Parents' beliefs about their influence on children's scientific and religious views: Perspectives from Iran, China and the United States

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Abstract

Parents in Iran, China and the United States were asked 1) about their potential influence on their children's religious and scientific views and 2) to consider a situation in which their children expressed dissent. The Iranian and US parents endorsed their influence on children's beliefs in both domains. By contrast, Chinese parents claimed more influence in the domain of science than religion. Most parents spoke of influencing their children via *Parent-only* mechanisms in each domain (e.g., discussion, teaching), although US parents did spontaneously note *Multiple* sources for the transmission of religious views (e.g., church, other influential adults). Parents proposed a similar stance towards children's dissenting religious and scientific views. Chinese and US parents were more likely to express *Supportive* approaches and Iranian parents were more likely to express a *Directive* approach by comparison. The present research informs our understanding of the cultural transmission of views about science and religion.

Keywords: Cultural transmission, parental beliefs, scientific cognition, religious cognition

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Children's home environments are an important context for their informal learning and cultural experiences (Harris, Koenig, Corriveau, & Jaswal, 2018; Rogoff, 2003; Super & Harkness, 1986). Interactions with parents and caregivers scaffold children's developing understanding of various domains of knowledge (Lane & Harris, 2014; Legare, Sobel, & Callanan, 2017; Vygotsky, 1978) and serve as a primary vehicle for the transmission of sociocultural beliefs (Tudge et al., 1999). Children's conceptualization and understanding of unobservable phenomena (e.g., scientific processes such as evolution or religious entities such as God) are likely to be particularly dependent on informal interactions and conversations with familiar adults (Harris & Koenig, 2006). Yet, there has been limited research on the potential influence that parents have on the development of children's personal beliefs about such typically unobservable entities and events. In the present study, we examined how parents conceive of their role in cultivating children's views in the domains of science and religion. Investigating parents' understanding of their influence in these two domains could provide insight into the ways that parents transmit their cognitive framework (Callanan & Oakes, 1992; Corriveau, Chen, & Harris, 2015; Luce, Callanan, & Smilovic, 2013) and inform accounts on the impact of the home environment on children's conceptual development more generally.

Hitherto, the limited research on parents' beliefs about the transmission of their views and values in English language journals has focused on US parents (e.g., see Braswell, Rosengren, & Berenbaum, 2012). To gain a more comprehensive overview of the influence of the home environment in different sociocultural contexts, we examined parental beliefs in three cultures that vary meaningfully with respect to religious values, parenting practices and cultural

norms – Iran, China and the United States. The focus of the present investigation was whether parents conceive of their role to be similar or different in the transmission of their scientific views as compared to their religious views in each culture.

Parents' Influence in the Domains of Science and Religion

Parents might adopt different approaches to scaffolding the development of children's beliefs about science, as compared to religion. Previous research has indicated that, at least within the United States, parents who identify more strongly as religious are more likely to devalue the role of science in their children's lives (Braswell et al., 2012; McPhetres & Zuckerman, 2018; Payir et al., 2020). Indeed, from an objective point of view, the process through which scientific claims are established is distinct from the non-evidential nature of religious claims (Shtulman, 2013; Van Leeuwen, 2014). In the domain of science, but not religion, claims about natural phenomena are empirically tested and theories are updated and revised. Furthermore, there tends to be a wider consensus about the existence of unobservable scientific entities, such as oxygen or bacteria, as compared to religious entities, such as angels or the soul (Clegg, Cui, Harris, & Corriveau, 2019; Davoodi et al., 2019; Harris, Pasquini, Duke, Asscher, & Pons, 2006; Shtulman, 2013). These differences in the epistemic nature of science and religion raise the possibility that the transmission of parents' beliefs will be distinct across the two domains.

In contrast, another body of research suggests that parents may see their role in transmitting scientific and religious beliefs to their children as qualitatively similar because adults' reasoning about scientific and religious phenomena can feature high levels of integration. For example, there is evidence that the same individual can employ both natural and supernatural explanations for the occurrence of everyday events such as illness and death (Legare, Evans,

Rosengren, & Harris, 2012). Shtulman (2013) also found similarities in how US adults justify their beliefs in the existence of both religious and scientific phenomena. In each case, they frequently referred to expert authority figures and professed doubt that any new empirical evidence could shake their beliefs. Parents might therefore rely on similar modes of discourse when discussing religious and scientific topics with their children, especially since both domains involve phenomena that children are typically not able to experience first-hand (e.g., heaven, germs; Harris & Koenig, 2006). To provide a robust test of these competing predictions, the present investigation was situated in three sociocultural contexts that vary markedly with respect to the authority and significance of religion in people's everyday lives.

The Present Research

We recruited parents from Iran, where public life is governed by an Islamic theocracy and the large majority of citizens subscribe to the Muslim faith (Kazemipur & Rezaei, 2003), from China, a predominately secular society in which religious groups are a minority (Yang, 2011), and from the United States, a pluralistic religious society where church and state institutions are formally separated (although Christianity is the most commonly practiced religion; Norris & Inglehart, 2011). Our primary research aim was to examine potential similarities or differences in parents' beliefs about their influence on children's personal views in the domain of science as compared to religion. We also probed parental stance toward their child's potential dissent in each of these two key domains. Moreover, because we interviewed parents in three distinct cultural settings, which vary considerably in the public relationship between religion and science, we anticipated potential cross-cultural variation in parents' conceptions of their influence across these two domains.

A common method for operationalizing parental beliefs is to ask participants to respond to a variety of standardized, categorical options or scalar ratings regarding their values and approaches (e.g., see Buri, 1991). Such measures are informative but they are likely to constrain the more in-depth examination of parents' reflections that was sought in the current research (Braswell et al., 2011). Hence, we asked specific, pre-determined questions but parents were also invited to provide open-ended explanations of their possible influence on the development of their children's beliefs. To analyze these explanations, we adopted a bottom-up approach by reviewing the open-ended responses within each culture and highlighting recurrent as well as distinctive themes to create the coding categories.

Parents' endorsement of their influence on children's views

We first asked parents if they believed that they acted as an important influence on their children's views with respect to science and religion (i.e., *"Do you think your views influence your child's views?*"). We expected the majority of parents in all three cultures to acknowledge their role in the transmission of scientific beliefs to their children, reflecting a pattern of widespread support for the existence of scientific phenomena (Harris & Corriveau, 2020). By contrast, based on the distinctive role of religion in the three countries, we expected that the extent to which parent recognize their own role in transmitting religious views to their children would vary. Specifically, the parents from a cultural background with a higher level of societal religiosity would consider themselves to have a more predominant influence in the transmission of religious information. Because of the widespread valuation of religion in public and private life in Iran, we predicted that the majority of parents in Iran would be confident of their influence in the domains of both religion and science (see Davoodi et al., 2019). We expected parents in China to be less confident about their own role in the transmission of religious, as compared to

scientific beliefs, because religious belief is not valued in the majority population in China (Yang, 2011). Finally, given that many US adults report religious affiliations (Inglehart et al., 2014), we expected the pattern among US parents to be similar to that of the parents in Iran.

Parents' elaborations about their influence on children's views

Having questioned parents about whether or not they influence their child's views, we invited them to elaborate in more detail on how they might act as a transmission source for their children's scientific and religious views (i.e., *"If so, how?"*). In reviewing the responses to this question, we coded if parents primarily conceived of their influence in terms of transmission mechanisms that occur within the parent-child interaction (e.g., via discussion or modelling) or, instead, conceive of their influence as one component in a larger combination of transmission sources (e.g., parent-child interactions in combination with community or other external influences). We tested for potential parallels and differences in parents' conception of their influence in the two domains, and explored the possibility that parental approaches to the scientific and religious transmission process differed across the three countries.

Parents' stance towards children's dissenting views

Next, we asked parents to consider a situation in which their child developed dissenting views from them in each domain (i.e., *"How would you react if your child developed different views to you?"*). We reasoned that such questions would cast further light on the sociocultural norms and cultural practices deemed responsible for the transmission of parental views. In examining responses to this question, we coded the extent to which the approaches focused on supporting and accepting children's dissenting personal views, hereafter referred to as a *Supportive* approach or stance, or directing and changing those views, hereafter referred to as a *Directive* stance. Again, we were interested in whether the parents anticipated reacting in a

similar or different manner to the prospect of their child adopting views that diverged from their own across the two domains. We also explored any potential cross-cultural variation in approaches towards children's dissenting religious and scientific views.

Method

Participants

Three hundred and forty parents of 4- to 11-year-old children were recruited from the United States (n = 124, 62% mothers), Iran (n = 77, 95% mothers) and China (n = 139, 80% mothers) to participate in the study. The data was part of a larger project that aimed to investigate the role of cultural mechanisms in the development of children beliefs in the domains of science and religion.

Due to differences in the optimal method for collecting the data across the cultural sites, we adapted our methods of recruitment. The Iranian parents were recruited via social media and were interviewed in neighborhood centers in Tehran. The Chinese parents were predominantly recruited through local schools in two urban cities, Beijing and Jinan. The US parents participated via Amazon Mechanical Turk. An additional 31 parents agreed to complete the survey but were excluded because they did not complete any of the open-ended questions (n = 29 parents in China, n = 1 parent in the US) or provided irrelevant responses to all of the questions of interest (n = 1 parent in the US). Relevant demographic information of the sample is displayed in Table 1.

Materials and Procedure

The current data are taken from a questionnaire examining parents' valuation of science and religion in the three cultures. Subsections of the questionnaire were developed to prompt open-ended descriptions of parents' potential influence on their child's scientific and religious

views. To measure parents' beliefs about their role, they were first asked: "*Do your views about science influence your child's scientific views?"* and then, "*If so, how?"* In a following section, parents were asked: "*How would you respond if your child developed different scientific views from you?"* Participants were then asked to respond to the same two questions for the domain of religion.

We also collected information about the religious affiliation, highest educational attainment and self-reported socioeconomic status of the participants in a different section of the questionnaire. The measures of religiosity and education were adapted to control for the cultural differences in religious practices and mainstream educational opportunities in each country (see Appendix A). The reason for gathering this demographic information was to check whether the samples differed meaningfully with respect to some of the personal and cultural factors that can impact adult attitudes towards science and religion (Chan, 2018; Davoodi, Corriveau & Harris, 2016; Yang, 2011). Some of the demographic information from the cross-cultural sample of parents is reported in Clegg et al. (2018), Cui et al. (2020), Davoodi et al. (2019), Davoodi et al., (2020), Payir, Davoodi, Jamshidi-Sianaki, Harris, & Corriveau (2018) and Payir et al. (2020). The data related to the main focus of the current report – specifically, parents' responses to the open-ended survey questions – have not been presented or discussed in any other publication.

The survey materials administered in Iran and China were first translated from English to Persian and Mandarin by researchers who were native speakers and fluent in English. The translated versions were then back-translated to English to ensure cross-validation and that inconsistencies were resolved in the final versions administered to participants in each culture.

Coding Scheme

After independently inspecting the data from each country, a team of researchers, including the authors and the research assistants who were familiar with the data, first developed a coding scheme to appropriately capture parents' responses in each culture. These categories were not mutually exclusive and were designed to represent the concepts and practices that appeared most frequently in each culture. Following this, the authors agreed upon and finalized a set of broader coding categories that could theoretically apply to a substantial number of subcategories from the three datasets. We designed the final categories to be mutually exclusive in order to permit the cross-domain and cross-cultural comparisons in the analyses below.

Coding reliability. NM, TD, and YKC initially coded 30% of responses in each culture in the original language. Research assistants who were trained on the coding scheme over several sessions, but who were not aware of the predictions, performed reliability coding and then coded all responses from each culture (individual coders for the Iranian, Chinese and US data were fluent in the native language of each dataset). The percentage of coding agreements between the authors and the second coders was very high for responses in all three countries: Iran (agreed on 89% of cases), China (90%), and the US (88%).

Coding and Results

Preliminary Analyses

We conducted cross-cultural comparisons on the parents' demographic variables (see Appendix B for further details). As expected, almost all parents in Iran reported an affiliation with Islam, a large majority in China indicated having no religious affiliation, and over half of US participants reported a religious affiliation (predominately branches of Christianity, such as Protestantism and Catholicism; see Table 1). The analyses confirmed that the sample of parents

in Iran reported significantly higher levels of religiosity as compared to parents in the United States and China. The sample of US parents was also significantly more religious than the sample in China. In addition, a significantly greater proportion of the US parents had attended college compared to the parents in Iran and China. Parents did not differ in their mean perceived socioeconomic status across the three cultures. The majority of families in each country reported that, relative to other families in their community, they fell into middle-income status.

Table 1. *Distribution of parents' self-reported religious affiliation, education level and socioeconomic status in each country.*

	Iran %	***China*** %	***US*** %
Religious denomination			
Buddhism	0	10.14	1.61
Islam	96.1	0	.81
Judaism	0	0	2.42
Protestantism	0	2.90	29.03
Roman Catholicism	0	2.17	22.58
Taoism	0	3.62	0
Other	0	.72	8.06
None	3.89	80.43	35.48
Education level			
High school or less	33.77	35.29	8.87
Some college/Bachelor's degree	46.75	51.47	74.19
Graduate degree	19.48	13.21	16.94
Perceived SES			
High income	13.33	11.11	15.32
Middle income	62.67	70.63	58.06
Low income	24.0	18.25	26.61

Data from all parents who completed at least one of the open-ended questions were retained and coded for the analyses. This led to a small proportion of missing data for individual participants. In addition, several individual responses to one of the questions were considered as irrelevant during initial coding. To permit a clear interpretation of the results, we report the proportion of missing and irrelevant data in the coding of the open-ended responses in Appendix C (see Tables S1-S3).

Parents' Endorsement of their Influence on Children's Views

We coded if parents initially responded with an affirmation (e.g., "I believe my views do influence my children") or a denial (e.g., "I don't think so") to the first question about their potential influence in each domain. A small proportion of parents in each country were unsure about their influence (e.g., "Maybe a little bit", "To some extent") and therefore did not clearly fit into the affirmation or denial response category. We reasoned that because these responses represented a qualitatively different type of answer, we could not collapse them with either response. Because we were interested in parents' subsequent explanations about their influence, we excluded these ambiguous responses. Ambiguous or mixed responses were infrequent (7.62% for the question about scientific influence, 6.94% for religious influence; see Table S1 for the breakdown in each country). Initial responses that did not provide an explicit answer to the specific question that was asked, (e.g., "Science helps prove and disprove things") were also excluded.

To explore the effect of Domain (Science, Religion) and Country (Iran, China, United States) on parents' influence, we conducted stepwise mixed-effects binomial logistic regression models on the endorsement of their influence using the *glmer* function of the *lme4* package in R statistical software (version 3.4.2). The models included Domain and Country as fixed effects

and participant as a random effect to account for the non-independence of observations across the two domains. We ran three models in a step-wise manner. We entered Domain in a first step, Country in a second step, and, in a third and final model, we added the interaction between Domain and Country.

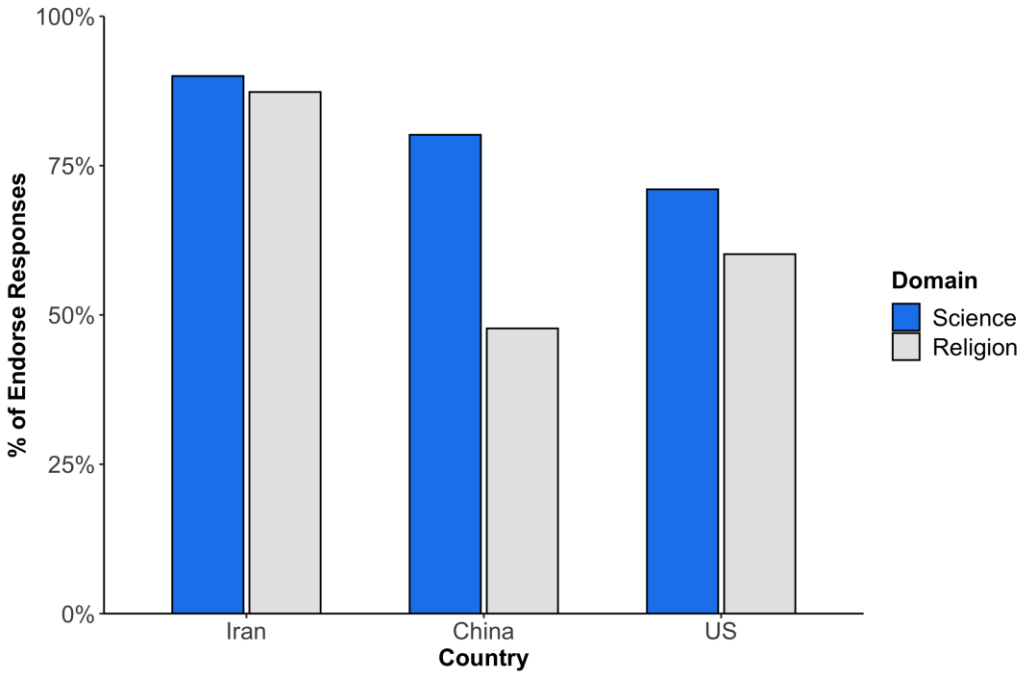

Figure 1. The percentage of parents that endorsed their influence on children's beliefs by domain and country.

Inspection of Figure 1 indicates cultural variation in parents' affirmation of their influence across the two domains, particularly with respect to their influence in the domain of religion. The results of the logistic regression analyses confirmed this conclusion and the model that best fit the data included the interaction between Country and Domain. As summarized in Table 2, the final model revealed significant main effects of Country and Domain, as well as a significant interaction between the two predictors.

Table 2. *Mixed-effects binomial logistic regression model on parents' endorsement of their influence (with Religion as the reference level for Domain).*

	Best-Fitting Model				
	β (*SE*)	*Z*	OR	95% CI for OR	
				Lower	Upper
Intercept	2.80 (.54)***	5.21	16.47	5.73	47.28
Domain	.33 (.59)	.56	1.39	.44	4.44
Country					
Iran – China	-2.96 (.62)***	.62	.05	.02	.17
Iran – US	-2.14 (.57)***	.57	.12	.04	.36
US – China	-0.82 (.44)	-1.93	.44	.19	1.01
Domain X Country (Iran – China)	1.94 (.74)**	2.63	6.93	1.64	29.36
Domain X Country (Iran – US)	.38 (.69)	.55	1.46	.38	5.70
Domain X Country (US – China)	1.56 (.55)**	2.81	4.74	1.60	14.03
AIC	651.73				
BIC	682.49				
-2LL	-318.87				
LRT	11.67**				

*$p < .05$, **$p < .01$ ***, $p < .001$
Note: This model is compared to a model with the main effects of Country and Domain.

To clarify the Country x Domain interaction, we ran a mixed-effects binomial logistic regression model on parents' endorsement of their scientific and religious influence within each country separately, with Domain as a fixed effect and participant as a random effect. The results showed that the majority of parents in Iran affirmed their influence in the domains of both science (87% of parents endorsed their influence) and religion (90% of parents; $\beta = .27$, $SE = .54$, $p = .617$). There difference in the percentage of US parents that affirmed their influence in the two domains was not significant (71% of parents endorsed their scientific influence, 60%

endorsed their religious influence; $\beta = .64$, $SE = .35$, $p = .067$). By contrast, parents in China were significantly more likely to affirm their influence on children's scientific beliefs (80% of parents endorsed their influence), as compared to religious beliefs (48% of parents endorsed), $\beta = 18.86$, $SE = 2.19$, $p < .001$, OR = 155e+08, 95% CI = [2.14e+06, 1.13e+10][1].

In summary, the majority of parents in all three countries endorsed their influence on children's scientific beliefs. However, there was variation in the percentage of parents who said they influence their children's religious as compared to scientific beliefs. A similar percentage of parents in both Iran and the United States saw themselves as influential in the domains of science and religion. In comparison, Chinese parents were more likely to endorse their influence in the domain of science than in the domain of religion.

Parents' Elaboration about their Influence on Children's Views

Next, we coded parents' elaborations to the second part of the first question about their influence (i.e., *"If so, how?*"). Table 3 presents the coding categories of *Parent-only source* and *Multiple sources*, with examples. Responses that did not clearly expand on the mechanisms or sources that could influence their child's views (e.g., "I believe my views do influence my children" without further elaboration) or were unclear (e.g., "Yes, there is only one true view to have"; "Scientific matters should be explained in a simple language") were coded as uninformative and excluded from the analysis of the elaborations. Importantly, because we prompted parents to elaborate only when they *did* consider themselves to be an influence (i.e., "*If so*, how?), we focused on capturing the nature of the responses that explicitly endorsed parental influence in our secondary coding. In fact, given the question format, the majority of parents who

[1] The large odd ratios indicate that both levels of our outcome variable did not show up at both levels of our predictor. In this instance, the parents in China who responded "No" to the scientific influence question either responded "No" to the religion influence question or did not respond at all. None of the parents responded "No" to the scientific influence question and "Yes" to the religious influence question in this culture.

said they *did not* have an influence on their child's beliefs tended to not elaborate on their answer (e.g., "No" with no further elaboration). The raw number and percentage of coded responses to the open-ended question about parents' influence is reported in Appendix C (see Table S1).

Table 3. *Coding categories for parents' elaborations about their influence on children's scientific and religious beliefs.*

Category	**Description**	**Exemplars**
Parent-only source	*Parents only refer to mechanisms through which they transmit their beliefs to their children*	"I discuss age appropriate science topics with her"; "I teach them what I know"; "My child observes my behavior towards science and internalizes these values"; "I share the gospel with them"
Multiple sources	*Parents refer to other influential sources in combination with their own influence*	"We watch documentaries", "We take them regularly to science museums"; "Their grandmother and I have spoken about God", "Mainly I explain scientific matters to my child, and then there is also school and the media"; "We take him to church and we talk about Jesus at home"

To investigate the effect of Domain (Science, Religion) and Country (Iran, China, United States) on the nature of parents' elaborations, we repeated the same steps from the model above and conducted mixed-effects binomial logistic regression models, in a step-wise manner, on responses coded as Parent-only source or Multiple sources. Alpha levels were adjusted (α = .05/2 = .025) to account for the two levels of analyses on responses to the first question.

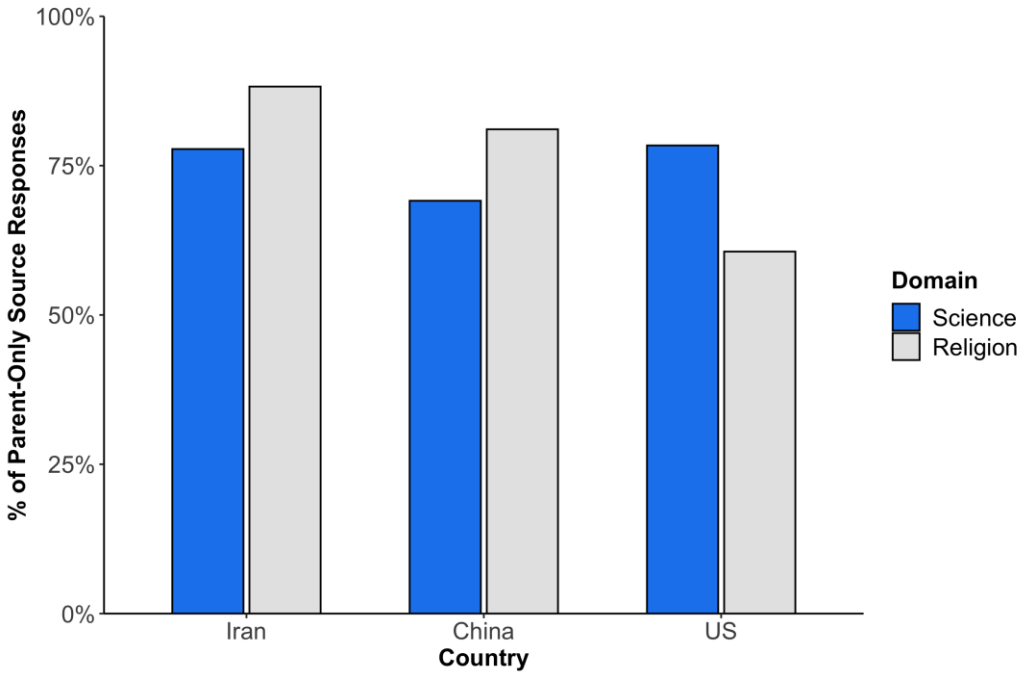

Figure 2. Among the parents who endorsed their influence on children's beliefs, the percentage that mentioned Parent-only sources (vs Multiple sources) by domain and country.

Inspection of Figure 2 indicates that the pattern of elaborations about parental influence was generally similar across both domains and across culture, with the potential exception of US parents' elaborations about their religious influence. The final model that best fit the data included the interaction between Country and Domain. As summarized in Table 4, the final model revealed a significant main effect of Country and Domain, as well as a significant Country x Domain interaction.

Table 4. *Mixed-effects binomial logistic regression models on parents' elaborations about their influence (with Religion as the reference level for Domain).*

	Best-Fitting Model				
	β (SE)	*Z*	OR	95% CI for OR	
				Lower	Upper
Intercept	2.24 (.51)***	4.36	9.36	3.43	25.57
Domain	-.83 (.57)	-1.46	.43	.14	1.33
Country					
Iran – China	-0.63 (.65)	.65	.53	.15	1.90
Iran – US	-1.76 (.57)**	-3.10	.17	.06	.53
US – China	1.13 (.54)	2.07	3.08	1.06	8.96
Domain X Country (Iran – China)	.14 (.77)	.19	1.16	.25	5.26
Domain X Country (Iran – US)	1.80 (.72)*	2.50	6.05	1.47	24.88
Domain X Country (US – China)	-1.66 (.68)*	-2.43	.19	.05	.73
AIC	392.65				
BIC	419.65				
-2LL	-189.32				
LRT	9.74**				

*$p < .05$, **$p < .01$ ***, $p < .001$
Note: This model is compared to a model with the main effects of Country and Domain.

To clarify this interaction and check for any domain differences in parents' elaborations by country, we first ran mixed-effects binomial logistic regression models on the mode of transmission within each culture separately. The results did not reveal a significant main effect of Domain for parents in Iran or China ($\beta = .76$, $SE = .54$, $p = .161$ and $\beta = .67$, $SE = .51$, $p = .192$ respectively). Thus, the parents from these two cultures tended to emphasize parent-only transmission mechanisms, rather than multiple sources, with respect to their influence in the domains of both science and religion. Based on the adjusted alpha levels, the main effect of

Domain also did not reach statistical significance among the US parents ($\beta = 1.07$, $SE = .49$, $p = .026$), although the overall model suggests that cross-domain patterns are slightly different in the US, as compared to cross-domain patterns in Iran and China.

Because we were interested in possible cross-cultural variation in parents' conceptions of their influence in each domain, we further explored this interaction to test for any effect of Country on the elaborations for science and religion separately and adjusted for these additional two comparisons ($\alpha = .025/2 = .013$). The results showed that there were no cultural differences among parents with respect to the nature of their influence in the domain of science (all p's > .211). In the domain of religion, however, parents in Iran were more likely to consider parent-only sources (88%) in comparison to US parents (61%), $\beta = 1.58$, $SE = .51$, $p = .002$, OR = 4.88, 95% CI = [1.81, 13.13] (see the light gray columns in Figure 2). Based on the adjusted alpha levels, the main effect of Country was not significant for the nature of religious transmission sources between parents in China and the US ($\beta = 1.02$, $SE = .49$, $p = .037$) or between parents in China and Iran ($\beta = .56$, $SE = .60$, $p = .354$).

In brief, Iranian and Chinese parents emphasized transmission mechanisms that occur within parent-child interactions rather than multiple influences for both science and religion. US parents also emphasized the home environment for science but often acknowledged multiple influential sources for religion. This tendency among US parents was especially marked in comparison to Iranian parents' conceptions of their religious influence.

Parents' Stance towards Children's Dissenting Views

Parental responses to the second question (i.e., "*How would you respond if your child developed different views from you?")* fell into two broad classes of approach: 1) *Directive* approaches involving the desire to actively guide, re-direct and/or reject children's dissenting

views or 2) *Supportive* approaches involving the desire to actively discuss, explore and/or accept children's views. To capture the dominant stance for each participant, we coded every individual response for the extent to which it expressed Directive and Supportive approaches.

Table 5 displays the coding scheme that we developed for the degree to which parents expressed a Directive stance. Responses received a code of 1 if they expressed either of two approaches that would combat children's dissenting beliefs. The first of these were references to interactions in which parents proposed instructing their child, with no explicit reference to their child's contribution (e.g., "I'll explain to my child": Independent approach). The second approach represented references to an explicit desire to change and/or emotionally reject their children's differing beliefs (e.g., "I would not accept that"; "I would be annoyed": Reject approach). Responses that included explicit references to both an "Independent" and "Reject" approach received a code of 2 and responses that did not include either received a code of 0. Hence, every parent was assigned a score for adopting a Directive stance that ranged between 0 and 2.

Table 6 displays the coding of the extent to which parents expressed a Supportive stance towards children's dissent. Responses received a code of 1 if they expressed one of two approaches aimed at supporting children's dissenting beliefs. One approach involved exploring and scaffolding their child's viewpoint through collaborative discussion or activities (e.g., "We'll research and investigate the topic together": Collaborative approach). The other approach involved an expression of openness to accepting their children's beliefs (e.g., "I would be fine with it": Accept approach). Responses that include broader references to both a "Collaborative" and "Accept" approach received a code of 2 and responses that did not mention either received a

code of 0. Therefore, as well as receiving a score for a Directive stance, parents were *also* assigned a score for adopting a Supportive stance that ranged between 0 and 2.

A small proportion of individual responses were not captured by the coding of either a Supportive or Directive stance (i.e., received a code of 0 for both stances; 4.56% for the question about scientific influence, 9.52% for religious influence; see Tables S2 and S3 for the breakdown in each country). These exceptional responses were excluded in the following analyses. The raw number and percentage of responses that were coded for the different approaches towards children's dissent are reported in Appendix C (see Tables S2 – S3).

Table 5. *Coding for parents' expression of a Directive stance towards children's scientific and religious dissenting views.*

Directive Stance Score	**Exemplars**
Independent + Reject = 2	"I would try to sway him towards my religion", "I would explain to her and if I cannot convince her, I would then definitely seek the guidance of a religious leader"; "I would reject and direct her to the correct direction"
Independent or Reject = 1	"I would pray fervently for God to direct me with him" **[Independent];** "I would be disappointed" **[Reject];** "Using graphs, books, and other tools, I would patiently explain to her what is correct" **[Independent];** "I would convince her**" [Reject]**
Neither = 0	"I know that my son has an independent personality, can think for himself, and can choose freely"; "I am in agreement with my children"; "I will respect her choice".

Table 6. *Coding for parents' expression of a Supportive stance towards children's scientific and religious dissenting views.*

Supportive Stance Score	Exemplars
Collaborative + Accept = 2	"I would be glad to discuss our differing opinions and agree to disagree"; "I would again be open to let them explore. It would be something we would discuss openly and thoroughly"; "I will respect his views and will try to find the right answer together"
Collaborative or Accept = 1	"I would listen to their thoughts" **[Collaborative**]; "There would be no issue. Everyone is entitled to their own beliefs" **[Accept];** "I will react with a calm mind and discussions" **[Collaborative];** "I'll respect her choice" **[Accept].**
Neither = 0	"I will seek help from sources such as the internet or books", "I will try to talk sense to them"; "I will seek the help of others to convince him"; "I would not accept that".

To examine the effect of Domain (Science, Religion), Country (Iran, China, US) and Stance (Directive, Supportive) on parental approaches to children's differing views, we conducted a stepwise mixed-effects linear regression model using the *lmer* function of the *lmerTest* package in R statistical software (version 3.4.2). The model included Domain, Country and Stance as fixed effects and participant as a random effect. We entered the main and interaction effects in a stepwise manner.

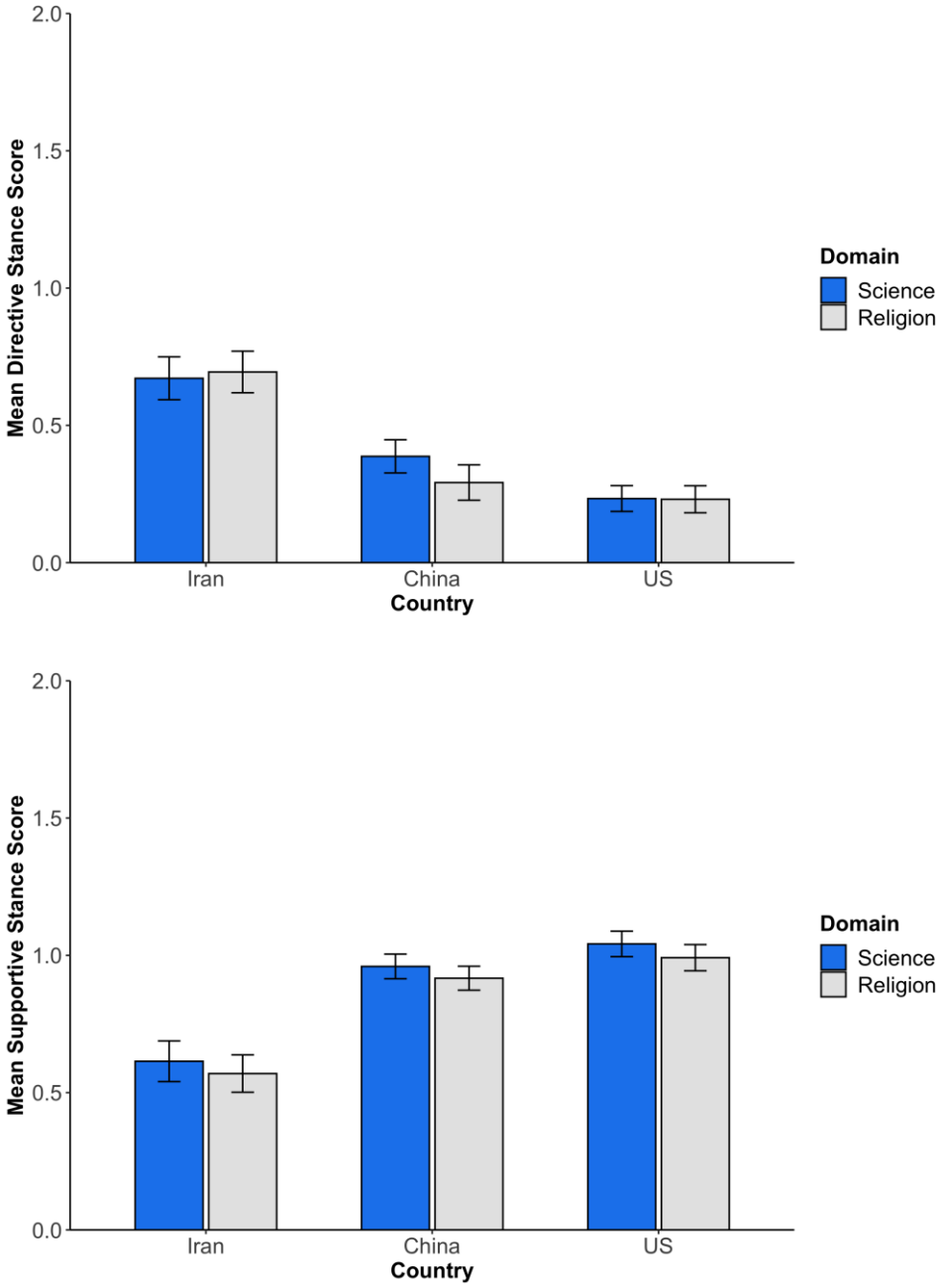

Figure 3. The mean scores for the degree to which parents expressed a Directive stance (top panel) and a Supportive stance (bottom panel) in their response towards children's dissent by domain and country. Error bars represent standard error of the mean.

Inspection of Figure 3 shows that that parents' stance was similar across the domains of science and religion in each country, but that there was cultural variation in the dominant stance

towards dissent. The results of the linear regression analyses confirmed this pattern and the final model that best fit the data included only the interaction between Stance and Country. As summarized in Table 7, the final model revealed significant main effects of Country and Stance, qualified by a significant Country x Stance interaction.

Table 7. *Mixed-effects linear regression on parents' stance towards children's dissent (with Directive as the reference level for Stance).*

	Model of Best Fit			
	β (*SE*)	*T*	95% CI for *β*	
			Lower	Upper
Intercept	.66 (.05)***	13.32	.59	.78
Stance	-.09 (.07)	-1.37	-.22	.04
Country				
Iran – China	-.34 (.06)***	-5.62	-.46	-.22
Iran – US	-.45 (.06)***	-2.23	-.57	-.33
US – China	.11 (.05)*	2.15	.01	.25
Stance X Country				
(Iran – China)	.69 (.09)***	8.02	.52	.85
Stance X Country				
(Iran – US)	.88 (.08)***	10.38	.72	1.04
Stamce X Country				
(US – China)	-.19 (.07)*	-2.54	-0.36	-.04
AIC	2031.3			
BIC	2072.0			
-2LL	-1007.7			
LRT	107.83***			

*$p < .05$, **$p < .01$ ***, $p < .001$
Note: This model is compared to a model with only the main effect of Stance.

Notice that the best fitting model does not include Domain as a predictor since it did not significantly add to model fit. Therefore, to check for the overall dominant stance towards children's dissenting views by country, we collapsed the data across Domain. We ran separate mixed-effects binomial logistic regressions within each culture on the coding of approaches

towards dissent with Stance as a fixed effect and participant as a random effect. The results showed that, among parents in Iran, there were no differences in the expressions of a Directive compared to a Supportive stance overall ($\beta = .09$, $SE = .07$, $p = .216$). By contrast, parents in China and the United States scored higher on the Supportive as compared to more Directive stance, $\beta = .60$, $SE = .05$, $p < .001$ and $\beta = .94$, $SE = .07$, $p < .001$ respectively (see Figure 3).

To check for any cross-cultural differences in the two stances, we ran two additional linear regression models, with Country as a categorical predictor (and Bonferroni-corrected alpha levels; $\alpha = .05/2 = .025$). The first of these models revealed Directive responses were, on average, higher among Iranian parents ($M = .68$) as compared to parents in both China ($M = .34$), $\beta = .34$, $SE = .06$, $p < .001$ and the US ($M = .23$), $\beta = .45$, $SE = .06$, $p < .001$. Based on the adjusted alpha levels, there was no such difference between parents in China and the US ($\beta = .11$, $SE = .06$, $p = .045$). Conversely, both Chinese parents ($M = .94$) and US parents ($M = 1.02$) endorsed a Supportive stance to a greater extent compared to parents in Iran ($M = .59$), $\beta = .43$, $SE = .06$, $p < .001$ and $\beta = .35$, $SE = .06$, $p < .001$ respectively. Again, there was no such difference in the degree to which US and Chinese parents endorsed a Supportive stance ($\beta = .08$, $SE = .05$, $p = .118$)

In sum, the analyses of parental responses to children's dissenting views revealed that responses were strikingly similar across the domains of science and religion in each country. Parents in Iran were equally prone to propose approaches that could counter or support children's dissent, regardless of domain, whereas the US and Chinese parents were predominately supportive of their child's views, again regardless of domain. Despite these cross-domain similarities within each culture, there was cultural variation in predominant when comparing among the three countries. Parents in Iran were the most directive in the responses that they

proposed to children's dissent compared to parents in the other two cultures. The US and Chinese parents were overall more supportive of children's dissent compared to Iranian parents.

Discussion

The results revealed that there was some cross-cultural variability in parents' endorsement of their influence in the domain of science as compared to religion. US and Iranian parents claimed to influence their children's views in both domains whereas Chinese parents claimed more influence in the domain of science than religion. However, in general, elaborations on the nature of parental influence did not meaningfully differ across the domains of science and religion. Thus, with the exception of US parents' beliefs about their religious influence, parents emphasized transmission mechanisms within the home environment (e.g., informal conversation) for children's developing views about both scientific and religious topics. These responses highlight the important role of adult testimony in the transmission of views regarding typically unobservable phenomena (Harris & Gimenez, 2005; Harris et al., 2006).

Such stability across the domains of religion and science emerged when parents were asked about their reactions to children's potential dissent. Iranian, Chinese and US parents proposed remarkably similar cross-domain approaches when reacting to children's opposing views. This was an unexpected finding given the distinction between the epistemic foundation of scientific as compared to religious claims (Shtulman, 2013; Van Leeuwen, 2014), as well as the generally high consensus in the existence of scientific phenomena in the three cultures (Clegg et al., 2018; Davoodi et al., 2019). For instance, in an effort to transmit this confidence, one might have expected parents to be more directive (and less accepting) when children's views about science diverged from their own, as compared to their views about religion. One possible explanation is the observed approaches to dissent reflect a general parenting style to guiding

children's personal opinions about various topics (see below for further thoughts on this explanation). A second potential interpretation of the relatively low rates of explicit challenges to dissenting scientific views is that parents expect their children will ultimately come to agree with societal consensus about the evidential and factual nature of scientific claims.

Taken together, the present research supports previous findings suggesting that adults might not draw sharp distinctions when reflecting about the processes by which religious and scientific knowledge is transferred (Harris & Corriveau, 2014; Shtulman, 2013). For example, in response to children's dissent, a parent in the United States, who expressed a Supportive stance in both domains, said "He is his own person and his views are his own to form" in regards to science, and "He can believe whatever he wants" in regards to religion. Another illustrative example is when a parent in Iran, who expressed a Directive stance, mentioned "I would explain to him that what I say is more accurate" in response to children's scientific dissent and "I would explain to him that he is wrong about this" in response to their child's religious dissent. Our findings build on previous work to underline some of the qualitative similarities in parents' approaches to children's learning in two central domains of knowledge. Importantly, the general parallels across the scientific and religious domains were evident in all three cultural contexts, even though the cultures vary considerably in their valuation of religious beliefs and practices.

There were several clear and consistent cross-cultural differences among parents' beliefs about their influence. Iranian parents strongly endorsed their influence in both domains, rarely mentioned influential sources outside of the home environment, and proposed a balance between a Directive and a Supportive stance in response to children's dissent. US and Chinese parents, on the other hand, proposed a predominantly Supportive stance. For Iranian parents, the overwhelming endorsement of their own influence in both domains is likely to reflect the strong

cultural endorsement of scientific and religious philosophies at a public level in Iran (Davoodi et al., 2019; Payir et al., 2018). Both scholars and political figures in this context have, on the whole, successfully integrated Islamic practices with the pursuit of scientific and technological advances (Bahari, 2009). Presumably, Iranian parents take their role seriously in upholding cultural traditions in the development of children's views about religion and science.

As mentioned above, the tendency to suggest Directive approaches among Iranian parents, as compared to Chinese and US parents, could be reflective of general parenting norms rather than specific patterns in response to the transmission of scientific or religious beliefs. For example, parents in Iran have been shown to socialize children into "politeness" norms (i.e., agreeing with others and not conveying contradictory views; Shokoohi-Yekta, Shahaeian, & Parand, 2012) and to encourage culturally prominent behaviors, such as respect for, and subordination to, the decisions and viewpoints of adults (Assadi, Smetana, Shahmansouri, & Mohammadi, 2011; Behzadi, 1994).

The parents in China took their role seriously in cultivating children's views, but primarily in the domain of science. In stark contrast to responses in Iran, fewer than half of Chinese parents claimed to influence their children's religious views. This finding supports a plethora of previous studies across different branches of psychology, as well as sociology and anthropology, showing the lack of support for institutional religious belief and practice in China (Yang, 2011; Yang & Hu, 2012). Interestingly, however, parents in China generally did not emphasize a Directive stance toward children's dissent with respect to either science or religion. One potential explanation for the lack of re-direction in the context of religious dissent is that Chinese parents do not consider religious guidance as an important or relevant aspect of child-rearing. Indeed, when asked to choose from a list of the important qualities that children can be

encouraged to learn at home in the 6th round of World Values Survey (Inglehart et al., 2014), only 1.2% of the Chinese participants chose the quality of "devout religious belief". The finding that parents in China were not predominately directive in response to children's dissenting scientific views is more surprising, given public efforts in emphasizing secular and scientific ideas (Potter, 2003). One reason, related to the aforementioned expectation that children will ultimately conform to societal views regarding science, is that it is not clear what dissenting scientific views would mean in this context. Therefore, parents were generally not motivated to advocate a firm Directive stance.

A substantial number of US parents endorsed their influence not only on children's scientific views, but also on their religious views. This pattern of results likely reflects the prevalence of religious practice within the United States (Norris & Inglehart, 2011). In fact, approximately 65% of the participants in our sample reported a religious affiliation. Nevertheless, of the parents who affirmed their religious influence in this culture, almost 40% of parents spontaneously considered sources beyond direct interactions with their child, including public institutions, other influential adults and children's autonomous information-seeking behaviors. This framework for the transmission of religious views complements the pluralistic standing of religiosity in the United States (Inglehart et al., 2014). In comparison to the Iranian parents, US parents were more reluctant to say that they were the only influence in children's views about religion, and were generally more supportive of children's dissent. The reported cultural differences might also be explained by the limited endorsement of authoritarian parenting styles in the United States, at least with respect to children's personal beliefs (Smetana, 2000; Smetana & Asquith, 1994). However, the relatively Supportive (versus Directive) stance of US parents towards children's dissent in the domain of science is somewhat surprising. The

interpretations of the similar pattern of responses among the Chinese parents could be applied here. Future work should further explore the proposed explanations for parents' reactions to dissent in the domain of science.

Exploring perspectives from parents in Iran, China and the United uncovered interesting findings regarding parental beliefs about their influence – in particular, the considerable cross-domain similarities in the transmission process and their reactions to inter-generational dissent. Future observational studies should investigate how far these beliefs map on to the conversational and pedagogical cues that parents employ in conversations with their children about religion and science (e.g., see Canfield & Ganea, 2014). It would also be important to inquire whether children in these cultures recognize their parents as an important influence on their views, and how comfortable they would be in voicing dissent on scientific and religious topics.

The present study adopted an exploratory, bottom-up approach to investigate the potentially powerful influence that parents have on children's conception and valuation of scientific and religious phenomena. Our findings revealed meaningful cross-cultural variation in parental approaches, but also striking similarities in the conception of their religious and scientific influence within three distinct cultures. This research adds to the increasing focus on the cultural transmission of views about scientific and religious concepts.

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Supplementary Information

Appendix A. Demographic Measures

A composite index of parents' level of religiosity was calculated from their responses to a number of questions regarding: 1) their religious identity; and 2) how frequently they engaged in religious practices and services, both of which were included in the questionnaire. Parents who self-identified as a religious person in response to the first question (i.e., *"Would you say you are a religious person or not a religious person?"),* received a score of 1 in all of the three cultures, and received a score of 0 otherwise. We adapted the coding of the second indicator of religiosity (i.e., frequency of religious worship) to control for the differences in the way religion is commonly practiced in the three countries. In Iran, since an integral part of being a pious Shia Muslim is privately praying at least 3 times a day, parents received a score of 1 if they indicated that they practiced private worship more than once a week. Otherwise, they received a score of 0. In China, since it is more common for people with religious affiliations to worship privately, participants were given a score of 1 if they practiced private worship once a month or more. Otherwise, they received a score of 0. In the US, since a common practice associated with Christianity is regular attendance at a public religious institution, parents received a score of 1 if they attended religious services once a month or more. Otherwise, they received a score of 0. Consequently, every parent was assigned a score of religiosity ranging between 0 and 2.

In addition to questions about their religious status, parents were asked to report their highest educational level. The options presented to parents differed slightly between the countries to align with the mainstream education system and opportunities for adults. In Iran, the first category was *Middle school*, followed by *High school*, *Associate's degree*, *College degree*, *Master's degree*, and *Doctoral degree*; in China, the first category was *Elementary school*,

followed by *Some high school*, *High school*, *Some college*, *College degree*, and *Graduate school or Professional degree*; in the United States, the first category was *Some high school*, followed by *High school*, *Some college*, *College degree*, and *Graduate school or Professional degree*.

Finally, parents were asked to report their perceived socioeconomic status. To measure this variable, participants were presented with a picture of a ladder and invited them to mark the rung that represented their economic status as compared to other people in their town or city. The highest rung ("1") represented families who have the most money, education and educated jobs and the lowest rung ("10") represent the least well-off families (see Adler, Epel, Castellazzo, & Ickovics, 2000).

A small number of participants did not provide responses for the religiosity index questions (n = 2 parents in Iran, n = 3 parents in China), level of education (n = 3 parents in China) or socioeconomic question (n = 2 parents in Iran, n = 13 parents in China) and were therefore excluded from the cross-cultural analyses of these demographic variables (see Appendix B).

Appendix B. **Cross-Cultural Analyses of Sample Demographics**

A one-way ANOVA revealed a significant main effect of Country on the mean religiosity index score (range 0-2), F (2, 332) = 88.10, p < .001, partial η^2 = .35. Post-hoc comparisons (Bonferroni-corrected alpha levels, α= .05/3 = .017) showed that parents in Iran reported higher levels of religiosity (M = 1.61, SD = .69) compared to parents in both China (M = .29, SD = .53), p < .001, 95% CI [1.08, 1.55], and the US (M = .81, SD = .82), p < .001, 95% CI [.56, 1.04]. In addition, US parents reported higher levels of religiosity than parents in China, p < .001, 95% CI [.31, .71].

To compare parents' highest level of education across cultures, we collapsed responses into one of three ordered categories: 1) completed high school or less; 2) completed some college or gained a college (Bachelor's) degree; or 3) received a graduate degree. A Kruskal-Wallis H test demonstrated that education level differed significantly among parents from the three cultures, χ^2 (2) = 16.36, p <. 001. Follow-up pairwise comparisons, with Bonferroni adjusted p-values, revealed that parents in the United States had attained a higher educational level compared to parents in Iran (p = .031) and China (p < .001), whereas parents in Iran and China did not differ significantly (p = 1.00).

To compare parents' perception of their socioeconomic status across the three cultures, we treated their responses on the ladder as a continuous variable (1 = *Highest income*, 5 = *Middle income*, 10 = *Lowest income*). A one-way ANOVA did not reveal a main effect of Country on perceived socioeconomic scores (range 1-10), F (2, 322) = .07, p =.934, partial η^2 = .00. The mean socioeconomic status rating for parents in Iran (M = 5.35, SD = 1.59), China (M = 5.44, SD = 1.65) and the United States (M = 5.38, SD = 1.71) fell in the middle-income range.

Appendix C. The Raw Number and Percentage of Coded Responses to the Open-Ended Questions

Table S1. *Coding of responses for the first open-ended question regarding parents' influence on their children's scientific and religious beliefs in each country.*

	Iran				**China**				**US**			
	Science		Religion		Science		Religion		Science		Religion	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
"Do your views influence your child's views?"												
Yes	63	81.82	62	80.52	101	72.66	53	38.13	76	61.29	68	54.84
Maybe	7	9.09	5	6.49	3	2.16	3	2.16	15	12.10	10	8.06
No	7	9.09	9	11.69	25	17.99	58	41.73	31	25.00	45	36.29
Missing	0	0	1	1.30	10	7.19	20	14.39	0	0	0	0
Irrelevant	0	0	0	0	0	0	5	3.60	2	1.61	1	.81
"If so, how?"												
Parent-only source	42	66.67	45	72.58	47	46.53	30	56.60	58	76.32	40	58.82
Multiple sources	12	19.05	6	9.68	21	20.79	7	13.21	16	21.05	26	38.24
Uninformative	9	14.29	11	17.74	33	32.37	16	30.19	2	2.63	2	2.94

Table S2. *Coding of the Directive approaches for the second open-ended question regarding parents' reaction to children's dissenting scientific and religious beliefs in each country.*

	Iran				**China**				**US**			
	Science		Religion		Science		Religion		Science		Religion	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Independent + Reject	7	9.09	7	9.09	13	9.35	9	6.47	5	4.03	6	4.84
Independent only	29	37.66	27	35.06	20	14.39	8	5.76	13	10.48	4	3.23
Reject only	4	5.19	9	11.69	2	1.44	2	1.44	5	4.03	11	8.87
Neither	30	48.96	29	37.66	89	64.03	77	55.40	97	78.23	96	77.42
Uninformative only	3	3.90	3	3.90	8	5.76	21	15.11	4	3.23	6	4.84
Missing	4	5.19	2	2.60	7	5.04	22	15.83	0	0	1	81

Table S3. *Coding of the Supportive approaches for the second open-ended question regarding parents' reaction to children's dissenting scientific and religious beliefs in each country.*

	Iran				**China**				**US**			
	Science		Religion		Science		Religion		Science		Religion	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Collaborative + Accept	5	6.49	3	3.90	13	9.35	5	3.60	18	14.52	15	12.10
Collaborative only	17	22.08	14	18.18	23	16.55	6	4.32	19	15.32	10	8.06
Accept only	15	19.48	21	27.27	70	50.36	72	51.80	70	56.45	76	61.29
Neither	33	42.86	34	48.05	18	12.95	13	9.35	13	10.48	16	12.90
Uninformative only	3	3.90	3	3.90	8	5.76	21	15.11	4	3.23	6	4.84
Missing	4	5.19	2	2.60	7	5.04	22	15.83	0	0	1	.81