endorse nature as purposefully created was higher than non-religious participants’ tendency to do so, non-religious participants also increasingly defaulted to understanding natural phenomena as purposefully made in the being-made group when

Table 2

Overall correlations between test item endorsement in the Speeded Creation task, explicit personal beliefs and understanding of natural selection (CINS) in the being-made group of Study 1.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Speeded Creation task	–											
2. Belief in some kind of higher power/God/gods	.56**	–										
3. Belief in a constantly active creator God	.59**	.79**	–									
4. Belief in a currently passive creator God	.15*	.43**	.13	–								
5. Belief that the Earth is alive	.29**	.26**	.25**	.05	–							
6. Belief that Nature is a powerful being	.27**	.25**	.17*	.21**	.60**	–						
7. Belief that everything in nature has a soul	.33**	.37**	.32**	.21**	.44**	.50**	–					
8. Belief that God operates within and through all natural processes	.55**	.87**	.80**	.37**	.29**	.23**	.45**	–				
9. Belief that there is truth in only one religion	.35**	.42**	.56**	.07	.02	–.08	.001	.46**	–			
10. Belief that Nature helpfully responds to animals needs	.28**	.33**	.25**	.24**	.38**	.46**	.32**	.29**	–.01	–		
11. Belief that animals have power to change their own biology	.15*	.07	.003	.20**	.29**	.38**	.27**	.10	–.10	.46**	–	
12. CINS	–.28**	–.30**	–.30**	–.25**	–.17*	–.21**	–.15*	–.30**	–.28**	–.40**	–.35**	–

* $p < .05$.

** $p < .01$.

Table 3

Factor loadings and uniqueness for confirmatory factor model of explicit agent-based beliefs using principal component analysis with Varimax (orthogonal) rotation in Study 1, Study 2 and Study 3.

Item	Study 1		Study 2		Study 3	
	God factor	Gaia factor	God factor	Gaia factor	God factor	Gaia factor
I believe in the existence of some kind of higher power/God/gods	.892		.821		.727	
I believe that some kind of higher power/God/gods created the Earth and living kinds (animals, plants) and continues/continue to actively interact with them	.906		.672		.840	
I believe that some kind of higher power/God/gods originally created the Earth and living kinds (animals, plants) but does not/do not currently interact with them or change them*	–		.783		.871	
I believe that some kind of higher power/God/gods operates/operate within and through all living things and natural processes	.887		.780		.622	
I believe there is truth only in one religion**	.690		–		–	
I believe that the Earth is alive		.725		.779		.582
I believe that Nature is a powerful being		.823		.823		.660
I believe that everything in nature has a soul		.679		.699		.517
I believe that Nature responds to the needs of animals to help them survive		.703		.689		.640
I believe that animals have the power to change their own biology in order to survive		.684		.395		.727
Eigenvalue	3.8	2.2	2.8	2.2	3.3	1.6
Percent of variance explained	38%	22%	28%	22%	33%	16%

* In Study 1, a belief in a currently passive creator God loaded similarly to both factors and was therefore not included in the God factor in this study.

** In Study 2 and Study 3, a belief in truth in only one religion did not load into either factors and was not included into the God factor in these studies.

they did not have time to censor their thinking. Results from the human-made group indicate that this central result was not simply due to a “yes” bias or an indiscriminate tendency to simply endorse any kind of intentional agency (see Rosset, 2008): Regardless of belief or condition, participants had little difficulty denying that humans purposefully create natural phenomena. Further, although older participants endorsed the intentional creation of nature more than younger participants, this did not explain the effect of speed on this tendency among participants overall.

Differences between the being-made and human-made groups indicated that participants could respond and show discrimination under speeded conditions. This was further confirmed by control-trial performance, which showed that participants were able to respond under speeded conditions overall. Interestingly, performance on control trials also sheds light on the underlying robustness of creation endorsement in non-religious participants: Even though these individuals were trying their best to respond “no”

to every picture representing a natural entity, the number of “yes” responses was still higher among many non-religious individuals when judging the living and non-living natural entities in the test items, indicating endorsement of design. This provides insight into the automatic and unavoidable nature of test item endorsement in the speeded being-made group.

Our individual differences analyses further revealed the underlying nature of people’s creation endorsement on the Speeded Creation task. Endorsement of nature-as-created in the being-made group was systematically and independently predicted not only by beliefs in a creator God but also by Gaia beliefs in the intrinsic agency of Nature and the Earth (see also Kelemen & Rosset, 2009; Kelemen et al., 2013). These findings provide preliminary evidence that beliefs in a Christian or Abrahamic creator God are not the only agent-based beliefs that strengthen biases to construe nature in terms of purposeful creation. Non-doctrinal agency conceptions are also relevant.

Table 4

Linear regressions predicting test item endorsement in the Speeded Creation task from personal beliefs and natural selection understanding (CINS).

Variable	Study 1			Study 2			Study 3		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
<i>Being-made group</i>									
God factor	.172	.017	.549***	.064	.119	.061	.101	.087	.167
Gaia factor	.079	.023	.195**	.075	.033	.295*	.107	.042	.276*
CINS	-.060	.103	-.033	.086	.133	.084	-.164	.165	-.118
Speed	-.158	.044	-.183***	-.117	.047	-.276*	-.110	.055	-.196
<i>Human-made group</i>									
God factor	.022	.015	.132	.018	.032	.059	-.010	.021	-.057
Gaia factor	.015	.018	.075	.002	.005	.054	.016	.010	.248
CINS ^a				-.027	.024	-.145	-.001	.039	-.030
Speed	-.024	.041	-.052	-.033	.008	-.467***	-.051	.013	-.445***

^a Data on the CINS were not collected from human-made group participants in Study 1.* $p < .05$.** $p < .01$.*** $p < .001$.

In sum, findings from Study 1 were more consistent with the dual process hypothesis, providing preliminary support for the view that the tendency to construe both living and non-living nature as intentionally made derives from automatic cognitive processes, not just practiced explicit beliefs. Results showed that even non-religious participants increasingly construe natural entities as purposefully created when reflective reasoning is undermined by speeded responding. However, one possible objection to the current results is as follows: If creation endorsement is truly a form of explanatory default, then one would predict that evidence of this bias should be found even in a highly unlikely population – members of the minority group of North Americans who formally identify as extreme non-believers in religion and who underscore this identity via their organizational affiliation with an atheist or secular organization. To perform this stronger test, we therefore repeated Study 1 with a group of organized North American atheists.

3. Study 2

3.1. Materials and methods

3.1.1. Participants

The participants were 148 North American adults (53% female; age: $M = 35$ years, $SD = 17$ years) who were recruited via the email lists of atheist and other explicitly non-religious associations and organizations. All participants were native English speakers. Most participants had at least some college education (96%). In contrast to Study 1, all participants were entirely non-religious and strongly disagreed that any kind of higher power, God or gods exists, ($M = 1.1$, $SD = .25$ on a five-point scale, (1 = strongly disagree and 5 = strongly agree). Also, in contrast to Study 1, all participants were explicitly primed about their non-religious identity prior to participation by informing them that they were contacted because we wanted to examine “non-religious individuals’ reasoning about nature”. Analyses included participants who completed over 50% of the test items and passed at least 75% of the control items in each condition. An additional 40 participants did not meet these inclusion criteria (primarily in speeded conditions due to

the added cognitive load). All analyses were also run with the entire sample, including these dropped participants, and the same patterns of results were found. Participants were randomly assigned to one of four conditions in the Speeded Creation task: speeded being-made group ($n = 25$), unspeeded being-made group ($n = 48$), speeded human-made control group ($n = 28$) or unspeeded human-made control group ($n = 47$).

3.1.2. Design and procedure

The design and procedure were identical to Study 1.

3.2. Results

3.2.1. Speeded Creation task

We again compared test item endorsement across demographic variables and found no differences. However, we continued to include age as a control in the following analysis, given the effect observed in Study 1. We conducted a 2 (Culture: Study 1 US non-religious vs. Study 2 US atheist) \times 2 (Type: being-made group vs. human-made control group) \times 2 (Speed: speeded vs. unspeeded) \times 2 (Age: younger vs. older) ANOVA to compare patterns of test item endorsement between non-religious participants in Study 1 and atheist participants in Study 2 across groups and conditions. The analysis revealed main effects of Culture, ($F(1, 257) = 17.35$, $p < .001$, $\eta p^2 = .06$), Type, ($F(1, 257) = 27.50$, $p < .001$, $\eta p^2 = .10$) and Speed, ($F(1, 257) = 11.54$, $p < .01$, $\eta p^2 = .04$), that were subsumed by significant interactions between Culture and Type ($F(1, 257) = 7.12$, $p < .01$, $\eta p^2 = .03$) and between Speed and Type ($F(1, 257) = 4.80$, $p < .05$, $\eta p^2 = .02$.) There was also a significant interaction between Culture and Age ($F(1, 257) = 7.36$, $p < .01$, $\eta p^2 = .03$), which occurred due to the previously reported effect of age found in Study 1. However, no further effects of this variable were found in explaining participants’ endorsement of creation.

Further post hoc analyses revealed that US non-religious participants in Study 1 ($M = 22\%$, $SD = 32\%$) showed generally higher test item endorsement than highly motivated US atheists ($M = 5\%$, $SD = 15\%$) who were more able to suppress this tendency. However, this difference between the two groups of participants was more

marked in the being-made (US non-religious Study 1 $M = 30\%$, $SD = 36\%$ and US atheist Study 2 $M = 7\%$, $SD = 20\%$) than the human-made group, because both non-religious and atheist participants denied that nature is human-made (US non-religious, $M = 8\%$, $SD = 17\%$ and US atheist, $M = 2\%$, $SD = 3\%$). No three-way interaction between Culture, Speed and Type was found. Importantly, the absence of this interaction reveals that, even though the US atheists were better at inhibiting their tendency to endorse test items as created than Study 1's non-religious participants, the atheists were not immune to the effects of speed in the being-made group or able to completely suppress intuitions about purposeful creation. Instead, whether they were organized atheists or not, the speeded condition affected non-religious participants' responding in both Study 1 and Study 2 substantially more in the being-made group ($M_{diff} = 18\%$) than the human-made group ($M_{diff} = 3\%$; $F(1, 342) = 4.58$, $p < .05$, $\eta p^2 = .02$). (See Fig. 1 for the specific mean test item endorsement proportions in the being-made and human-made groups.)

To further confirm that atheists' tendency to endorse creation under speed in the being-made condition was not simply due to general response biases, confusion or inability to respond at speed, we conducted a 2 (Speed: unspeeded vs. speeded) \times 4 (Item Type: test items vs. no-bias controls vs. yes-bias controls vs. cognitive load items) repeated-measures ANOVA on test item endorsement and inaccurate control item performance in the being-made condition. This analysis revealed main effects of Speed, $F(1, 71) = 33.94$, $p < .001$, $\eta p^2 = .32$), and Item Type, $F(1.578, 112.011) = 6.27$, $p < .01$, $\eta p^2 = .08$), and a significant interaction between Speed and Item Type ($F(1.578, 112.011) = 4.39$, $p < .05$, $\eta p^2 = .06$). Participants did not experience difficulties in responding accurately on yes-bias controls ($M_{diff} = 0.01\%$), but speed impacted performance to some degree on both no-bias controls ($M_{diff} = 7\%$) and cognitive load items ($M_{diff} = 14\%$) along with test items ($M_{diff} = 13\%$). This echoes Study 1; despite heightened effort to give "no" responses, non-religious North Americans and highly motivated North American atheists experienced more difficulty suppressing a tendency to endorse creation for test items when placed under processing restrictions in the speeded being-made group. (See Table 1.)

Lastly, we again checked whether speeded effects on test item endorsement were limited to living things. Consistent with Study 1, a 2 (Test Item Type: living nature vs. non-living nature) \times 2 (Speed: unspeeded vs. speeded) repeated-measures ANOVA on test item endorsement did not reveal any significant interactions. Again, this indicates that speeded effects on test item endorsement were similarly driven by items representing both living and non-living natural phenomena (for the full results see Appendix B).

3.2.2. Predictors of creation endorsement in the Speeded Creation task

We performed a principal components analysis with Varimax (orthogonal) rotation. Individual difference variables loaded onto two primary factors similar to those found in Study 1. One encompassed belief in God or other explicitly religious beliefs (God factor), and a second involved beliefs pertaining to Nature's immanent agency

(Gaia factor). Both factors demonstrated acceptable internal consistency (God factor $\alpha = .76$ and Gaia factor $\alpha = .69$). Subsequently, we regressed participants' creation endorsement in each group onto the God and Gaia belief factors, as well as on their CINS scores. Speed was included as a control. Creation endorsement was significantly predicted by Speed and, as in Study 1, by the Gaia factor in the being-made group, ($R^2 = .178$, $F(4, 68) = 3.69$, $p < .01$). By contrast, in the human-made group only Speed significantly predicted participants' responding in this task, ($R^2 = .216$, $F(4, 70) = 4.83$, $p < .01$). (See Table 4.)

3.3. Discussion

Study 2 findings replicated those from Study 1: In Study 2, North American atheists also increased their tendency to endorse nature as purposefully made by some non-human being when judging natural entities under speeded conditions. Individual difference analyses also replicated the Study 1 finding that culturally secular agent-based beliefs strengthen creation endorsements. As in Study 1 – and in the absence of explicit God-beliefs – Gaia beliefs in Nature's and the Earth's intrinsic agency predicted a higher tendency to judge natural phenomena as purposefully created in Study 2. Study 2 also clarifies that the cultural membership of a participant does play a significant role in the inhibition of creation endorsement. However, interestingly, even though North American atheist participants in Study 2 showed significantly lower creation endorsement than North American non-religious participants in Study 1, they still demonstrated a tendency to increasingly default to a view of both living and non-living nature as purposefully created when forced to rely on automatic reasoning processes.

Results from Studies 1 and 2 provide significant support for the dual process hypothesis. In Study 3, however, we turned to address the further possibility that the effects we found were nation-specific. That is, despite the explicitly non-religious beliefs of the non-religious participants tested, our concern was that the high level of ambient theistic discourse present in the United States—given its widely recognized status as a Western religious exception (e.g., Kelemen, 2003; Putnam & Campbell, 2010; Smith, 2013)—might mean our results would not replicate elsewhere. To rule out the potential priming effect of North American theistic culture on even non-religious adults, we therefore repeated the study once more. However, this time our non-religious adult participants lived in Finland.

To be clear, religion is not absent in Finland (Eurobarometer, 2010, 2012). For example, even though Finnish adults generally show higher religious disbelief than adults in the United States overall (Ketola, Niemelä, Palmu, & Salomäki, 2011), a majority of the population still has nominal affiliation with the Lutheran National Church and most families elect that their children attend (non-confessional) religious education (Kumpulainen, 2012; Kääriäinen, Niemelä, & Ketola, 2005; Statistics Finland, 2014). However, for the purposes of the current study, Finland offers an interesting point of comparison to assess non-religious individuals in particular. That is because in Finland, as in all other Nordic countries (Iceland, Norway, Denmark, Sweden), being non-religious is a non-issue

(Taira, 2012; see also Zuckerman, 2008, 2012). That is, disbelief in God does not lead to marginalization from mainstream culture in the way that it does in the United States where religious disbelief is perceived as a rejection of one of the core foundational beliefs underpinning society, and theistic discourse is therefore more desired and frequent (Edgell, Gerteis, & Hartman, 2006; Gervais, 2014; Putnam & Campbell, 2010; Smith, 2013; see also Gentile, 2008). Thus, the third study explored whether non-religious individuals who live in a cultural environment where there is no normative expectation of religious belief and little ambient cultural scaffolding of theism via pronounced “God talk” (e.g., Putnam & Campbell, 2010), also showed a tendency to default to a view of nature as purposefully created when processing at speed.

4. Study 3

4.1. Method

4.1.1. Participants

The participants were 151 Finnish adults (65% female; $M = 26$ years, $SD = 9$ years) who were recruited via the email lists of student associations and organizations all around Finland. All participants were native Finnish speakers and had at least some college education. In order to compare the present results with findings from Studies 1 and 2, only individuals who showed explicit disbelief in the existence of a higher power, God or gods were included ($M = 1.3$, $SD = .44$ on a five-point scale, 1 = strongly disagree and 5 = strongly agree). Analyses included participants who completed over 50% of the test items and passed at least 75% of the control items in each condition. An additional 56 participants did not meet these inclusion criteria (primarily in speeded conditions due to the added cognitive load). All analyses were also run with the entire sample, including these dropped participants, and the same patterns of results were found. Participants were randomly assigned to one of four conditions in the Speeded Creation task: speeded being-made group ($n = 38$), unspeeded being-made group ($n = 49$), speeded human-made control group ($n = 26$) or unspeeded human-made control group ($n = 46$).

4.1.2. Design and procedure

The design and procedure were identical to Study 1 except that all study materials were in Finnish. Materials were translated by a fluent Finnish-English speaker and checked for accuracy by a native Finnish speaker.

4.2. Results

4.2.1. Speeded Creation task

We again compared test item endorsement across demographic variables and found no differences. However, as in Study 2, we continued to include age as a control in the following analysis, given the effect observed in Study 1. A 3 (Culture: Study 1 North American non-religious vs. Study 2 North American atheists vs. Study 3 Finnish non-religious) \times 2 (Type: being-made group vs. human-made group) \times 2 (Speed: speeded vs. unspeeded) \times (Age: younger

vs. older) ANOVA was conducted to compare the patterns of test item endorsement by non-religious participants across all studies, conditions and groups. Similarly to Study 2, the analysis revealed main effects of Culture, ($F(2, 400) = 9.70$, $p < .001$, $\eta^2 = .05$), Type, ($F(1, 400) = 37.64$, $p < .001$, $\eta^2 = .09$) and Speed, ($F(1, 400) = 15.43$, $p < .001$, $\eta^2 = .04$), that were subsumed by significant interactions between Culture and Type ($F(2, 400) = 4.17$, $p < .05$, $\eta^2 = .02$), and between Speed and Type ($F(1, 400) = 5.08$, $p < .05$, $\eta^2 = .01$). An interaction between Culture and Age ($F(1, 400) = 4.85$, $p < .01$, $\eta^2 = .02$), was also found, but, once again, was attributable to the previously reported difference between younger and older participants in Study 1 and is therefore not considered further here.

The effects occurred because although non-religious participants in all three studies endorsed test items more in the being-made group and denied human involvement in the origination of nature (Study 1 human-made group $M = 8\%$, $SD = 17\%$; Study 2 human-made group $M = 2\%$, $SD = 4\%$; Study 3 human-made group $M = 4\%$, $SD = 5\%$), different groups of non-religious participants showed somewhat different levels of creation endorsement in the being-made group (see Fig. 1). Namely, the non-religious North American participants in Study 1 showed a significantly higher tendency to endorse test items ($M = 22\%$, $SD = 32\%$) than the US atheists in Study 2 ($M = 5\%$, $SD = 15\%$), whereas the Finnish non-religious participants in Study 3 ($M = 11\%$, $SD = 21\%$) did not differ from either of the other groups in their level of overall test item endorsement. Furthermore, participants in all three cultural groups were affected by the speeded conditions particularly in the being-made group ($M_{diff} = 16\%$), rather than the human-made group ($M_{diff} = 4\%$). This finding, as well as the lack of a three-way interaction between Culture, Speed, and Type replicate findings from Study 2 and indicate that although some non-religious groups (US atheists and Finnish non-religious) were able to suppress it more than others (US non-religious), all groups of non-religious participants in the being-made speeded condition tended to increasingly default to creation endorsement when forced to rely on their automatic gut reactions. (See Fig. 1.)

Next we explored Finnish participants' control item performance, with a 2 (Speed: unspeeded vs. speeded) \times 4 (Item Type: test items vs. no-bias controls vs. yes-bias controls vs. cognitive load items) repeated-measures ANOVA on test item endorsement and inaccurate control item performance in the being-made condition. The analysis revealed that overall test-item endorsement and control-item inaccuracy were higher under speeded conditions, ($F(1, 80) = 12.87$, $p < .01$, $\eta^2 = .14$). Pairwise comparisons indicated that participants' responding was significantly higher on the test items ($M = 17\%$, $SD = 26\%$) compared to the cognitive load items ($M = 7\%$, $SD = 15\%$), no-bias controls ($M = 3\%$, $SD = 7\%$) and yes-bias controls ($M = 1\%$, $SD = 3\%$; $F(1, 532, 122.541) = 18.63$, $p < .001$, $\eta^2 = .19$). There was no significant interaction between Speed and Item Type. (See Table 1.)

Finally, we again checked whether speeded effects were driven solely by endorsement of living things. A 2 (Test Item Type: living nature vs. non-living nature) \times 2 (Speed: unspeeded vs. speeded) repeated-measures ANOVA indicated that, as in Studies 1 and 2, there were

no significant interactions: speeded effects occurred for both living and non-living natural phenomena (for full results see [Appendix B](#)).

4.2.2. Predictors of the creation endorsement in the Speeded Creation task

We again performed a principal components analysis with Varimax (orthogonal) rotation. Individual difference variables loaded onto two primary factors similar to those found in Study 1 and 2. One encompassed belief in God or other explicitly religious beliefs (God factor), and a second involved beliefs pertaining to Nature's immanent agency (Gaia factor). Both factors demonstrated acceptable internal consistency (God factor $\alpha = .75$ and Gaia factor $\alpha = .65$). Subsequently, we regressed participants' creation endorsement in each group onto the God and Gaia belief factors, as well as on their CINS scores. In the being-made group, creation endorsement was significantly predicted by the Gaia factor, ($R^2 = .201$, $F(4, 77) = 4.84$, $p < .01$) and marginally also by Speed. By contrast, in the human-made group, only Speed was a significant predictor ($R^2 = .291$, $F(4, 64) = 6.57$, $p < .001$.) (See [Table 4](#).)

Study 3 therefore presented yet another replication of the finding that beliefs in Nature's immanent agency – beliefs that are not generally culturally understood or labeled as religious – predict creation endorsement, a consistent finding that importantly motivated one further analysis. Across all three studies, the definition of “non-religiosity” required that individuals' displayed explicit disbelief in any kind of higher power, God or gods – a definition based especially on Abrahamic religions and closely related formal religious belief systems. Nevertheless, the consistent predictive power of agent-based Gaia beliefs suggested that a more stringent definition of disbeliever might be relevant – one also excluding individuals endorsing the immanent supernatural agency of Nature or the Earth (i.e. Gaia factor). In a final analysis of all three studies, this stringent definition of non-religiosity was adopted to see whether the bias to default to endorsing creation was still present even when participants denied any kind of extrinsic or intrinsic agency in nature.

4.2.3. Secular agency disbelievers' creation endorsement

Only non-religious individuals were included in these analyses. Thus, in order to be categorized further as a “secular agency disbeliever”, individuals had to disagree (rate themselves 2 or lower in each belief on a scale 1 = strongly disagree and 5 = strongly agree) with all of the personal beliefs that loaded both onto the God and Gaia factors (see [Table 3](#)). Among the non-religious participants, there were 138 secular agency disbelievers (Study 1 $n = 17$, Study 2 $n = 74$, Study 3 $n = 47$) and 296 secular agency believers (Study 1 $n = 110$, Study 2 $n = 74$, Study 3 $n = 112$).

To explore whether the bias to endorse creation still emerged even when strictly controlling for beliefs in intrinsic agency, we conducted a 3 (Culture: Study 1 vs. Study 2 vs. Study 3) \times 2 (Type: test vs. human-made) \times 2 (Belief: believers vs. disbelievers) \times 2 (Speed: unspeeded vs. speeded) ANOVA. Because the same cultural groups were tested in this analysis as in the previous ANOVA, the same main effect of Culture was found, ($F(2, 400) = 3.05$, $p < .05$,

$\eta p^2 = .02$), showing that overall US non-religious participants in Study 1 ($M = 22\%$, $SD = 32\%$) endorsed test items significantly more than US atheists in Study 2 ($M = 5\%$, $SD = 15\%$), but that non-religious Finnish did not significantly differ from either of the other groups ($M = 11\%$, $SD = 21\%$). The analysis also revealed main effects of Type, ($F(1, 400) = 15.11$, $p < .001$, $\eta p^2 = .04$), Belief, ($F(1, 400) = 8.23$, $p < .01$, $\eta p^2 = .02$) and Speed, ($F(1, 400) = 10.02$, $p < .01$, $\eta p^2 = .02$), that were subsumed by significant interactions between Belief and Type, ($F(1, 400) = 4.38$, $p < .05$, $\eta p^2 = .01$) and a marginal interaction between Speed and Type, ($F(1, 400) = 3.64$, $p = .057$, $\eta p^2 = .01$). These effects occurred because secular agency believers showed a generally higher level of creation endorsement than disbelievers, especially in the being-made group, (believers being-made group $M = 23\%$, $SD = 33\%$; disbelievers being-made group $M = 7\%$, $SD = 14\%$) and the difference in their tendency to endorse creation in the being-made vs. human-made groups was far stronger (believers $M_{diff} = 18\%$, disbelievers $M_{diff} = 4\%$). However, the analysis revealed no three-way interaction, indicating that both secular agency believers and disbelievers were affected by the speeded condition particularly when judging items in the being-made group (secular agency believers $M_{diff} = 16\%$, secular agency disbelievers $M_{diff} = 12\%$) in comparison to the human-made group (secular agency believers $M_{diff} = 4\%$, secular agency disbelievers $M_{diff} = 3\%$). In short, both secular agency believers and disbelievers in all studies were more likely to assess nature as “purposefully made by some being” when forced to respond at speed. (See [Fig. 2](#).)

4.3. Discussion

Consistent with Study 1 and Study 2, Study 3 revealed that non-religious participants in Nordic Finland, where non-religiosity is not an issue and where theistic cultural discourse is not present in the way it is in the United States, default to viewing both living and non-living natural phenomena as purposefully made by a non-human being when their processing is restricted. Interestingly, comparisons across the different groups of non-religious participants in all three studies showed that, despite the absence of prominent theistic cultural discourse, non-religious Finnish participants were more likely than North American atheists to fail in suppressing their overall level of creation endorsement. This pattern of results shows that ambient theistic cultural discourse is therefore not the only factor that explains people's tendency to endorse purposeful creation in nature.

Additionally, in further support of the conclusion that there is a natural human bias to construe nature as designed, after repeatedly confirming that Gaia beliefs strengthen individuals' tendencies to view nature as created, in our final analysis we controlled for both God beliefs that are explicitly regarded as religious and Gaia beliefs that are not generally culturally conceptualized as supernatural commitments. The findings of this stringent analysis indicated that even secular agency disbelievers – individuals who explicitly reject ideas of any external or intrinsic agency in nature – were not able to simply and

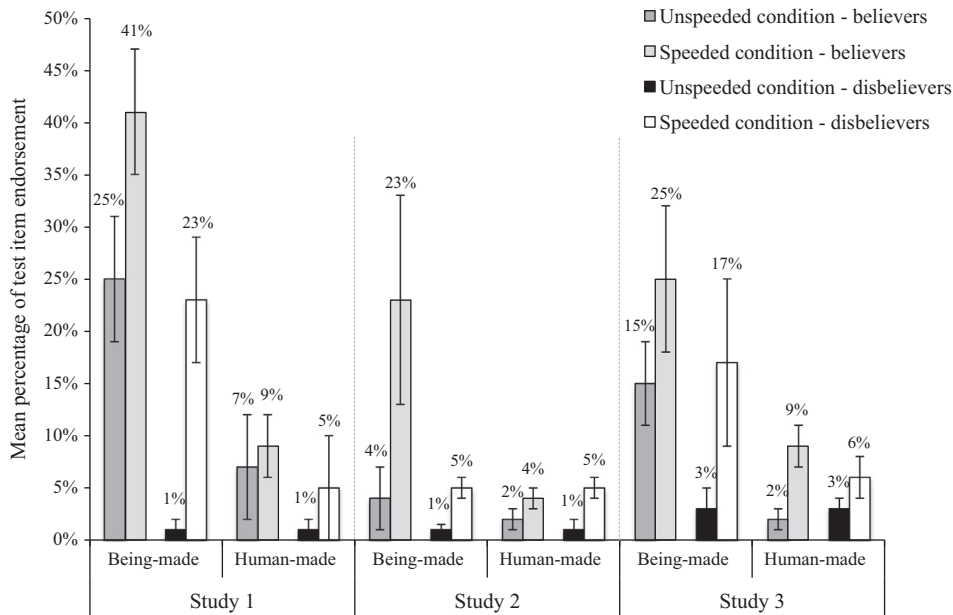


Fig. 2. Mean percentage of test item endorsement in being-made and human-made groups by secular agency believers and disbelievers in Study 1, Study 2 and Study 3.

consistently negate the purposeful creation of nature when deprived of time to reflect.

5. General discussion

The current three studies assessed the roles of cognition and culture in adults' recurrent and persistent tendency to view living and non-living natural phenomena as intentionally created. Across all three studies support was found for the dual process hypothesis (e.g., Atran, 2002; Barrett, 2000; Baumard & Boyer, 2013; Bloom, 2007; Boyer, 1994, 2002 [2001]; Kelemen, 2004; Pyysiäinen, 2001) rather than the cultural exposure hypothesis (e.g., Alters & Nelson, 2002; Miller et al., 2006; see also Corriveau et al., 2014). Specifically, regardless of their explicit disavowal of belief in supernatural agents (Study 1), minority identity as organized atheists within a religiously exceptional culture (Study 2), or their membership in a secularized culture in which ambient cultural "God talk" is generally absent (Study 3), people increasingly defaulted to construing nature as "purposefully made by some being" when they did not have time to reflect.

Across the three studies, control trials and control conditions also served to rule out alternative interpretations of these effects. The distinct pattern of test item endorsement occurred even though control and cognitive load item performance revealed that non-religious participants, in particular, were using a "no-bias" response strategy. Similarly, the results from the human-made control group repeatedly showed that people did not endorse just any kind of agency; indeed, human creation of nature was consistently negated even under speeded conditions in each study. This pattern of results further confirms that findings in the being-made group were therefore not due to a general "yes-bias" under cognitive load, or an indiscriminate

tendency to endorse intentional agency regardless of origin (see Rosset, 2008). This latter finding is relevant from a theoretical standpoint. Consistent with previous developmental findings (e.g., Gelman & Kremer, 1991; Kelemen & DiYanni, 2005), this difference between the being-made and human-made groups lends support to the idea that adults' endorsement of nature-as-created does not simply reflect Piagetian artificialism or anthropomorphism (Piaget, 1971 [1929]; also Evans, 2000, 2001; Guthrie, 1993; Waytz, Epley, & Cacioppo, 2010a; cf. Barrett, 2012; Kelemen, 2004) but a tendency to assess the natural environment in terms of more abstract non-human agency.

These results are highly relevant to research on both religion and atheism or non-religiosity. They lend empirical support to the proposal that religious non-belief is cognitively effortful (e.g., Barrett, 2004, 2012; Bering, 2010; McCauley, 2000; McCauley, 2011; Norenzayan & Gervais, 2012). These results also help clarify prior empirical findings, which link intuitive reasoning and religious beliefs (e.g., Gervais & Norenzayan, 2012; Kelemen et al., 2013; Lindeman & Aarnio, 2006; Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Shenhav, Rand, & Greene, 2011; Svedholm & Lindeman, 2012). They suggest that even though people are able to inhibit spontaneous gut feelings and abandon them as guiding principles in reflective reasoning, this does not lead to a complete conceptual change at a more spontaneous or automatic level of cognitive processing (see also e.g., Bloom & Weisberg, 2007; Emmons & Kelemen, 2014; Kelemen, 2004; Legare et al., 2012; Shtulman & Valcarel, 2012).

In addition to suggesting a deep-seated automatic tendency to see intentional causation in nature, current findings, which clarify the predictive role of not only God but also Gaia beliefs, are helpful in revising and specifying the explicit or cultural expression of this "naked intuition"

(Bering, 2010). Namely, the current results show that the increased tendency to see creation in nature is not simply reduced to Abrahamic god beliefs (e.g., Evans, 2008; Evans & Lane, 2011; Poling & Evans, 2004). Beliefs in Nature's and the Earth's intrinsic agency—which are generally overlooked—also play a significant and independent role (see also Kelemen & Rosset, 2009; Kelemen et al., 2013 in the context of teleological reasoning). Notably, this was the case even among US atheists who very explicitly self-identified as non-religious, showing that despite cultural characterizations of certain concepts as secular rather than religious, various kinds of agent-based beliefs are relevant to understanding the source of the human tendency to understand nature as created.

The current results therefore also serve as a reminder that supernatural reasoning encompasses far more than Abrahamic god belief; explicit references to culturally recognized supernatural agents, such as “God” or “gods”, (e.g., Haught, 2003; Norenzayan & Gervais, 2013), are not enough to reliably capture the range of supernatural conceptions people possess (also Boyer, 2002 [2001]; Lanman, 2012; Wildman, Sosis, & McNamara, 2012). As a result, true non-belief may be even rarer among adults than previously suggested (see also Barrett, 2012; Bering, 2010). For example, in our own follow-up research, preliminary findings suggest that, across cultures, finding secular individuals who reject any kind of supernatural agency in nature is difficult and is even more pronounced, for example, in China (Järnefelt et al., 2015; also e.g., Yang & Hu, 2012; Zuckerman, 2007), which is often characterized as a seat of atheism. In addition to re-assessing the range of beliefs and disbeliefs that constitute religious ideas, and expanding the database to include groups besides the relatively highly educated adults studied here and in most psychological studies, more research is needed in order to assess the cognitive consequences of an even wider array of agent-based conceptions, such as aliens, ghosts, luck, fate, destiny and chance, as well as the role of animism and folk religion in various cross-cultural contexts (e.g., Anttonen, 2003–2004; Barrett, 2012; Boyer, 2002 [2001]; Guthrie, 1993; Harvey, 2008; Hood, 2009; Närvä, 2008; see also e.g., Aarnio & Lindeman, 2007; Banerjee & Bloom, 2014; Norenzayan & Lee, 2010; Wilson, Bulbulia, & Sibley, 2013).

In addition to research on religious belief and disbelief, the current findings also have implications for science education. Specifically, it has long been known that most people misunderstand natural selection, absorbing newly learned scientific information into existing intuitive and scientifically inaccurate explanatory belief systems (e.g., Gregory, 2009; Kelemen, 2012; Nehm & Reilly, 2007; Shtulman, 2006; also Lombrozo, Thanukos, & Weisberg, 2008). The current results shed further light on why people's misconceptions so often take a particular shape. For example, natural selection is often understood as a quasi-intentional designing force that gives animals the functional traits that they need in order to survive (e.g., Blancke et al., 2014; Kelemen, 2012; Moore et al., 2002). The present results converge with prior research suggesting that the roots of these scientifically inaccurate teleological and design-based intuitions run deep, persisting even in

those with no explicit religious commitments and, indeed, even among those with an active aversion to them.

The findings also present challenges to claims that teleological need-based reasoning has a non-agentive character that means it is an unproblematic conceptual bridge in a process of theory revision from an intuitive creation-based theory of natural origins to one based on non-intentional evolutionary processes (Evans & Lane, 2011; Keil, 2011; Legare, Lane, & Evans, 2013). Specifically, factor analyses across all of the current studies confirmed that need-based teleological ideas (e.g. “I believe that Nature responds to the needs of animals to help them survive”) consistently loaded as part of the Gaia factor and as such represent an agentive - and probably intentional - view of nature, rather than a mechanistic one. Furthermore, such need-based ideas were also consistently strongly positively correlated with a failure to understand natural selection (CINS scores).

In closing, the current findings suggest that there is a deeply rooted natural tendency to view nature as designed. However, many questions remain regarding possible connections between these early developing design intuitions (e.g., Kelemen, 2004; Kelemen & Carey, 2007; Ma & Xu, 2013; Newman, Keil, Kuhlmeier, & Wynn, 2010) and related capacities for agency-detection (Barrett, 2000; Barrett, 2004; Barrett, 2012; Guthrie, 1993; see also e.g., Blackmore & Moore, 1994; Rieki, Lindeman, Alenoff, Halme, & Nuortimo, 2013; Van Elk, 2013; Van Elk, Rutjens, Van der Pligt & Van Harreveld, 2014), as well as higher-order Theory of Mind-related capacities (e.g. empathy, metacognition). For example, Theory of Mind abilities are often identified as a primary source of formal religious god beliefs (e.g., Atran 2002; Atran & Norenzayan, 2004; Evans, 2008; Evans & Lane, 2011; Legare et al., 2013; Norenzayan et al., 2012; Waytz, Gray, Epley, & Wegner, 2010b; Willard & Norenzayan, 2013). This connection seems reasonable given the role that higher order mindreading abilities might be expected to play in the effective transmission of socially desirable, reflective, cultural ideas (e.g., Baron-Cohen & Wheelwright, 2004; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004). However, the role of higher order TOM in promoting the kinds of automatic design-based intuitions studied here remains unclear as does the role of artifact cognition – another hypothesized, and potentially more likely, source of spontaneous design intuitions (Järnefelt, 2013; Kelemen, 2004). Future research will further explore the role of these capacities in the default tendency to view nature as purposefully created.

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Appendix A

Full Instructions to the Speeded Creation task (Speeded Being-Made Condition).

In this task you will see pictures of different kinds of things. You will also see colorful shapes.

When you see a picture of a thing, your task is to identify if any being purposefully created the item at some point in time or whether the item (or a precursor) just happened and was therefore not made by any being. That is, when prompted to give a response, please consider the question "did any being purposefully make this", and respond either "YES" or "NO".

It is important for you to note that by using the term "being" we are deliberately non-specific. For us, "being" might refer to any kind of being who makes things deliberately. Some possibilities that you might draw upon are: A human, Mother Nature, an alien, an animal, God, a mystical power, a spiritual force, etc.

For our purposes, the specific identity of the "being" is unimportant and can vary across items so please do not feel restricted to considering only one kind of being (e.g. human) for everything. Thus, for some items, you might think the "being" is a human, for other items an animal and for others that it is a more abstract higher power. Regardless of who/what it is, all that matters is that you judge whether ANY kind of being was involved. That is, please consider whether some being/any being made the item (or its precursors) or not.

Please respond using the computer keyboard:

In your opinion, did any being purposefully make the thing in the picture? YES or NO. Sometimes only a colorful shape appears. If so, please always press NO.

On the computer keyboard²:

If YES press letter D.

If NO press letter J.

You will have very limited time to evaluate the thing in the picture. Be alert because the pictures will change quickly.³

This is not a test of knowledge. We are not interested in whether the answers are right or wrong – we are simply interested in your thinking about the origins of the items we present.

As a final clarification, please do not assess if the picture was manipulated or photo-shopped. We are interested in your opinion about the thing depicted in the picture, not the picture itself.

You will first receive eight practice trials so you can get a feel for the task. In the main task, you will also get a break after every 24 items.

If you are ready to proceed to the practice phase, please press the SPACE bar.

PLEASE REMEMBER TO ANSWER AS QUICKLY AS YOU CAN.

Appendix B

Analysis of variance for responses to living and nonliving test items in being-made groups in Study 1, Study 2 and Study 3.

	df	F	ηp^2	p
Study 1				
Between subjects				
Speed	1	8.698	.038	<.01
Belief	1	65.952	.231	<.001
Speed × belief	1	.003	.000	.959
Error	220			
Within subjects				
Test item type	1	21.929	.091	<.001
Test item type × speed	1	.955	.004	.330
Test item type × belief	1	1.461	.007	.228
Test item type × speed × belief	1	2.377	.011	.125
Error	220			
Study 2				
Between subjects				
Speed	1	7.856	.100	<.01
Error	71			
Within subjects				
Test item type	1	2.340	.032	.131
Test item × speed	1	.200	.003	.656
Error	71			
Study 3				
Between subjects				
Speed	1	4.063	.046	<.05
Error	85			
Within subjects				
Test item type	1	12.258	.126	<.01
Test item × speed	1	1.475	.017	.228
Error	85			

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² The order the keys was counterbalanced.

³ In contrast, in the unsped condition participants were instructed to think long and carefully which option to choose.

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