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Retraction

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Retraction of "Declines in Religiosity Predict Increases in Violent Crime—but Not Among Countries With Relatively High Average IQ"

The following article has been retracted at the request of the authors:

Clark, C. J., Winegard, B. M., Beardslee, J., Baumeister, R. F., & Shariff, A. F. (2020). Declines in religiosity predict increases in violent crime—but not among countries with relatively high average IQ. *Psychological Science, 31*, 170–183. doi:10.1177/0956797619897915

Clark and colleagues requested that this article be retracted out of concern that some of the measures used in the research were invalid. Specifically, they note that the National IQ data used in their analyses, largely based on Lynn and Vanhanen's (2012) compilation, are plagued by lack of representativeness of the samples, questionable support for some of the measures, an excess of researcher degrees of freedom, and concern about the vulnerability of the data to bias. They also noted that the cross-national homicide data used in the research are unreliable, given that many countries included in the data set provided no actual data on homicides that had occurred. Instead, in these countries, homicide rates were estimated on the basis of other variables that may or may not be closely related to homicide rates. Importantly, some of the variables used to create the estimates were confounded with variables of interest in the research. When the authors reanalyzed the data without the imputed values, the reported effects were no longer apparent.

In the conclusion of their request for retraction, the authors reflected that although articles with certain types of errors may still be helpful to have in the literature, they do not believe theirs falls into that category. They explicitly expressed concern that leaving the article in the literature could "prolong the use of Lynn & Vanhanen's cross-national IQ measures."

As Editor of *Psychological Science*, I have decided to honor the authors' request and retract this article. I hope that this action on the part of the authors and the journal will encourage all researchers to exercise extreme care in selection and use of the data sets on which they base their analyses, conclusions, and interpretations. Critiques of Lynn and Vanhanen's (2012) National IQ data were available in the literature prior to the publication of Clark et al. (2020). It is unfortunate that these critiques were not consulted, thereby potentially avoiding publication and the necessity for retraction.

—Patricia J. Bauer
Editor in Chief

Reference

Lynn, R., & Vanhanen, T. (2012). *Intelligence: A unifying construct for the social sciences*. London, England: Ulster Institute for Social Research

Declines in Religiosity Predicted Increases in Violent Crime—But Not Among Countries with Relatively High Average IQ

In press at *Psychological Science* as of October 11, 2019

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Abstract

Many have argued that religion reduces violent behavior within human social groups. Here we test intelligence as a moderator. We hypothesized that religion would have greater utility for regulating violent behavior among societies with relatively lower average IQs than among societies with relatively more cognitively gifted citizens. Two studies supported this hypothesis. In a longitudinal analysis from 1945 to 2010 (with up to 176 countries and 1046 observations), Study 1 demonstrated that declines in religiosity were associated with increases in homicide rates, but only in countries with relatively low average IQs. In a multiverse analysis (171 models) using modern data (97-195 countries) and various controls, Study 2 consistently confirmed lower rates of religiosity were more strongly associated with higher homicide rates as average country-level IQ was lower. These findings raise questions about how secularization might differentially affect groups of different mean cognitive ability.

Keywords: IQ, intelligence, self-control, religion, religiosity, crime, violence

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Declines in Religiosity Predicted Increases in Violent Crime—But Not Among Countries with Relatively High Average IQ

Many of the world's great global religions offer inviolable moral rules and threats of supernatural punishment should those rules be violated. By appealing to basic human intuitions and motivations such as desires to conform to a powerful authority, to belong to an organized in-group, and to avoid punishment, religions may constrain and guide human behavior. Overall, religiosity predicts numerous positive life outcomes (McCullough & Carter, 2013); among these are moderate deterrent effects of religiosity on criminal behavior (Baier & Wright, 2001). Religion is associated with higher self-control, which facilitates prosocial behavior and decreases antisocial behavior (McCullough & Carter, 2013). However, the relationship between religiosity and moral behavior has been contested by scholars and the size of this effect varies substantially, suggesting there are moderators influencing the inconsistency of this relationship (Shariff, 2015).

Like religion, higher intelligence and self-control (which are positively related [Boisvert, Stadler, Vaske, Wright & Nelson, 2013; see also Zuckerman, Silberman & Hall, 2013]) are associated with lower rates of antisocial behavior and crime (Boutwell et al., 2015; Moffitt, 1993; Moffitt et al., 2011). Though the (likely multiple) reasons for these relationships remain obscure, higher intelligence and self-control afford citizens some unique capacities to function in large, complicated social environments that require sophisticated cooperation and coordination. Religious belief has declined among advanced industrialized societies with highly educated and intelligent populaces (Inglehart & Norris, 2003; Lynn & Vanhanen, 2002; 2006), suggesting that religion may be less uniquely useful for people with relatively higher cognitive ability and self-control. These individuals may be better able than others to structure their lives around abstract moral principles (e.g., utilitarianism [Piazza & Sousa, 2014]) and to resist immediate temptations

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to attain longer-term rewards. Furthermore, groups comprised of such people may be better able to create and sustain secular institutions (e.g., democracies, rule of law) that constrain behavior (Kanyama, 2014), foster a sense of fairness, and maintain the trust required for cooperation and economic prosperity (Fukuyama, 1995). Therefore, social groups comprised of citizens with relatively high cognitive ability and high self-control may not benefit much from the vivid moral lessons of religion, whereas social groups comprised of citizens relatively lower in cognitive ability and self-control may benefit from the particularly powerful and intuitive interdictions and admonishments of many religious narratives. This would not indicate that certain groups *need* religion more than others; there are many cultural routes to regulating and enforcing norms of cooperation and peace. However, religiosity may be differentially advantageous for populations of different mean cognitive ability, and thus a decline in religiosity may have a different effect on these groups.

Here, we test the hypothesis that intelligence moderates the relationship between religiosity and (im)moral behavior. We hypothesized that religion would have greater utility for regulating violent behavior among societies with lower average IQs than among societies with more cognitively gifted citizens. We focus on intelligence (rather than self-control) for two reasons: first, intelligence is associated with lower religiosity (Zuckerman et al., 2013) suggesting that religion may provide less service to those of high intelligence in the modern world; and second (and more practically), intelligence scores are widely available across many countries (whereas self-control data are not), allowing for cross-national analyses. Although IQ, especially when measured cross-nationally, is controversial, myriad analyses suggest that it has high construct validity, even in non-Western countries (Hunt, 2011). For example, educational attainment correlates strongly with both cross-national measures of IQ scores and IQ estimates

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derived from surrounding regions (*r*s > .90; Lynn & Meisenberg, 2010). Like all psychometric constructs, IQ is not perfect and the quality of cross-national data varies. Still, analyses with estimates of cross-national IQs have proven fruitful and have spurred novel theorizing about numerous important group-level outcomes (Rindermann & Thompson, 2010). Of course, all human societies are populated by very intelligent people. In the present research, lower intelligence is merely a relative description, and it would be more precise to characterize our results as reflecting different degrees of high intelligence across different societies.

We used an easily quantified form of violent behavior—homicide rates—to examine our hypothesis. (Other crime rates are less reliable due to cross-national differences in how they are defined, detected, and recorded [Neopolitan, 1996].) We predicted that lower religiosity would be associated with higher homicide rates among societies with relatively low average intelligence, but would have a weaker or non-existent relationship in societies with relatively high average intelligence. We tested this first using longitudinal data (Study 1), and then again using available modern data and various controls (Study 2).

Study 1

Method

Study 1 examined the within-country association between religiosity and homicide rates over time (i.e., whether these two variables change in tandem over time), and whether the nature of this association varied based on the country's average IQ. All countries and time points for which the relevant data could be obtained were included. This resulted in models that contained up to 1046 observations from 176 countries covering a span of 65 years.

Religiosity. Country-level religiosity was operationalized as the percent of the population that practiced religion (Association of Religion Data Archives [ARDA]; Maoz & Henderson,

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2013). Every half-decade from 1945 to 2010, the ARDA provided estimates of the average (over the previous five-year period) percent of the population that was affiliated with any religious party. To our knowledge, these are the best available country-level longitudinal data for religiosity.

IQ. No large-scale country-level longitudinal data for IQ exist (e.g., data on the Flynn Effect include only 31 countries [Pietschnig & Voracek, 2015]), so we used three separate (but related) average IQ estimates by country drawn from the NIQ dataset (Becker, 2019). LV12GeoIQ are psychometric test data from Lynn and Vanhanen (2012) with missing nations supplemented by geographic means of neighboring countries. NIQ_QNWSAS (henceforth referred to as NIQ) are combined school assessment studies data (mainly PIRLS, PISA, and TIMSS) and psychometric test data from Lynn and Vanhanen (2012), weighted and adjusted for sample size, data quality, and population composition *without* geo replacement (i.e., relevant samples were obtained from each included country). Becker describes NIQ as less in quantity but higher in quality than LV12GeoIQ. RIQ data (Becker & Rindermann, 2016) are calculated from Lynn and Vanhanen (2012) and school assessment studies (mainly PIRLS, PISA, and TIMSS) corrected for schooling such that populations with lower school attendance rates were adjusted slightly upwards (these data also include geo replacement).

Note that all three datasets are based, at least in part, on Lynn's data (Lynn & Vanhanen; 2012). To our knowledge, these are the most complete and well-validated country-level IQ data available (Lynn & Meisenberg, 2010), but the quality of the data varies by country. We included the NIQ dataset precisely because it attempts to correct and adjust for differences in data quality. Lynn and Meisenberg (2010) thoroughly discuss the validity of Lynn's data, but a few points are worth mentioning: (1) These country-level data are strongly correlated with educational

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attainment, Gross Domestic Product per capita (GDP), and various health outcomes (*r*s > .60); (2) Within-country IQ studies are highly correlated (*r* = .92); (3) The date the IQ studies were conducted (some decades ago, some more recent) does not influence the relationship between IQ and (more recent) educational attainment, suggesting that the year the IQ data were collected does not substantially reduce their predictive validity. This all supports our use of these time-invariant (time-stable) IQ data as estimates of country-level IQ. Note also that noise in the data, if anything, should obscure our hypothesized pattern of results.

Homicide and GDP. Our dependent variable, annual homicide rates by country over time, was drawn from Clio Infra and available beginning in the 1800s (Bierman & van Zanden, 2014). Because of the limited availability of other relevant time-varying covariates, the only time-varying covariate included in Study 1 was GDP (The World Bank, 2017).[1] GDP data were available beginning in 1960. Because GDP had a very large positive skew and the range was much larger than the other analysis variables (range of original GDP variable: 35.4 to 116612.9), GDP was square root transformed prior to analysis. Additionally, because religiosity was collected in half-decade intervals, homicide rates and GDP were averaged in five-year intervals to align with religiosity. Supplemental Table 2 also reports all correlations between all variables within each five-year time period.

Time. All models also controlled for measurement year with a series of binary variables (less one) to account for historical changes in homicide rates. This technique is advantageous because it allows the model to account for natural changes over time without imposing a

[1]We also explored the inclusion of income inequality as an additional control variable (The World Bank, 2017), but these data were extremely limited (only available beginning in 1981 and only for a limited number of countries) so they were ultimately rejected for Study 1. Note that income inequality was included in Study 2 to overcome this limitation.

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structure (e.g., linear, quadratic) on the functional form of change. Because of data constraints and the need for overlapping assessments for the variables, the time-frame for Study 1 was 1945 to 2010 for models without GDP and from 1960 to 2010 for models that controlled for GDP.

Analytic Plan. We used fixed effects, within-country linear regressions (Allison, 2009) to examine (1) whether changes in religiosity were associated with simultaneous changes in homicide rates and (2) whether the strength of this association varied based on country-level IQ. These models are appropriate for panel data because the time points are nested within country and the estimates are adjusted for this dependence. The primary advantage of this strategy is that the models automatically control for time-stable variables that might vary between countries (geographic location, stable population and environmental characteristics). In essence, each country is used as its own control variable (Allison, 2009). This strategy therefore limits possible third factor explanatory variables to unobserved within-country factors that changed during the study period.

Because of the focus on within-country variability, it is not possible to obtain main effects for unchanging variables (i.e., IQ; though this is tested in Study 2). For example, time-stable variables might explain average differences in homicide rates between countries, but they do not explain why a particular country might fluctuate in homicide rates over time. Using these models, we were able to examine whether country-level homicide rates systematically increased as a country decreased in religiosity.

Although it is not possible to obtain main effects for time-stable variables, it is possible to examine interactions between time-stable (in our case, IQ) and time-varying (i.e., religiosity) variables. As such, we were able to use these models to examine the critical question of whether the association between religiosity and homicide rates varied for countries with different average

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IQ levels. All fixed effects models were estimated with robust standard errors. The general structure of the fixed effects models used in the present study is (based on Allison, 2009):

$Homicide_{it} = \mu_t + \beta_1 Religiosty_{it} + \beta_2 IQXReligiosity_{it} + \beta_3 GDP_{it} + \sum \beta_z MeasurementYear_{it} + \alpha_i + \varepsilon_{it}$

Where…

- $Homicide_{it}$ = Homicide rate for country *i* at time *t*
- μ_t = Intercept for time *t*
- $Religiosty_{it}$ = Religiosity score for country *i* at time *t*
- $IQXReligiosity_{it}$ = A product term between IQ and Religiosity (an interaction) for country *i* at time *t*
- $\beta_3 GDP_{it}$ = GDP for country *i* at time *t*
- $\sum \beta_z MeasurementYear_{it}$ = Sum of the effect of all dummy coded time variables for country *i* at time *t*
- α_i = the combined effect of unobserved time-invariant variables for country *i*
- ε_{it} = error term for country *i* at time *t*

No alternate models were tested that are not reported here (with the exception of pre-peer review models that included a lower quality measure of country-level IQ but that demonstrated very similar patterns of results as those reported here). All analyses for Study 1 were conducted in Stata 14 (StataCorp, 2015), and all data and code will be made publicly available upon acceptance for publication.

Results

First, we examined the extent to which change over time in religiosity was, on average, associated with change over time in homicide rates, before and after adding GDP as a covariate (See Table 1, Models 1 and 3). All models controlled for measurement year as described above, but these variables were excluded from Table 1 for space. Results showed that, on average, religiosity was not significantly associated with homicide rates over time, with or without controlling for GDP.

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Next, we added interactions between religiosity and each of the three time-invariant IQ variables in models with and without GDP (each product term examined in its own model; See Table 1, Models 2a, 2b, 2c, 4a, 4b, and 4c). The interaction was significant at $p<.005$ in four of the six models, $p<.05$, in five of the six models, and $p<.091$ in all six models.[2] This interaction suggests that the nature of the association between religiosity and homicide rates over time varied based on the country's average IQ.

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[2] Note, we also cross-checked models using GDP and homicide estimates from the same individual years for which the five-year average religiosity estimates were reported. In these analyses, all six interactions were statistically significant (ps<.022). These results are reported in Supplemental Table 3.

Table 1

Within-Country Associations between Changes in Religiosity and Simultaneous Changes in Homicide Rates by Average Country IQ

	Coef	95% CI		Robust SE	*p*
Model 1 (*N*=176, obs.=1046)					
Religion	0.04	-0.05	0.14	0.05	.350
Model 2a (*N*=136, obs.=922)					
Religion	-2.82	-5.21	-0.43	1.21	.021
Religion X NIQ	0.03	0.01	0.06	0.01	.018
Model 2b (*N*=173, obs.=1038)					
Religion	-3.43	-5.61	-1.24	1.11	.002
Religion X LV12GeoIQ	0.04	0.01	0.06	0.01	.002
Model 2c (*N*=173, obs.=1038)					
Religion	-2.98	-4.96	-0.99	1.01	.004
Religion X RIQ	0.03	0.01	0.05	0.01	.003
Model 3 (*N*=164, obs.=864)					
Religion	-0.07	-0.20	0.05	0.06	.255
GDP	-0.04	-0.08	-0.01	0.02	.010
Model 4a (*N*=130, obs.=762)					
Religion	-2.06	-4.45	0.32	1.20	.089
Religion X NIQ	0.02	0.00	0.05	0.01	.090
GDP	-0.03	-0.06	0.00	0.01	.073
Model 4b (*N*=163, obs.=861)					
Religion	-2.88	-4.59	-1.18	0.87	.001
Religion X LV12GeoIQ	0.03	0.01	0.05	0.01	.001
GDP	-0.03	-0.06	0.00	0.02	.091
Model 4c (*N*=163, obs.=861)					
Religion	-2.46	-4.02	-0.91	0.79	.002
Religion X RIQ	0.03	0.01	0.04	0.01	.002
GDP	-0.03	-0.06	0.00	0.02	.090

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Notes. Fixed effects linear regressions with robust standard errors used for all models. N=Number of unique countries included in the analysis. Obs=Observation count. Homicide rates and GDP averaged in five-year intervals to align with religiosity. All models also controlled for historical changes by including a series of dummy-coded time variables representing each of the measurement years (less one).

Probing of the significant interactions suggested that increases in religiosity were associated with simultaneous decreases in homicide rates for countries with lower average IQs only. For example, for countries with average IQs approximately one standard deviation below the overall mean, declines in religiosity were associated with increases in homicide rates (Bs from -0.46 to -0.33; see Table 2). However, the positive values (i.e., > 0) for the interaction terms indicated that the slope representing the association between religiosity and homicide rates systematically became more positive as average IQs were higher. For example, in countries with average IQs approximately one standard deviation above the mean, the association between religiosity and homicide was near-zero or positive (Bs from 0.10 to 0.15; see Table 2).[3]

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[3] Note that when people describe an IQ score of 100 as average, this average was based on the average IQ in the United Kingdom, which is above average relative to other countries.

Table 2

Posthoc Probing of Religiosity by IQ Interactions in Models Predicting Homicide Rates

	Coef	95% CI		*p*
Models with Religiosity x NIQ	0.02	0.00	0.05	.090
Religiosity estimate for ~ +1 *SD* IQ country	0.10	-0.05	0.26	.179
Religiosity estimate for ~ average IQ country	-0.11	-0.25	0.03	.114
Religiosity estimate for ~ -1 *SD* IQ country	-0.33	-0.70	0.05	.086
Models with Religiosity x LV12GEOIQ	0.03	0.01	0.05	.001
Religiosity estimate for ~ +1 *SD* IQ country	0.15	0.06	0.23	.001
Religiosity estimate for ~ average IQ country	-0.15	-0.30	-0.01	.034
Religiosity estimate for ~ -1 *SD* IQ country	-0.46	-0.76	-0.15	.004
Models with Religiosity x RIQ	0.03	0.01	0.04	.002
Religiosity estimate for ~ +1 *SD* IQ country	0.12	0.04	0.20	.004
Religiosity estimate for ~ average IQ country	-0.14	-0.28	0.00	.046
Religiosity estimate for ~ -1 *SD* IQ country	-0.40	-0.68	-0.11	.007

Notes. Fixed effects linear regressions used for all models. Homicide rates and GDP averaged in five-year intervals to align with religiosity. All models also controlled for temporal changes by including a series of dummy-coded time variables representing each of the measurement years (less one) and GDP. Estimated religiosity coefficients for different average IQ levels obtained by re-centering IQ variable. "-1 *SD* IQ" was approximately 1 standard deviation below the sample mean (~80); "average IQ" was around the sample mean (~90); and "+1 *SD* IQ" was approximately 1 standard deviation above the sample mean (~100). Because the precise values for the means and SDs varied for the three measures of IQ, we probed the interaction with even values that were roughly representative of the means and SDs. The precise means and SDs for the analytic sample were: NIQ: $M = 86.51$, $SD = 13.56$; LV12GEOIQ: $M = 87.54$, $SD = 11.01$; RIQ: $M = 86.82$, $SD = 11.90$.

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Study 2

Study 1 demonstrated that declines in religiosity from 1945 to 2010 predicted concurrent increases in homicide rates among countries with relatively low average IQs only. Study 2 sought to confirm these results with available modern data, which allowed for the inclusion of

additional control variables and tests with multiple operationalizations of religiosity to confirm that the results are not limited to ARDA estimates and to eliminate concerns that the present results are influenced by the Flynn Effect (because all data are time-stable).

Method

Study 2 examined the interaction between country-level IQ and religiosity on homicide rates. All countries for which the relevant data could be obtained were included. Given that there are no objective best measures of religiosity and IQ nor an objective best list of relevant control variables, we conducted a multiverse analysis using three operationalizations of religiosity, three operationalizations of IQ, all possible combinations of four control variables, and additional interactions between those control variables and each operationalization of religiosity. Multiverse analysis reports all (or at least many) of the conceivable statistical models to eliminate researcher degrees of freedom (Steegen, Tuerlinkx, Gelman, & Vanpaemel, 2016). Multiverse analysis is preferred to preregistrations of specific analysis plans because preregistrations allow researchers to specify the one statistical model that they think is most likely to produce the hypothesized result. In a multiverse, researchers analyze every single model they *could* have chosen and report the results for all models, thus eliminating entirely (or nearly entirely) researchers' ability to exert control over the results with variable and model selection. If most or all models in a multiverse demonstrate a meaningful effect size for the hypothesized effect, this is much stronger evidence that the effect is real than demonstrating the effect once in one preregistered model.

Religiosity. Religiosity was operationalized as the percent of the population affiliated with any religion (Pew Research Center, 2012), the percent of the population that practices

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religion (ARDA; Maoz & Henderson, 2013), and the percent of the population that reports that religion is an important part of their daily life (Gallup, 2009).

IQ. The same three average IQ estimates by country from Study 1 were again used in Study 2: LV12GeoIQ, NIQ, and RIQ.[4]

Homicide. Per capita homicide rates were drawn from the United Nations Office on Drugs and Crime (UNODC; most recent available year of data was used [majority from 2012]). To our knowledge, this source provides the best available estimates for homicide rates, and so no other operationalizations of homicide rates were included in the multiverse analysis. Please see the Supplement for secondary analyses using a different operationalization of violence (tourism safety scores), which demonstrate very similar patterns as those observed for homicide rates.

Controls. In all possible combinations, we controlled for various other factors generally regarded to be related to homicide rates: GDP and the Gini index of income inequality (2015 CIA World Factbook; latest available estimates were used where 2015 estimates were not available), population density (The World Bank, 2015), and educational attainment (secondary education completion rate; The World Bank, 2019).[5] At the request of a reviewer, we analyzed additional models (in models with all controls) also controlling for the interactions between each operationalization of religiosity and GDP, each operationalization of religiosity and income inequality, and each operationalization of religiosity and educational attainment (independently,

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[4] In a second round of revisions, a reviewer suggested we cross-check these analyses with school assessment study data only (i.e., *without* Lynn's data), so we reran our main analyses (first without controls then with all four controls) with these data instead (SAS from Becker [2019]). The interaction effect was very similar (*n*s = 71-98 countries, semipartial *r*s = .08-.33), though with the very limited number of countries, the interaction was not always statistically significant.

[5] Data for 2014 were used because they were the most complete; closest available estimates were used where 2014 estimates were not available (and only if within three years of 2014).

so only one additional interaction was included at a time). The Supplement contains a table of source information for all variables included in both Studies 1 and 2 (Supplemental Table 1).

Multiverse. This combination of variables and planned analyses produced 171 possible statistical models with up to 195 countries. All variables were *z*-transformed prior to analysis, except for GDP, which was square root transformed as in Study 1.[6,7] Data were analyzed first in SPSS and then cross-checked in R. All data and code will be made publicly available upon acceptance for publication.

Results

Correlations. As can be seen in the correlation matrix (Table 3), higher homicide rates were associated with lower IQ, GDP, and educational attainment. Higher homicide rates were unrelated to population density and either unrelated (ARDA and Pew) or positively associated (Gallup) with religiosity. Higher IQ was associated with higher GDP, population density, and educational attainment, and lower religiosity and income inequality. Higher religiosity was negatively associated with GDP and educational attainment, positively associated with income inequality, and unrelated to population density.

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[6] Reviewers requested the square root transformation instead of *z*-transformation for GDP. This was honored in all models except in models including the interactions between religiosity and GDP. For these models, we *z*-transformed GDP for purposes of computing the interaction term.

[7] Please see the Supplement for an initial (pre-peer review) multiverse, which included parasite stress and average annual temperature and did not include educational attainment and the additional interactions between control variables and religiosity. At the request of a reviewer, parasite stress and temperature were not included in the present multiverse, and although these variables were positively correlated with higher homicide rates (*r*s ≈.33) and negatively correlated with IQ (*r*s≈-.68), in the full model, they accounted for virtually zero variance in homicide rates (semipartial *r*s <.01).

Table 3.

Correlations between homicide rates, all IQ variables, all religiosity variables, and all control variables included in Study 2.

		Homicide Rate	2	3	4	5	6	7	8	9	10
NIQ (2)	*r*	-0.421									
	p	<.001									
	n	146									
LV12GeoIQ	*r*	-0.378	0.856								
(3)	*p*	<.001	<.001								
	n	195	147								
RIQ (4)	*r*	-0.375	0.870	0.978							
	p	<.001	<.001	<.001							
	n	195	147	199							
ARDA	*r*	0.082	-0.477	-0.536	-0.528						
Religiosity (5)	*p*	0.259	<.001	<.001	<.001						
	n	191	140	185	185						
Pew	*r*	0.101	-0.500	-0.534	-0.528	0.870					
Religiosity (6)	*p*	0.135	<.001	<.001	<.001	<.001					
	n	219	147	197	197	191					
Gallup	*r*	0.244	-0.698	-0.727	-0.750	0.715	0.730				
Religiosity (7)	*p*	0.003	<.001	<.001	<.001	<.001	<.001				
	n	146	125	144	144	141	146				
GDP (8)	*r*	-0.168	0.700	0.700	0.712	-0.333	-0.310	-0.598			
	p	.014	<.001	<.001	<.001	<.001	<.001	<.001			
	n	212	146	196	196	190	222	144			
Gini (9)	*r*	0.509	-0.468	-0.507	-0.536	0.340	0.184	0.505	-0.368		
	p	<.001	<.001	<.001	<.001	<.001	0.031	<.001	<.001		
	n	138	116	138	138	135	138	123	138		
Population	*r*	-0.102	0.189	0.199	0.180	-0.041	-0.106	-0.103	0.227	0.088	
Density (10)	*p*	0.144	0.023	0.006	0.013	0.579	0.125	0.220	<.001	0.303	
	n	205	143	192	192	189	211	144	212	138	
Educational	*r*	-0.248	0.585	0.668	0.667	-0.352	-0.303	-0.595	0.693	-0.316	0.123
Attainment (11)	*p*	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.114
	n	169	126	162	162	160	169	128	170	122	168

Shaded indicates significant negative correlation; outlined indicates significant positive correlation; unaccented indicates no significant relationship.

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Multiverse. In separate regressions, homicide rates were regressed on one of the three operationalizations of religiosity, one of the three operationalizations of IQ, and the relevant interaction (for nine possible interaction terms), independently and with every possible combination of the four control variables, excluding listwise. This produced a total of 144 possible models. For each of the nine full models (with all four controls), we tested three additional models controlling for the interactions between the relevant operationalization of religiosity and (1) GDP, (2) income inequality, or (3) educational attainment, which produced 27 additional models. Thus, we tested 171 models in total for the multiverse.

We used semipartial *r*s (the proportion of the variance in homicide rates uniquely explained by the interaction) as estimates of the interaction effect size; *p*-values <.001 were coded as .00099. Across all possible models (see Figure 1), the effect sizes for the interaction between religiosity and IQ ranged from small/medium, semipartial $r = .14$, to medium/large, semipartial $r = .46$ (Cohen, 1992), with a medium average effect size (*M* semipartial $r = .30$, *SD* = .08). The interaction was statistically significant at $p < .001$ in 64.9% of models, $p < .010$ in 88.9% of models, $p < .050$ in 97.7% of models, and $p < .078$ in 100% of models. Thus, the multiverse provided very strong support for the hypothesized interaction.[8,9]

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[8] Homicide and ARDA and Gallup religiosity were skewed, so analyses were re-run omitting countries >3 SDs above the homicide mean (Honduras, Venezuela, Belize) and countries >3 SDs below the religiosity mean (Czech Republic, Estonia, South Korea, Japan). This did not affect the effect size or statistical significance of the interaction with or without controls.

[9] To ensure the results were not influenced by a lack of representation of certain combinations of religiosity and IQ (e.g., high religiosity and high IQ or low religiosity and low IQ), we performed median splits on religiosity and IQ and cross-checked the interactions in 2 x 2 ANOVAs. All nine interactions (three IQ measures by three religiosity measures) were statistically significant, *p*s < .003, with medium to large effect sizes, η_p^2s = .064-.156. In the low IQ country group, high religiosity countries consistently had lower homicide rates than low religiosity countries, *p*s < .001. In the high IQ country group, there were no differences between high and low religiosity countries on homicide rates, *p*s > .127 (nor were the differences in the same direction).

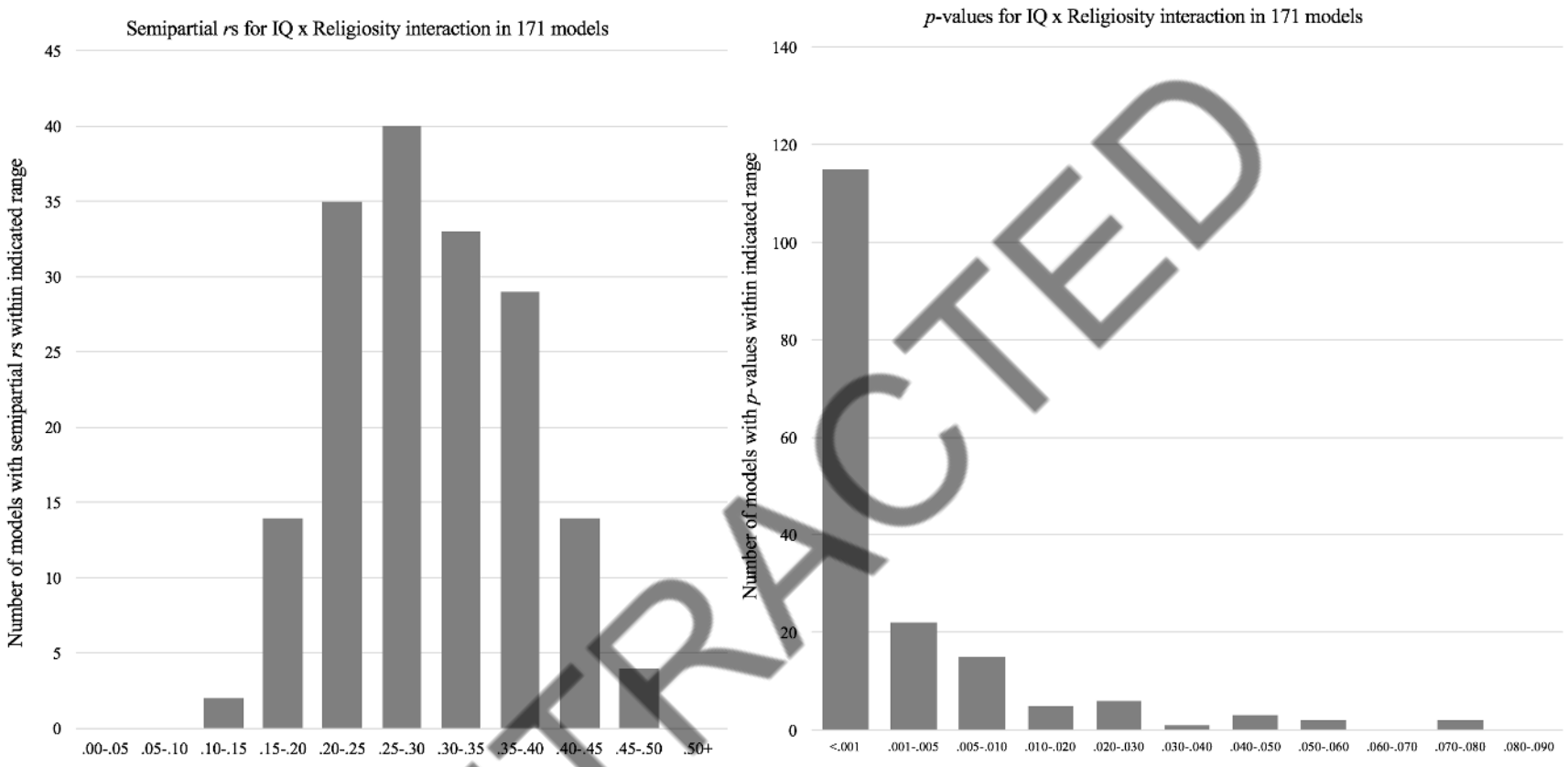

Figure 1. Multiverse analysis frequency histograms of semipartial *rs* and *p*-values for the interactions between IQ and religiosity.

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Sample models. To decide which models to expand upon for purposes of graphing the interaction, we checked the average semipartial *r*s for each of the nine interaction terms, and selected the smallest (LV12GeoIQ x Gallup religiosity), largest (NIQ x ARDA religiosity), and the one closest to the overall mean (RIQ x Pew religiosity). We expand upon these three interactions without any controls and then with all four controls (for six models total). Note that none of the additional included interactions (between each of the three operationalizations of religiosity with [1] GDP, [2] income inequality, and [3] educational attainment within each of the 27 additional models) were even consistently in the same direction across models and only one of the 27 tested interactions was statistically significant (between income inequality and ARDA religiosity in the models with NIQ, semipartial $r = -.160$, $p = .027$). Thus, we do not test or discuss these additional interactions further. As can be seen in Table 4, higher IQ was a significant predictor of lower homicide rates in four of the six models, religiosity was a significant predictor of lower homicide rates in five of the six models, and their interaction was significant in all six models.

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Table 4.

Homicide rates regressed on IQ, religiosity, their interaction, and controls in Study 2.

	F	R^2	*β*	*t*	*p*	95% CI	*Semipartial r*
Sample models for LV12Geo IQ x Gallup religiosity (small estimate)							
Model (*n* = 144)	7.89	0.13			<.001		
IQ (LV12Geo)			-0.41	-3.45	0.001	-.67, -.18	-0.270
Religiosity (Gallup)			-0.20	-1.39	0.166	-.51, .09	-0.109
IQ x Religiosity			**0.24**	**2.41**	**0.017**	**.05, .50**	**0.188**
Model (*n* = 111)	6.68	0.31			<.001		
IQ (LV12Geo)			-0.20	-1.07	0.287	-.61, .18	-0.087
Religiosity (Gallup)			-0.48	-2.70	0.008	-.90, -.14	-0.221
IQ x Religiosity			**0.35**	**2.76**	**0.007**	**.11, .67**	**0.225**
GDP			0.10	0.56	0.578	-.56, 1.00	0.046
Income Inequality			0.49	4.74	<.001	.31, .77	0.387
Population Density			-0.08	-0.86	0.390	-.58, .23	-0.070
Education			-0.29	-1.84	0.068	-.66, .02	-0.151
Sample models for NIQ x ARDA religiosity (large estimate)							
Model (*n* = 140)	26.20	0.37			<.001		
IQ (NIQ)			-0.67	-8.08	<.001	-.90, -.55	-0.552
Religiosity (ARDA)			-0.84	-6.20	<.001	-1.16, -.60	-0.423
IQ x Religiosity			**0.74**	**6.06**	**<.001**	**.52, 1.03**	**0.413**
Model (*n* = 101)	13.64	0.51			<.001		
IQ (NIQ)			-0.49	-3.66	<.001	-.84, -.25	-0.266
Religiosity (ARDA)			-1.07	-6.33	<.001	-1.49, -.78	-0.461
IQ x Religiosity			**0.89**	**5.92**	**<.001**	**.62, 1.24**	**0.431**
GDP			0.11	0.87	0.388	-.37, .94	0.063
Income Inequality			0.37	4.21	<.001	.22, .62	0.306
Population Density			-0.01	-0.11	0.916	-.45, .41	-0.008
Education			-0.26	-2.38	0.019	-.67, -.06	-0.174
Sample models for RIQ x Pew religiosity (middle estimate)							
Model (*n* = 195)	19.27	0.23			<.001		
IQ (RIQ)			-0.53	-6.84	<.001	-.68, -.37	-0.433
Religiosity (Pew)			-0.68	-4.69	<.001	-.91, -.37	-0.297
IQ x Religiosity			**0.58**	**4.46**	**<0.001**	**.24, .62**	**0.283**
Model (*n* = 122)	11.01	0.4			<.001		
IQ (RIQ)			-0.22	-1.33	0.187	-.60, .12	-0.096
Religiosity (Pew)			-0.90	-4.71	<.001	-1.25, -.51	-0.341

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IQ x Religiosity	**0.82**	**4.71**	**<.001**	**.34, .84**	**0.340**
GDP	0.02	0.10	0.924	-.64, .70	0.007
Income Inequality	0.39	4.27	<.001	.22, .61	0.309
Population Density	-0.04	-0.52	0.605	-.45, .26	-0.038
Education	-0.17	-1.29	0.198	-.46, .10	-0.094

As can be seen in Figure 2, simple slopes one standard deviation above and below the overall mean of IQ indicated that in countries with relatively high average IQ (IQ ≈ 95-98), there were small to non-existent relationships between higher religiosity and lower homicide rates (LV12Geo IQ x Gallup [b = -.10], t = -0.76, p = .452; NIQ x ARDA [b = -.16], t = -1.71, p = .092; RIQ x Pew [b = -.22], t = -2.45 p = .016), but in countries with lower average IQ (IQ ≈ 70-73), higher religiosity was associated strongly with lower homicide rates (LV12Geo IQ x Gallup [b = -.89], t = -2.92, p = .004; NIQ x ARDA [b = -2.06], t = -6.36, p < .001; RIQ x Pew [b = -1.44], t = -4.82, p < .001).

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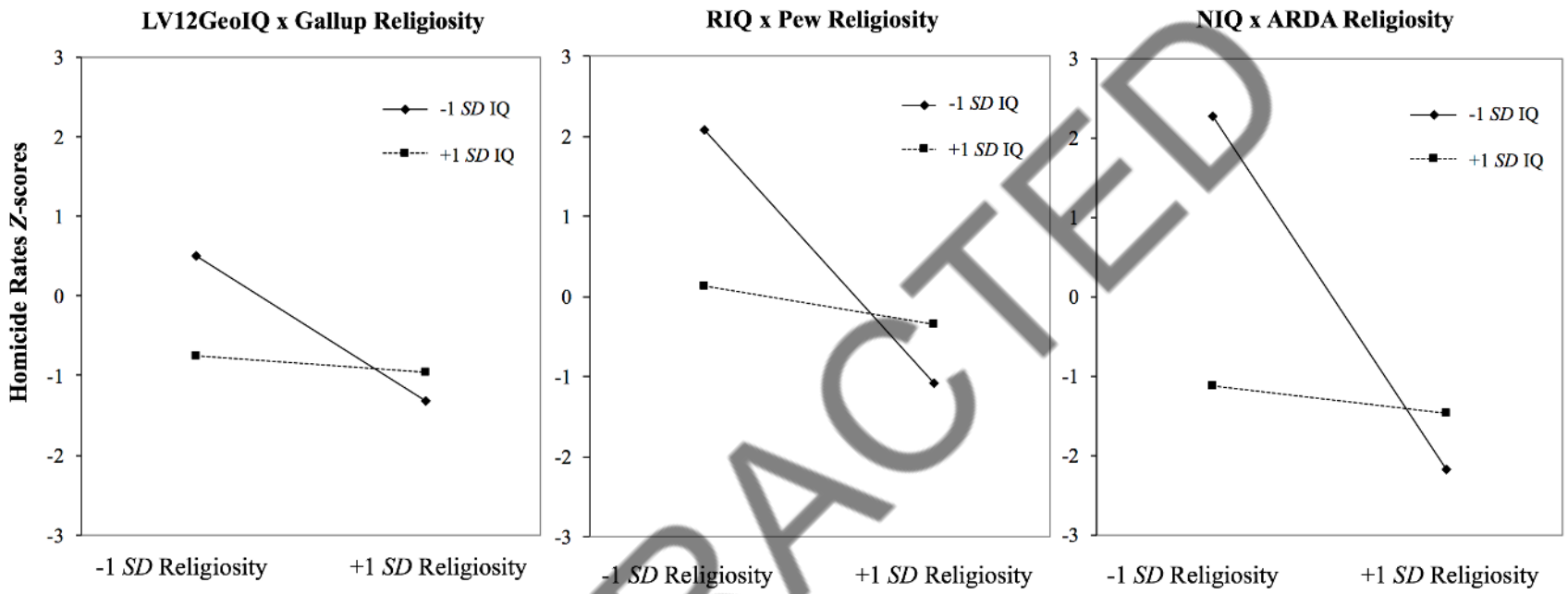

Figure 2. Interactions between IQ and religiosity on homicide rates with all four controls in Study 2.

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Galton's Problem and Spatial Autocorrelation. Galton's Problem is an issue with cross-cultural data (and perhaps statistical inference more generally) regarding drawing statistical inferences from non-independent data. Countries are treated as independent observations, yet neighboring societies (e.g., the United States and Canada) or otherwise historically related societies (e.g., the United States and the United Kingdom) share numerous traits and in some cases are near duplicates of each other, which can bias results in unpredictable ways. For example, if we are oversampling one particular type of culture (because one culture spreads across numerous countries), that particular culture can have a heavy influence on the overall results. Lines between countries are at least somewhat arbitrary in terms of dividing up distinct populations.

After consulting with several Galton's Problem experts, we sought to deal with this issue in three ways. First, following Hruschka and Henrich (2013), we reran the nine full models controlling for dummy coded world regions. Second, we tested the interactions within world regions and within countries that share the same majority religion to assess whether the interaction is particularly strong or weak in particular world regions or among countries of particular majority religions. Third, we hired a statistical expert to rerun our analyses controlling also for spatial autocorrelation between countries. Thorough results of these additional analyses are reported in the Supplement.

Controlling for world region. Controlling for world regions in the nine full models (now with nine control variables each and 97 to 122 countries each) did have a small influence on the size of the interaction effects, but generally did not affect the interpretation of the findings. Six of nine models continued to show significant IQ by religiosity interactions with small to medium effect sizes (ARDA models' semipartial *r*s = .190-234, *p*s<.006; Pew models' semipartial *r*s =

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.209-.258, *p*s<.003). The three Gallup models no longer reached statistical significance, but maintained generally small effects in the same direction (semipartial *r*s = .08-.10, *p*s<.260).

Testing within world region. We collapsed the seven world regions into four world regions (Europe and Central Asia, Middle East and Africa, South Asia and East Asia Pacific, and North and Latin America and the Caribbean) in an effort to get large enough sample sizes to test the interactions within regions. However, even doing so, the samples were very small across models (18 to 67 countries each), and so we caution against interpreting any of these specific interaction terms in isolation. Within each of the four world regions, we analyzed each of the nine interaction terms in the base models (without controls) and then again controlling for income inequality only (we were already severely underpowered to test models with additional controls, but income inequality did stand out as the most important control in the full multiverse). Because of the small sample sizes, the interactions were rarely statistically significant in any of the world regions. We arbitrarily decided that a semipartial *r* of .07 or higher for the IQ by religiosity interaction term would be a "consistent effect," that is, consistent with the IQ by religiosity interactions found in the multiverse. Of the 18 models tested within each world region, 9 were consistent in Europe and Central Asia, 10 were consistent in South Asia and East Asia Pacific, 12 were consistent in North and Latin America and the Caribbean, and 12 were consistent in the Middle East and Africa. Thus, the effect did not appear to be particularly absent in any world region, reducing the likelihood that the effects are not (at least somewhat) generalizable globally.

Testing within majority religion. We repeated these analyses within Christian majority countries (71 to 124 countries) and Muslim majority countries (23 to 45 countries). Again, we caution against interpreting any specific interaction, especially for Muslim majority countries,

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because of the small sample sizes. Here, there at least appeared to be a difference. Of the 18 models tested within each religion, 17 were consistent in Christian majority countries, whereas only 3 were consistent in Muslim majority countries—potentially due to reduced variance in religiosity in Muslim majority countries, which often feature uniformly high levels of reported religiosity. Nevertheless, the difference led us to create two additional dummy variables, whether a country was majority Christian or not and whether a country was majority Muslim or not, and to test whether either of these dummy variables moderated the nine IQ by religiosity interactions (in the base models, without controls). None of the 18 three-way interactions were statistically significant, and so we do not interpret this possible difference between Christian majority countries and Muslim majority countries. However, whereas we are quite certain the pattern is real in Christian majority countries, we are less certain about whether it holds in Muslim majority countries. A table in the Supplement titled Galton's Problem Analyses (Supplemental Table 5) reports the semipartial *r*s and *p*-values for the IQ by religiosity interactions within each of these new models (9 models controlling for region, 18 models within each of the four world regions and within each of the two religions, for 117 additional models total).

Accounting for spatial autocorrelation. Last, we hired a statistical consultant to account for spatial autocorrelation between countries (correlation due to spatial proximity). He ran Bayesian multilevel regressions including a Gaussian process (McElreath, 2018) to account for spatial autocorrelation between countries in 18 models: the 9 main models and the 9 models with the four main controls. The interaction was statistically significant at pMCMC < .001 in 1 model, pMCMC < .010 in 6 models, pMCMC < .050 in 8 models, pMCMC < .100 in 13 models, and pMCMC < .228 in all 18 models. He concluded that accounting for spatial autocorrelation weakened but did not abolish the effect. The full report, R code, and output for these analyses are

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available with the Supplement. Researchers who use his R code should cite him (rather than the present paper) as described in the Supplement.

Galton's Problem Conclusions. Though none of our efforts for dealing with Galton's Problem may rule out concerns related to non-independence of country-level comparisons completely, they do provide evidence that the effect likely cannot be attributed to one particular world region (though, as noted above, they may be more true of Christianity than Islam). Despite this, that controlling for region weakens the effect suggests the possibility that the strength of the interaction varies at least somewhat by subregion. Future research might conduct multiple within-country or within-region analyses to identify countries or regions that do not display the interaction reported here.

Data Auditor. As a final step to testing the robustness of the reported interaction, we hired an external adversarial data analyst to audit and cross-check our results. She cross-checked two additional 171 model multiverses, one with a different standardization approach, and one with median split dummy coded indicators of each operationalization of religiosity and IQ. The results largely confirmed those reported here. The full auditor report is available in the Supplement. Researchers who use her multiverse R code should cite her (rather than the present paper) as described in the Supplement.

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General Discussion

Whether religion serves a social function in suppressing antisocial behavior has been discussed for well over 2000 years, and psychological research has recently begun empirically to investigate this idea in earnest (e.g. Purzycki et al., 2016; Shariff, 2015; see Norenzayan et al. 2016 for a review). Here we introduce a possible moderator for the contested relationship between religiosity and moral behavior—intelligence. Our results indicated that higher

religiosity was largely unrelated to homicide rates in societies with relatively high average intelligence, whereas religiosity was a significant predictor of reduced homicide rates in societies with relatively low average intelligence. Study 1 supported this by examining changes over the past 65 years. Study 2 confirmed this pattern by comparing the majority of countries in the world at the same time in cross-sectional analyses with various controls. Thus the results supported our hypothesis that religiosity would have greater violence-deterring utility among populations with relatively lower mean cognitive ability than among more cognitively advantaged populations.

Though we scrutinized the reported interaction in several hundred ways and found quite consistent and robust support, our results should be interpreted with caution. All three of our main variables of interest (religion, intelligence, and morality) are multifaceted and challenging to measure, and even more challenging to compare across cultures. First, for example, the present results might apply more to some religions than others, and we imagine the effect could vary in countries experiencing religious conflict. So, whereas the interaction may be true in the aggregate, it almost certainly is not true in every type of cultural system. Despite finding supportive evidence for the interaction in each of the four world regions we tested, that controlling for world region weakened the interaction effect suggests that the interaction might vary in strength and significance in different regions. Moreover, whereas we found evidence for the effect in the present and over the past 65 years, the nature of the effect could change in the future as secularization likely continues to increase. Future research should investigate possible variation and potential reasons for it. Second, though we reported the interaction between intelligence and religiosity on homicide rates (mainly, because homicide rates are the most reliable cross-national measure of violence), our theorizing focused more on violence or antisocial behavior generally. In the Supplement, we tested the effect with an alternate measure

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of violence (based largely on citizens' reports of perceived violence in their own country) and found a similar pattern, but future work should explore whether the interaction emerges for other types of violent crime and antisocial behavior (should reliable sources of cross-national violence be identified).

Last, though country-level IQ appears to be an important predictive variable, it is controversial because IQ varies substantially within countries, and because such differences may be caused (at least in part) by differences in schooling and other cultural differences (e.g., nutrition). We controlled for at least one sort of education (secondary education completion rate) and the RIQ analyses adjusted for schooling, but we would not be surprised if a thorough index of all educational differences (in both quality and quantity) explained at least a large portion of the present effect (Rindermann & Ceci, 2009). However, we are not sure whether this would be a confound (the effect is driven by education, not intelligence) or a mechanism (higher intelligence leads to better educational systems and participation in those systems). Moreover, given the links between higher self-control with higher intelligence, higher religiosity, and lower antisocial behavior, we suspect self-control may be an important mediating variable or perhaps even the crucial variable that explains the present results. IQ might also be a proxy for a combination of other unmeasured variables that might better explain the pattern observed in the present analyses. We hope future work will investigate these possibilities.

Future research should also test whether the relationship between religiosity and intelligence on violent (or other antisocial) behavior operates on a group-level only, or whether similar patterns would be observed on an individual-differences level and/or from experimental manipulations of religiosity (Na et al., 2010). If the present results operate on a group-level only, this might suggest that it is not intelligence per se that regulates violent behavior even in the

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absence of religion, but rather that having a highly intelligent society contributes to highly functional group-level institutions and norms that help regulate behavior. In the Supplement, we reported exploratory analyses with two potential mechanisms, Rule of Law and Democracy, but the interaction was robust to these controls as well. Identifying the most viable mechanism(s) should be a crucial priority for future research.

Admittedly, though we hypothesized the observed pattern of results, we do not know exactly what it is about intelligence or religion that is associated with lower violent behavior. The mechanisms for intelligence and for religiosity might be similar (e.g., both might increase self-control) or they might be quite different (e.g., each might lead to different effective attitudes, norms, or institutions), but both appear to have some advantages for regulating violent behavior on a group-level. The present analyses were not intended to reach final conclusions, but rather to shine light on a potentially important and consequential relationship among these variables. We regard our research as a first step and welcome further input from other researchers.

The present work might inspire a bit of cautious reflection on the prescriptive values of WEIRD societies (Henrich, Heine, & Norenzayan, 2010). Educated societies might promote secularization without considering potentially disproportionately negative consequences for more cognitively disadvantaged groups. Some potential suppressors of violence (e.g., rule of law, trustworthy secular institutions, widespread concerns for fairness) may be more effectively implemented by populations with relatively high cognitive capacity (Kanyama, 2014), at least at the present moment. The benefits of religion may not be confined to homicide and so there may be sweeping, multifaceted ways in which religion reduces violent, antisocial behavior, and particularly among societies with relatively low average cognitive ability.

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We suspect that similar patterns might emerge for numerous cultural narratives. The prescriptive values of highly educated groups (such as secularism, but also libertarianism, criminal justice reform, and unrestricted sociosexuality, among others) may work for groups that are highly cognitively sophisticated and self-controlled, but they may be injurious to groups with lower self-control and cognitive ability. Highly educated societies with global esteem have more influence over global trends, and so the prescriptive values promulgated by these groups are likely to influence others who may not share their other cognitive characteristics. Perhaps then highly educated and intelligent groups should be humble about promoting the unique and relatively novel values that thrive among them and perhaps should be cautious about mocking certain cultural narratives and norms that are perceived as having little value in their own society.

One-size-fits-all social prescriptions to complicated social problems may lack important nuance. And indeed some cultural institutions (like religion, but also others such as monogamous marriage norms [see Henrich, Boyd, & Richerson, 2012]) that are denigrated as outmoded among high-IQ populations, may still serve valuable functions among other groups around the world.

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Author Contribution Statement

CJC conceived the idea with BMW. CJC and AFS compiled the data. JB analyzed and reported all data for Study 1; CJC analyzed and reported all data for Study 2. AFS helped CJC problem solve the various methodological and statistical challenges of conducting country-level analyses (with the help of other consultants). CJC, BMW, and AFS prepared the manuscript. JB and RFB provided critical revisions.

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