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Cultural influences on the teleological stance: evidence from China

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ABSTRACT

Recent research has suggested that humans have a robust tendency to default to teleological (i.e., purpose-based) explanations of natural phenomena. However, because samples have previously been heavily drawn from Western cultures, it is unclear whether this is a universal cognitive bias or whether prior findings are a product of Western philosophical and theological traditions. We evaluated these possibilities by administering a speeded judgment task to adults in China – a country that underwent nearly 40 years of institutionally enforced atheism in the Maoist era and which has markedly different cultural beliefs than those found in Western societies. Results indicated that Chinese adults, like Western adults, have a propensity to favor scientifically unwarranted teleological explanations under processing constraints. However, results also yielded suggestive evidence that Chinese culture may attenuate baseline tendencies to be teleological. Overall, this study provides the strongest evidence to date of the cross-cultural robustness of a teleological explanatory bias.

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1. Introduction

Western philosophers and Christian theologians have long endorsed the idea that natural phenomena can be accounted for by reference to a putative function – believing, for example, that water exists *so that* life can survive on Earth. This "teleological" (i.e., purpose-based) framework is pervasive both in scholarly writings and in everyday discourse, often being prioritized over mechanistic explanations that refer to antecedent physical causes (e.g., Aristotle, c. 350 B.C./2008). Even despite modern advances in scientific understanding, most prominently the advent of evolutionary theory, scientifically unwarranted teleological explanations remain rampant in Western thought (see Kelemen, 2012). In this article, we explore whether the ubiquity and frequent privileging of teleological explanation is primarily a legacy of the metaphysical claims embedded in much of Western culture or whether it additionally reflects something deeper about the natural structure of the human mind. Might a bias in favor of widespread purpose-based explanations be a universally developing aspect of human nature? If so, it should be detectable in a disparate cultural setting – for example in China, a society with radically different philosophical, religious, and historical traditions.

Results from a growing body of research support the hypothesis that a teleological bias is a reliably emerging and resilient feature of the human mind (e.g., Banerjee & Bloom, 2014; Barrett, 2012; Bering, 2011; Bloom, 2007; Kelemen, 1999a, 2004; Kelemen, Rottman, & Seston, 2013; Mills & Frowley,

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2015). Young children (DiYanni & Kelemen, 2005; Kelemen, 1999b, 1999c, 2003; Kelemen & DiYanni, 2005; Sánchez Tapia et al., in press), Roma adults without formal schooling (Casler & Kelemen, 2008), and Alzheimer's patients with degraded conceptual knowledge (Lombrozo, Kelemen, & Zaitchik, 2007), all show broad biases to explain living and non-living natural phenomena in purpose-based terms. Furthermore, this tendency is not restricted to people who have limited knowledge of detailed mechanistic explanations of natural objects and events, but can also be revealed in highly educated adults. In one study, undergraduates and university professors living in the United States were asked to evaluate scientifically inaccurate teleological explanations, either under highly speeded conditions or with no time limits. Because speeded responding interrupts careful cognitive processing and inhibitory control, it is thought to expose default cognitive biases (e.g., Evans & Curtis-Holmes, 2005; also see Goldberg & Thompson-Schill, 2009; Shtulman & Valcarcel, 2012). Results of this study showed that college students, scientists (physicists, chemists, and geologists), and humanities professors all became markedly more prone to endorse unscientific teleological statements when responding under time pressure, an effect that was not matched in their responses to control items (Kelemen et al., 2013). American adults therefore appear to have a deep-seated tendency to construe natural phenomena as purpose driven, even when they have been extensively scientifically trained to endorse mechanistic, rather than teleological, explanations of nature. This finding is robust; despite one failure to replicate (Rottman, Greenway, Rose, Finke, & Kelemen, unpublished data), the effect has been demonstrated in multiple additional samples of American (Kelemen & Rosset, 2009) and Irish (Mills & Frowley, 2015) participants.

This overall body of evidence is consistent with the hypothesis that a teleological stance is a naturally emerging human universal. However, one issue is that these prior studies have been almost exclusively conducted in Westernized Judeo-Christian societies. Because intuitions are shaped by culturally transmitted information in addition to evolutionary processes, it is plausible that participants in these studies could possess internalized teleological biases from having been immersed in societies with extensive discourse invoking teleological explanations. For this reason, assertions about cognitive universals cannot be made confidently without cross-cultural data (Coley, 2000; Heine & Norenzayan, 2006). Existing evidence from the religiously polarized cultural context of Israel has found that, compared to orthodox Jewish children, secular Jewish children have markedly reduced tendencies to extend a teleological framework to animal and human categories (Diesendruck & Haber, 2009). This finding suggests that culture may indeed attenuate inclinations to default to teleological explanations. In the single non-Western context in which teleological intuitions have been examined (that of indigenous Quechua-speaking Peruvians), the participant population was chosen because it was hypothesized to foster *elevated* levels of scientifically unwarranted forms of teleological reasoning due to greater religiosity, less formal education, and an agricultural lifestyle – a prediction that was borne out by the data (Sánchez Tapia et al., in press; also see Gelman, Mannheim, Escalante, & Sánchez Tapia, in press). Therefore, further research is necessary to more broadly determine the cross-cultural robustness of the teleological bias and the extent to which cultural factors influence its manifestation. While a strong assertion of universality cannot be gleaned from the results of any single study and will require many years of comprehensive investigations in numerous cultural settings around the world, the present research represents a significant step in this direction by studying adult teleological thinking in a society that is highly distinct from the Western cultural groups in which a teleological bias has been previously documented.

There are several reasons to believe that patterns of culturally widespread information in Western countries such as the United States could robustly impact the expression of the teleological bias. Most prominently, cultural worldviews regarding the existence of an omnipotent creator god could enhance lifelong tendencies to attribute intentional causes to natural phenomena and, in turn, to treat natural kinds as artifact-like and endowed with a purpose. From infancy, the presence of order and design is tightly linked to inferences about intentional agency (Ma & Xu, 2013; Newman, Keil, Kuhlmeier, & Wynn, 2010), and young children often demonstrate a propensity to believe that supernatural beings are responsible for the origins of natural kinds (Evans, 2001; Gelman & Kremer,

1991; Petrovich, 1997). Even by early childhood, beliefs in a creator god are related to beliefs that natural entities are intentionally designed for a purpose (Diesendruck & Haber, 2009; Kelemen & DiYanni, 2005). It is therefore possible that the cultural endorsement of a powerful creator god is largely responsible for initiating a widespread bias to interpret all phenomena teleologically (Banerjee & Bloom, 2013; Geertz & Markússon, 2010; Gervais, Willard, Norenzayan, & Henrich, 2011; Harris & Koenig, 2006; Rottman & Kelemen, 2012).

In order to investigate whether cultural input substantially contributes to the teleological bias, it is crucial to conduct research in a society with minimal "God-talk" (Tickle, 1997). The present study investigated whether a default teleological stance is evident in Chinese adults, as China is officially an atheist nation and is arguably one of the least explicitly theistic societies in the world. A recent poll has found that 81.5% of Chinese people claim to lack religious belief, 75.2% deny the existence of supernatural agents, 83.9% believe that the afterlife does not exist, and 87.8% have never prayed to a supernatural power (Association of Religion Data Archives, 2007; also see WIN-Gallup International, 2012). These data contrast starkly with polls taken in the United States, for example, which have shown that the majority of Americans (61%) feel certain that God exists (Smith, 2012). Although the extent to which China is truly a non-theistic country is controversial, such that Chinese culture may foster religious tendencies to a greater extent than Western scholars have often supposed (Adler, 2005; Stark & Liu, 2011; Yang, 2004),[1] an anti-religious cultural narrative remains strong in Chinese schools and universities. Therefore, if a teleological bias is culturally constructed from religious discourse about divinely created natural phenomena, it should be dramatically reduced in educated Chinese individuals.

China is an ideal country in which to explore the universality of the teleological bias for other reasons as well. First, unlike other highly secular countries like Denmark and Sweden (Zuckerman, 2008), which share Greek and Abrahamic philosophical traditions with the other Western societies in which the teleological bias has previously been uncovered, China has an intellectual inheritance that is primarily rooted in Confucianism, Daoism, Mohism, Legalism, and Buddhism.[2] Second, in contrast to the categorical classification tendencies in the United States and other Western societies, Chinese adults tend to engage in relational classifications of organisms (Markus & Kitayama, 1991; Nisbett, 2003), for example grouping monkeys with functionally relevant foods (bananas) rather than with categorically similar animals (pandas) as is the case for American adults (Ji, Zhang, & Nisbett, 2004). This marked relational approach is relevant in light of recent theorizing about the conceptual origin of the teleological bias. Specifically, in contrast to views that characterize the teleological bias as either a basic cognitive tendency (Atran, 1995; Keil, 1992; Lombrozo & Carey, 2006) or one derived from more fundamental intentionality biases (Kelemen, 2004; Kelemen et al., 2013; also see Banerjee & Bloom, 2014; Willard & Norenzayan, 2013), a recent theoretical account of the teleological bias – the "relational-deictic" hypothesis – has posited that the widespread appeal of teleological explanations stems from the emphasis that teleological explanations place on the inherent interconnectedness of various entities in the world (ojalehto, Waxman, & Medin, 2013). For example, when explaining why earthworms tunnel underground, teleological explanations (e.g., "in order to aerate the soil") inherently appeal to the interdependent relationships between earthworms and the dirt in which they live, whereas causal explanations (e.g., "because they move toward moisture and nourishment") tend to be asocial and individualistic. China therefore presents an optimal society in which to explore the teleological bias because the strong cultural emphasis on connectedness and collectivism supports a prediction that relational Chinese adults should be more teleological than individualistic Americans.

In order to investigate the cross-cultural appeal of scientifically unwarranted teleological statements about natural phenomena, Chinese adults were presented with a speeded judgment task that has previously revealed a default tendency in Westerners to more strongly favor purpose-based explanations upon being placed under processing constraints (Kelemen & Rosset, 2009; Kelemen et al., 2013; Mills & Frowley, 2015). If a teleological bias is a universally intuitive explanatory stance (Keil, 1992; Kelemen, 2003, 2004; Lombrozo & Carey, 2006; Lombrozo et al., 2007), then

an increase in the endorsement of teleological explanations under speeded conditions should be observed in China, despite the geographical and historical gaps that separate it from Western countries and the disparate worldview of its inhabitants. However, if a teleological bias is contingent upon the cultural endorsement of a creator god, then atheistic tendencies in China should lead to muted endorsements of teleological ideas under both explicit unspeeded conditions and implicit speeded conditions. Conversely, if a teleological bias is derived from relational reasoning, then cultural differences in emphases on relatedness predict that Chinese adults should manifest heightened tendencies to endorse teleological explanations even under unspeeded conditions.

2. Methods

2.1. Participants

Chinese students ($N = 105$, 52 female, $M_{age} = 22.5$, $SD = 1.7$) from Beijing Forestry University and Beihang University participated in the study at the Chinese Academy of Sciences in Beijing. Participants were randomly assigned to a speeded or unspeeded condition.[3]

2.2. Materials and procedure

The procedure was identical to that of Kelemen et al. (2013). However, all measures were presented in Mandarin. In the speeded judgment task, participants were presented with 100 sentences (30 test and 70 control sentences) that explained "why things happen." These explanations were presented consecutively on a laptop with PsyScope software (Cohen, MacWhinney, Flatt, & Provost, 1993). Participants were instructed to judge each sentence as being "true" or "false" by pressing one of two labeled response keys on the keyboard. Test sentences presented false (i.e., scientifically inaccurate) teleological explanations for natural phenomena (e.g., "Trees produce oxygen so that animals can breathe"). Control sentences consisted of 20 true causal explanations of natural phenomena, 30 false causal explanations of natural phenomena, 10 true teleological explanations of human intentions or artifact functions, and 10 false teleological explanations of human intentions or artifact functions (see Table 1 for examples; for a full list, including translations, see Table S1 in the online supplementary materials). Control sentences were matched to test sentences for reading time in Mandarin, and they therefore provided a measurement of participants' abilities to accurately judge explanations under speeded conditions.

Sentences were presented in 10 ten-sentence blocks that each contained a randomized assortment of three test items and seven control items, with a three-second pause after each block. Two unanalyzed blocks of practice sentences were additionally included at the beginning of the task to allow speeded participants to become accustomed to the allotted response time. Participants in the speeded

Table 1. Examples of test and control items.

Sentence Type	Item (correct answer in parentheses)	Chinese Translation
Test	Birds transfer seeds in order to help plants germinate. (false)	鸟类传播种子是为了帮助植物发芽。
	Germs mutate in order to become drug resistant. (false)	病菌变异是为了变得具有抗药性。
	Moss forms around rocks in order to stop soil erosion. (false)	苔藓长在岩石周围是为了防止土壤侵蚀。
	The Earth has an ozone layer in order to protect it from UV light. (false)	地球有一层臭氧是为了保护地球不受紫外线伤害。
Control	Women put on perfume in order to smell pleasant. (true)	女人喷香水是为了闻起来很香。
	People chew food in order to strengthen their jaw muscles. (false)	人们咀嚼食物是为了增强他们的咀嚼肌。
	Soda fizzes because carbon dioxide gas is released. (true)	汽水起泡是因为二氧化碳气体被释放。
	Oceans have waves because they contain a lot of saltwater. (false)	海洋中有波浪因为其含有大量的咸水。

condition were allowed a maximum of 5.3 seconds to respond (two standard deviations above the average reading time for Chinese pilot participants, which was determined to provide just enough time to comprehend each sentence and provide a response). If participants did not press a key within this time, the stimulus progressed automatically. In the unspeeded condition, participants were allowed an unlimited amount of time to respond.

Several additional measures were included to explore individual differences in responses on the speeded judgment task. First, because a tacit teleological bias may be effortfully suppressed by scientifically valid modes of reasoning (Kelemen & Rosset, 2009), we presented participants with the classic Stroop color task (Stroop, 1935) with Mandarin color words in order to measure individual differences in the ability to inhibit prepotent responses (for sample items, see Table S2 in the online supplementary materials). Next, participants completed translated versions of the Conceptual Inventory of Natural Selection (Anderson, Fisher, & Norman, 2002) and the Geoscience Concept Inventory (Libarkin & Anderson, 2006) in order to assess whether stronger scientific content knowledge weakens the teleological bias. Additionally, because a primary rationale for testing Chinese participants was their ostensibly lower level of religiosity, we measured beliefs in supernatural agents, asking participants to rate their agreement with the statement: "I believe in the existence of god(s)" ("我相信神的存在"). The general and encompassing word "神" ("shen") was used because many Eastern religions are polytheistic and because this phrasing allows for endorsement by both polytheists and monotheists. Finally, participants rated their agreement to two statements assessing agent-based "Gaia" beliefs in Mother Nature.[4]

All stimuli underwent several rounds of translation, back-translation, and discussion by bilingual translators in the United States and China who were blind to the hypotheses of the study. After data collection, a discussion with an additional expert caused us to become concerned about the potential for ambiguous translations of some items (e.g., for the "Gaia" item measuring belief in "Nature as a powerful being"). We therefore convened a further panel of bilingual, bicultural translators who were also blind to the hypotheses of the study. On the basis of their extensive discussions, several items were excluded from analyses for having ambiguous translations. Excluded items were three (out of 30) experimental items and eight (out of 70) control items from the speeded judgment task, six (out of 20) questions from the Conceptual Inventory of Natural Selection, four (out of 22) questions from the Geoscience Concept Inventory, and both of the questions measuring Gaia beliefs. Exclusion of three test items from the speeded judgment task and four items from the Geoscience Concept Inventory was already planned based on the opinions of scientific experts (see Kelemen et al., 2013 for discussion). Final analyses therefore involved 24 test sentences from the speeded judgment task and 18 items from the Geoscience Concept Inventory. Importantly, however, the inclusion of all items across all tasks does not change the overall pattern of results.

3. Results

Responses were coded as 0 (accurate) or 1 (inaccurate). To determine the effect of time pressure on participants' endorsements of scientifically inaccurate teleological statements about nature, as compared to their inaccuracy on control items, a 2 (Condition: speeded vs. unspeeded) X 2 (Sentence Type: test vs. control) repeated-measures ANOVA was conducted on participants' responses. This analysis revealed a main effect of Condition, $F(1, 103) = 16.80$, $p < .001$, $\eta_p^2 = .14$, indicating a higher proportion of errors in the speeded condition. There was also a main effect of Sentence Type, $F(1, 103) = 202.26$, $p < .001$, $\eta_p^2 = .66$, indicating that participants were much more inaccurate on test items overall. Crucially, there was a Condition X Sentence Type interaction, $F(1, 103) = 4.30$, $p = .041$, $\eta_p^2 = .04$, demonstrating that the effect of speeded responding was more pronounced for test items than for control items. In particular, the speeded condition led to a 14% increase in the inaccurate endorsement of teleological statements, while there was only a 6% increase in the inaccurate endorsement of control statements (see Figure 1). This replicates previous findings (Kelemen & Rosset, 2009; Kelemen et al., 2013) and demonstrates that mere processing speed is not the

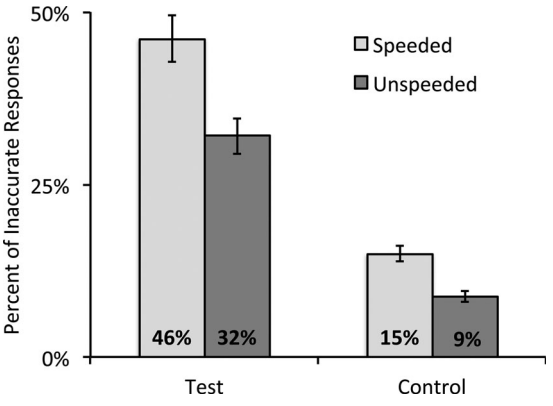

Figure 1. Percentages of inaccurate responses on teleological test items and on control items. Error bars are standard errors of the mean.

primary factor in the elevation of teleological endorsement. Rather, the interaction effect suggests that responding under speed interferes with inhibitory processes that must be engaged when denying teleological explanations, but which are unnecessary for evaluating control sentences. In other words, this research suggests that Chinese participants possess an intuitive bias to endorse teleological explanations that are otherwise effortfully suppressed. Because this sample was drawn from a cultural setting that is highly distinct from the Westernized populations that have been studied in previous research, this result lends support to the hypothesis that the teleological bias may be a universal cognitive default.

The relationships between teleological endorsement and knowledge/belief variables were examined with partial correlations, controlling for inaccuracy on control item responding in the speeded judgment task. Overall, scientific knowledge demonstrated a robust negative correlation with inaccurate teleological endorsement, Biological Knowledge: $r(101) = -.35$, $p < .001$; Geoscience Knowledge: $r(101) = -.30$, $p = .002$. There was no relationship detected between performance on the Stroop task and inaccuracy on test items, $r(101) = .06$, $p = .574$. Belief in gods was additionally uncorrelated with inaccurate teleological endorsement, $r(101) = .08$, $p = .415$. However, consistent with the low levels of religious beliefs found by the Association of Religion Data Archives (2007), Chinese participants reported very low levels of belief in god(s), with a mean rating of 1.81 ($SD = 1.00$) on a 1 (strongly disagree) to 5 (strongly agree) scale – a rating that is well below the midpoint of this scale, $t(103) = -12.21$, $p < .001$.

4. Discussion

This research has uncovered empirical evidence demonstrating that a teleological bias is present in China: a non-Western, non-Judeo-Christian society. In particular, Chinese adults revealed a pronounced tendency to endorse scientifically unwarranted teleological statements about the natural world when their processing resources were taxed through a demanding time constraint that precluded them from inhibiting default intuitions. The present demonstration that the teleological bias is robust in a cultural milieu highly distinct from those in which it has been previously documented provides the strongest indication to date that this explanatory form is a universally emerging stance, one that may develop regardless of environmental variation.

In prior research measuring endorsement of the same set or a subset of the teleological test items utilized in the present study (Banerjee & Bloom, 2014; Davis, Juhl, & Routledge, 2011; Kelemen & Rosset, 2009; Kelemen et al., 2013; Mills & Frowley, 2015; Willard & Norenzayan, 2013), Western participants who were otherwise demographically similar to the present sample (e.g., university

students) were found to endorse scientifically unwarranted teleological statements more than 50% of the time on average. This is substantially higher than the degree of endorsement found in the present sample of Chinese participants,[5] suggesting that overall teleological tendencies are diminished in Chinese culture. Therefore, even though Chinese adults possess a resilient tendency to endorse unwarranted teleological explanations when they are cognitively taxed, they simultaneously display a reduction in the overall extent to which they endorse teleological statements relative to similar counterparts in the United States, Canada, and Ireland. It is possible that this cross-cultural difference in mean levels of teleological endorsement reflects surface-level dissimilarities in reflective beliefs (Bering, 2010), such that explicit worldviews in China reduce the overall tendency to endorse scientifically unwarranted teleological explanations. That is, factors such as secularism could lead to the effortful chronic suppression of a universally held teleological bias (Barrett, 2012; Bering, 2011; Heywood & Bering, 2013; Järnefelt, Canfield, & Kelemen, 2015), while implicit biases continue to form in spite of these reflective cultural beliefs.

Beyond shedding light on the potential universality of an adult teleological bias, these results also yield some insight into the underlying structure of the teleological bias. Prominently, the findings fail to lend support to recent claims that teleological tendencies are actually a reflection of a more general tendency to think in relational-deictic terms (Ojalehto et al., 2013). Despite robust evidence that Chinese culture emphasizes and enhances relational reasoning more than American culture (Ji et al., 2004; Nisbett, 2003), Chinese students were less teleological than adults previously tested in Western samples. Additionally, while decreased religiosity could be partially responsible for attenuating the teleological bias at an intercultural level, the lack of a relationship between belief in gods and teleological endorsement in the present sample suggests that religiosity may not impact this bias at an intracultural level. Overall, the relationship between formal religion and teleology is not straightforward (see Banerjee & Bloom, 2014; Lombrozo et al., 2007; Willard & Norenzayan, 2013), and further research should employ subtler, more implicit measures of religiosity (e.g., Järnefelt et al., 2015). It is possible that implicit measures would be more closely related to the teleological bias in China, especially as magical beliefs and ritualistic activities (e.g., ancestor veneration, fortune telling, incense burning) suggesting latent commitments to supernatural phenomena are much more prevalent in this country than overt faith in the existence of doctrinally prescribed supernatural beings (Yang & Hu, 2012).

Overall, these data provide new support to the hypothesis that a teleological stance is a universally intuitive cognitive propensity, even if its overall expression can be cross-culturally variable. The teleological bias persists into adulthood despite ameliorating influences, enduringly co-existing alongside other explanatory theories rather than being replaced through processes of conceptual change (Kelemen & Rosset, 2009; Legare, Evans, Rosengren, & Harris, 2012). It is possible that this canalized tendency results from innately endowed predispositions, perhaps nascent from birth, which bias humans to believe that teleological forces underlie natural phenomena (e.g., Barrett, 2012; Bering, 2011; Bloom, 2007; Järnefelt et al., 2015; Kelemen, 1999a, 2004). Alternatively, this predilection may be directly taught through common folklore or may be reliably constructed from similar environmental inputs that recur across cultures, becoming more or less pronounced depending on the availability of other explanatory frameworks such as modern biological theories. While future studies are required to uncover the precise mechanisms of genetic and cultural influence on the emergence and expression of this affinity for teleological explanation, the present research contributes to a growing body of studies demonstrating that the entrenchment of this tendency runs deep.

Notes

1. While Chinese religions such as Buddhism and Daoism are allegedly non-theistic, China has had and continues to have a substantial number of theistic believers (Lagerway & Kalinowski, 2011). Though religious beliefs and practices were dramatically affected under communism, recent decades have seen a marked increase in religious practice, much of it – even among Buddhists and Daoists – theistic (Yang, 2011). Furthermore, recent analyses of

ancient texts suggest that both anthropomorphic theism and mind–body dualism have ancient roots in the literary culture (e.g., Clark & Winslett, 2011; Slingerland & Chudek, 2011).
2. This is not an exhaustive list; for example, the recent influences of post-Enlightenment thought (e.g., positivism, Marxism) have also been considerable.
3. The data were also reanalyzed after omitting 11 participants due to low (60%–80%) accuracy on control items, based on exclusion criteria from prior research that were designed to eliminate individuals who were unable to accurately read and respond to the stimuli under speeded conditions (see Kelemen et al., 2013). The pattern of results remained the same.
4. These questions were embedded within another 11 questions about scientific beliefs that were not analyzed and will not be discussed further.
5. For instance, a comparison to the undergraduate sample in Kelemen et al. (2013) demonstrates that the present Chinese sample is markedly less teleological, $t(333) = 5.72$, $p < .001$, $d = 0.67$.

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Online Supplementary Materials

Table S1

Full stimulus list for the speeded judgment task.

Test items	
Bats hunt mosquitoes in order to control over-population.	蝙蝠捕食蚊子是为了控制蚊子群体过剩。
Birds transfer seeds in order to help plants germinate.	鸟类传播种子是为了帮助植物发芽。
Earthworms tunnel underground in order to aerate the soil.	蚯蚓在地下穿行是为了疏松土壤。
Ferns grow at ground level in order to conserve humidity.	蕨类植物在地表生长是为了保持湿度。
Finches diversified in order to survive.	雀类种类具有多样性是为了生存。
Germs mutate in order to become drug resistant.	病菌变异是为了变得具有抗药性。
Glaciers compact snow in order to conserve volume.	冰川将雪压紧在一起是为了把持体积。
Hurricanes circulate seawater in order to gather energy.	飓风使海水循环流动是为了能够积聚能量。
Lemurs have adapted in order to avoid extinction.	狐猴适应环境是为了免遭灭绝。
Microbes convert nitrogen in order to enrich the soil.	微生物固氧是为了丰富土壤成分。
Mites live on skin in order to eliminate dead skin cells.	螨虫长在皮肤上是为了去除死亡的皮肤细胞。
Molecules fuse in order to create matter.	分子相互结合是为了产生新物质。
Moss forms around rocks in order to stop soil erosion.	苔藓长在岩石周围是为了防止土壤侵蚀。
Mountains fold inwards in order to maintain mass.	山向内折叠是为了维持质量不变。
Oceans dissolve rocks in order to retain ocean minerals.	海洋分解岩石是为了维持海洋矿物含量。
Parasites multiply in order to infect a host.	寄生虫繁殖是为了感染宿主。
Particles collide in order to produce chemical reactions.	粒子相互碰撞是为了产生化学反应。
Rain falls in order to allow plants to grow.	下雨是为了使植物生长。
Sand dunes form in order to stop waves eroding vegetation.	沙丘的形成是为了阻止海浪侵腐植被。
The Earth has an ozone layer in order to protect it from UV light.	地球有一层臭氧是为了保护地球不受紫外线伤害。
The Earth rotates around the sun so that it can receive light.	地球绕太阳公转是为了能接收到阳光。
The fittest animals survive so that species can grow stronger.	最适应环境的动物生存下来是为了是群种更加强大。
Trees produce oxygen so that animals can breathe.	树产生氧气是为了使动物可以呼吸。
Water exists so that life can survive on Earth.	水之所以存在是为了生命可以在地球上存活。
Bees frequent flowers in order to aid pollination.**	蜜蜂经常停在花朵上是为了帮助传播花粉。
Lightning releases electricity in order to travel.**	闪电释放电流是为了传播。
The sun makes light so that plants can photosynthesize.**	太阳产生光以便于植物可以进行光合作用。
Earthquakes happen because tectonic plates must realign.***	地震的发生是因为地壳板块必须重新排列。
Geysers blow in order to discharge underground heat.***	间隔泉喷水是为了释放地下的热量。
Volcanoes erupt in order to release underground pressure.***	火山喷发是为了释放地下的压力。
Control Items (true teleological, false teleological, true causal, false causal)	
Alarm clocks beep in order to wake people up.	闹钟响铃是为了叫醒人们。
Children wear mittens in the winter in order to keep their hands warm.	孩子在冬天戴连指手套是为了保持他们的手暖和。
Doctors prescribe antibiotics in order to treat infections.	医生开抗生素的药方是为了治疗感染。
People buy microwaves in order to heat their food.	人们买微波炉是为了加热他们的食物。
Schools exist in order to help people learn new things.	学校之所以存在是为了帮助人们学新东西。
Stoplights change color in order to control traffic.	交通信号灯变换颜色是为了控制交通。
Women put on perfume in order to smell pleasant.	女人喷香水是为了闻起来很香。
Bicycles have handlebars so that people can steer them.**	自行车有把手以便于人们控制它们的方向。
Pencils exist so that people can write with them.**	铅笔存在以便于人们用它们写字。
People wear contact lenses in order to see more clearly.**	人们戴隐形眼镜是为了视野更清楚。
Cows have udders in order to allow farmers to milk them.	奶牛有奶头是为了让农民挤奶。
Hair becomes grey so that people can look older.	人的头发变白是为了使人们看上去更老。
Houses have doorbells in order to make dogs bark.	房屋有门铃是为了使狗叫。
Mice run away from cats in order to get exercise.	老鼠从猫身上逃跑是为了锻炼身体。
Musicians have two hands in order to play instruments.	音乐家有两只手是为了演奏乐器。
People chew food in order to strengthen their jaw muscles.	人们咀嚼食物是为了增强他们的咀嚼肌。
Electric fans have blades so that they can accumulate dust.*	电风扇有扇片以便它们可以吸附灰尘。
Skyscrapers are built so that cities have landmarks.*	摩天大楼被建成是为了让城市有地标。

Kittens have soft fur so that people will want to pet them.**	小猫有柔软的毛以便于人们想要去拍它们。
Lamps shine brightly so that they can produce heat.**	灯发出明亮的光以便于它们可以产生热量。
A light bulb shines because electricity passes through its filaments.	灯泡闪亮发光是因为电流通过过其灯丝。
Butcher knives slice through meat because they have sharp edges.	屠刀可以将肉切片是因为它们有着锋利的刀刃。
Candles melt because the wax becomes very hot.	蜡烛融化是因为蜡变得非常热。
Conception occurs because sperm and egg cells fuse together.	受精作用的发生是因为精子和卵子融合到一起。
Fireworks explode because gunpowder ignites when a fuse is lit.	烟花爆炸是因为当引线被点燃时火药燃烧起来。
Icicles melt because the temperature increases.	冰柱融化是因为温度升高。
Lily pads float on the water because they have a large surface area.	睡莲叶子浮在水面上因为它们有大的表面积。
Lizards shed their skins because they outgrow them.	蜥蜴蜕皮是因为它们的体积超过皮的容量。
Lollipops are sweet because sugar is a main ingredient.	棒棒糖是甜的，因为它的主要成分是糖。
Magnets stick together because their poles attract.	磁铁粘到一起是因为它们的磁极相互吸引。
Mushrooms grow in the forest because the soil has the right nutrients.	蘑菇长在森林中是因为土壤里有合适的营养。
Objects fall downwards because they are affected by gravity.	物体向下落是因为它们受重力影响。
Otters are water resistant because their fur has natural oils.	水獭防水是因为他们的皮毛有天然的油脂。
Soda fizzes because carbon dioxide gas is released.	汽水起泡是因为二氧化碳气体被释放。
Suction cups stick because they create a pressure vacuum.	吸盘可以粘附是因为他们产生真空压力。
Tadpoles become frogs because they undergo metamorphosis.	蚯蚓变成青蛙，因为它们经历了变态发育。
Teeth decay because the enamels are dissolved.	牙齿腐坏因为珐琅质被分解。
Banyan trees stay firmly planted because they have strong roots.*	榕树能够保持根深蒂固，因为它们有强壮的根须。
Butter is greasy because it contains a great deal of fat.**	黄油是油腻的，因为它含有很多脂肪。
Clothes cling in the dryer because tumbling together produces static.**	衣服在甩干机中粘附在一起是因为翻搅产生静电。
American prairies are flat because they are covered with grass.	美洲大草原是平坦的，因为它们被草覆盖。
Billboards are brightly colored because they are large.	公告牌是色彩鲜艳的，因为它们很大。
Cellphones receive text messages because they are portable.	手机接收短信，因为它们是可以随身携带的。
Chocolate is brown because it contains a significant amount of sugar.	巧克力是棕色的，因为它含有大量的糖分。
Cleaning fluids are corrosive because they have pungent odors.	清洗液有腐蚀性，因为它们有刺激性气味。
Cows make mooing noises because they graze on grass.	奶牛产生哞哞的叫声是因为它们吃草。
Keys open locked doors because they are made of metal.	钥匙打开锁着的门，因为它们是由金属制成的。
Male lions have large manes because they are carnivores.	雄狮有大鬃毛，因为它们是肉食动物。
Oceans have waves because they contain a lot of saltwater.	海洋中有波浪因为其含有大量的咸水。
Paper towels are absorbent because they are thin.	厨房纸巾能吸水，因为它们很薄。
Pebbles have rounded edges because they are little.	鹅卵石有着圆形的边缘因为它们很小。
Polar bears are white because they swim in icy ocean water.	北极熊是白色的，因为它们在结冰的海水中游泳。
Potatoes contain starch because they grow in the ground.	土豆含有淀粉因为它们生长在地里。
Pruning shears have sharp blades because they have handles.	修枝剪刀有锋利的刀刃，因为它们有把手。
Rivers have rapids because a lot of fish swim in them.	河中有急流是因为很多鱼在其中游泳。
Rocks are heavy because they are made of inorganic material.	石头很重是因为它们是由无机物质组成的。
Roses have delicate petals because they have prickly thorns.	玫瑰有着美丽的花瓣，因为它们有扎人的刺。
Raspberries are bright red because they grow on bushes.	覆盆子是亮红色的，因为他们生长在灌木丛中。
Saturn is a planet because it has rings surrounding it.	土星是行星，因为它周围有环状物。
Sea lions have a thick layer of blubber because they feed on fish.	海狮有着很厚的一层鲸脂是因为它们以鱼类为食。
Snakes make hissing noises because they move by slithering on the ground.	蛇产生咝咝的声音是因为它们在地面上滑行前进。
Snowflakes are white because they are symmetrical.	雪花是白的，因为它们的形状是对称的。
Soda cans are cylindrical because they are made of aluminum.	汽水罐是圆柱形的，因为它们是由铝制成的。
Soup is hot because it is primarily liquid.	汤是热的，因为它主要是液体。
Spiders spin intricate webs because they have eight legs.	蜘蛛织出复杂的网是因为它们有八条腿。
The moon shines brightly because it has many craters.	月亮明亮是因为月亮上有很多火山门。
Toads make croaking noises because they catch flies with their tongues.	蟾蜍发出呱呱的叫声是因为它们用舌头捕食苍蝇。
Pandas are black and white because they eat bamboo.*	熊猫是黑白两色的，因为它们吃竹子。
Wild wolves howl because they live in the mountains.*	野狼嚎叫是因为它们生活在山野中。
Peppermint gum is chewy because it freshens peoples' breath.**	薄荷口香糖耐嚼是因为它使人们口气清新。

* = Items changed from the previously used English version to make them familiar for Chinese participants.

** = Test sentences removed from analyses due to misleading or ambiguous translations.

*** = Test sentences removed from analyses for reasons discussed in Kelemen et al. (2013).

Table S2

Sample stimulus list for the Stroop task.

“Red” in red ink	红
“Orange” in green ink	橙
“Blue” in orange ink	蓝
“Green” in blue ink	绿