Supplemental Materials and Analyses for Clark, Winegard, Beardslee, Baumeister, and Shariff (under review):

Declines in Religiosity Predict Increases in Violent Crime Only Among Countries with Relatively Low Average IQ

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Source Information

Supplemental Table 1. *Source Information*

Variable		Study 1	Study 2
Religion	**Construct**	% of the population that practices religion	% of the population that practices religion
	Source	ARDA (Maoz & Henderson, 2013)	ARDA (Maoz & Henderson, 2013)
	Available at:	http://www.thearda.com/Archive/Files/Descriptions/WRPNATL.asp	http://www.thearda.com/Archive/Files/Descriptions/WRPNATL.asp
	Construct		% of the population affiliated with any religion
	Source		Pew, 2012
	Available at:		http://www.pewforum.org/2012/12/18/table-religious-composition-by-country-in-percentages/
	Construct		% of the population that reports that religion is an
	Source		Gallup, 2009
	Available at:		https://news.gallup.com/poll/142727/Religiosity-Highest-World-Poorest-Nations.aspx#1
IQ	**Construct**	Psychometric tests and school assessment studies,	Psychometric tests and school assessment studies,
	Source	THE NIQ-DATASET V1.3.2 (Becker, 2019)	THE NIQ-DATASET V1.3.2 (Becker, 2019)
	Available at:	http://viewoniq.org/?page_id=9	http://viewoniq.org/?page_id=9
	Construct	Psychometric tests only with geo replacement	Psychometric tests only with geo replacement
	Source	Lynn and Vanhanen (2012)	Lynn and Vanhanen (2012)
	Available at:	http://viewoniq.org/?page_id=9	http://viewoniq.org/?page_id=9
	Construct	Psychometric tests and school assessment studies	Psychometric tests and school assessment studies
	Source	Becker & Rindermann, 2016	Becker & Rindermann, 2016
	Available at:	http://viewoniq.org/?page_id=9	http://viewoniq.org/?page_id=9
Homicide	**Construct**	Annual per capita homicide rates over time	Annual per capita homicide rates
	Source	Clio Infra (Bierman & van Zanden, 2014)	United Nations Office on Drugs and Crime, 2013
	Available at:	https://clio-infra.eu/Indicators/HomicideRates.html#	http://www.unodc.org/gsh/en/data.html

GDP	**Construct** **Source** **Available at:**	GDP per capita The World Bank, 2017 http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.PCAP.CD&country=#	GDP per capita The World Bank, 2017 http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.PCAP.CD&country=#
Income Inequality	**Construct** **Source** **Available at:**	Gini Index of income inequality The World Bank, 2017 http://databank.worldbank.org/data/reports.aspx?source=2&series=SI.POV.GINI&country=#	Gini Index of income inequality Central Intelligence Agency, 2015 https://www.cia.gov/library/publications/the-world-factbook/rankorder/2172rank.html
Population Density	**Construct** **Source** **Available at:**		Population density The World Bank, 2015 https://data.worldbank.org/indicator/EN.POP.DNST
Educational Attainment	**Construct** **Source** **Available at:**		Secondary education completion rate The World Bank, 2019 https://data.worldbank.org/indicator/SE.SEC.CMPT.LO.ZS

Supplemental Table 2

Correlations Among Primary Study Variables by Measurement Year

	Homicide (CY) *r* (*p*)	Homicide (5YA) *r* (*p*)	Religiosity *r* (*p*)	NIQ *r* (*p*)	LV12GeoIQ *r* (*p*)	RIQ *r* (*p*)	GDP (CY) *r* (*p*)
			1945				
Homicide (5YA)	**0.963 (<.001)**	1					
Religiosity	0.124 (.540)	0.095 (.593)	1				
NIQ	**-0.396 (.025)**	-0.242 (.138)	-0.202 (.126)	1			
LV12GeoIQ	**-0.381 (.032)**	**-0.327 (.042)**	**-0.289 (.023)**	**0.802 (<.001)**	1		
RIQ	**-0.399 (.024)**	**-0.361 (.024)**	-0.221 (.084)	**0.801 (<.001)**	**0.982 (<.001)**	1	
GDP (CY)	NA	NA	NA	NA	NA	NA	NA
GDP (5YA)	NA	NA	NA	NA	NA	NA	NA
			1950				
Homicide (5YA)	**0.981 (<.001)**	1					
Religiosity	0.088 (.722)	0.140 (.453)	1				
NIQ	**-0.841 (<.001)**	**-0.590 (<.001)**	-0.227 (.062)	1			
LV12GeoIQ	**-0.698 (<.001)**	**-0.533 (.001)**	**-0.364 (.002)**	**0.823 (<.001)**	1		
RIQ	**-0.676 (<.001)**	**-0.529 (.001)**	**-0.284 (.015)**	**0.819 (<.001)**	**0.979 (<.001)**	1	
GDP (CY)	NA	NA	NA	NA	NA	NA	NA
GDP (5YA)	NA	NA	NA	NA	NA	NA	NA
			1955				
Homicide (5YA)	**0.999 (<.001)**	1					
Religiosity	0.254 (.161)	0.240 (.178)	1				
NIQ	**-0.544 (<.001)**	**-0.522 (<.001)**	-0.215 (.064)	1			
LV12GeoIQ	**-0.497 (.002)**	**-0.480 (.002)**	**-0.345 (.002)**	**0.813 (<.001)**	1		
RIQ	**-0.500 (.001)**	**-0.468 (<.001)**	**-0.285 (.011)**	**0.806 (<.001)**	**0.976 (<.001)**	1	
GDP (CY)	NA	NA	NA	NA	NA	NA	NA
GDP (5YA)	NA	NA	NA	NA	NA	NA	NA
			1960				
Homicide (5YA)	**0.993 (<.001)**	1					

Religiosity	0.245 (.128)	0.277 (.076)	1				
NIQ	**-0.443 (.002)**	**-0.505 (<.001)**	**-0.247 (.020)**	1			
LV12GeoIQ	**-0.467 (<.001)**	**-0.484 (<.001)**	**-0.346 (<.001)**	**0.844 (<.001)**	1		
RIQ	**-0.473 (<.001)**	**-0.497 (<.001)**	**-0.302 (<.001)**	**0.842 (<.001)**	**0.984 (<.001)**	**1**	
GDP (CY)	-0.328 (.051)	**-0.369 (.025)**	-0.182 (.132)	**0.569 (<.001)**	**0.621 (<.001)**	**0.660 (<.001)**	1
GDP (5YA)	-0.328 (.051)	**-0.369 (.026)**	-0.181 (.132)	**0.569 (<.001)**	**0.620 (<.001)**	**0.660 (<.001)**	**1.00 (<.001)**
			1965				
Homicide (5YA)	**0.989 (<.001)**	1					
Religiosity	**0.297 (.043)**	**0.305 (.035)**	1				
NIQ	**-0.528 (<.001)**	**-0.519 (<.001)**	**-0.266 (.008)**	1			
LV12GeoIQ	**-0.450 (<.001)**	**-0.464 (<.001)**	**-0.362 (<.001)**	**0.854 (<.001)**	1		
RIQ	**-0.435 (.001)**	**-0.453 (<.001)**	**-0.325 (<.001)**	**0.857 (<.001)**	**0.985 (<.001)**	1	
GDP (CY)	**-0.380 (.011)**	**-0.391 (.008)**	**-0.236 (.028)**	**0.541 (<.001)**	**0.607 (<.001)**	**0.621 (<.001)**	1
GDP (5YA)	**-0.370 (.014)**	**-0.381 (.010)**	**-0.224 (.036)**	**0.508 (<.001)**	**0.577 (<.001)**	**0.588 (<.001)**	**0.995 (<.001)**
			1970				
Homicide (5YA)	**0.988 (<.001)**	1					
Religiosity	0.156 (.295)	0.227 (.102)	1				
NIQ	**-0.461 (<.001)**	**-0.561 (<.001)**	**-0.278 (.004)**	1			
LV12GeoIQ	-0.233 (.087)	**-.278 (.030)**	**-0.364 (<.001)**	**0.859 (<.001)**	1		
RIQ	-0.216 (.114)	**-0.286 (.026)**	**-0.323 (<.001)**	**0.862 (<.001)**	**0.985 (<.001)**	1	
GDP (CY)	**-0.339 (.024)**	**-0.389 (.005)**	**-0.243 (.014)**	**0.598 (<.001)**	**0.639 (<.001)**	**0.668 (<.001)**	1
GDP (5YA)	**-0.339 (.023)**	**-0.390 (.004)**	**-0.217 (.028)**	**0.585 (<.001)**	**0.630 (<.001)**	**0.654 (<.001)**	**0.992 (<.001)**
			1975				
Homicide (5YA)	**0.958 (<.001)**	1					
Religiosity	0.171 (.240)	0.171 (0.212)	1				
NIQ	**-0.311 (.028)**	**-0.536 (<.001)**	**-0.321 (<.001)**	1			
LV12GeoIQ	-0.178 (.189)	**-0.286 (.024)**	**-0.401 (<.001)**	**0.854 (<.001)**	1		
RIQ	-0.194 (.152)	**-0.268 (.035)**	**-0.366 (<.001)**	**0.855 (<.001)**	**0.983 (<.001)**	1	
GDP (CY)	**-0.379 (.011)**	**-0.384 (.006)**	-0.143 (.141)	**0.396 (<.001)**	**0.439 (<.001)**	**0.469 (<.001)**	1
GDP (5YA)	**-0.366 (.015)**	**-0.354 (.011)**	-0.127 (.189)	**0.342 (.001)**	**0.397 (<.001)**	**0.430 (<.001)**	**0.976 (<.001)**
			1980				

Homicide (5YA)	**0.914 (<.001)**	1					
Religiosity	-0.014 (.920)	-0.055 (.657)	1				
NIQ	**-0.483 (<.001)**	**-0.359 (<.001)**	**-0.329 (<.001)**	1			
LV12GeoIQ	-0.179 (.179)	-0.148 (.217)	**-0.408 (<.001)**	**0.855 (<.001)**	1		
RIQ	-0.156 (.242)	-0.142 (.236)	**-0.381 (<.001)**	**0.857 (<.001)**	**0.983 (<.001)**	1	
GDP (CY)	-0.230 (.098)	-0.245 (.051)	-0.174 (.054)	**0.429 (<.001)**	**0.477 (<.001)**	**0.507 (<.001)**	1
GDP (5YA)	-0.222 (.110)	-0.243 (.053)	**-0.182 (.044)**	**0.440 (<.001)**	**0.486 (<.001)**	**0.516 (<.001)**	**0.989 (<.001)**
			1985				
Homicide (5YA)	**0.963 (<.001)**	1					
Religiosity	0.074 (.589)	0.062 (.6288)	1				
NIQ	**-0.323 (.008)**	**-0.498 (<.001)**	**-0.369 (<.001)**	1			
LV12GeoIQ	**-0.240 (.042)**	**-0.230 (.042)**	**-0.439 (<.001)**	**0.849 (<.001)**	1		
RIQ	**-0.255 (.031)**	-0.202 (.075)	**-0.419 (<.001)**	**0.859 (<.001)**	**0.982 (<.001)**	1	
GDP (CY)	**-0.283 (.049)**	**-0.275 (.041)**	-0.089 (.310)	**0.537 (<.001)**	**0.559 (<.001)**	**0.594 (<.001)**	1
GDP (5YA)	**-0.305 (0.033)**	**-0.287 (0.032)**	-0.070 (.419)	**0.478 (<.001)**	**0.509 (<.001)**	**0.5449**	**0.986 (<.001)**
			1990				
Homicide (5YA)	**0.982 (<.001)**	1					
Religiosity	0.073 (.575)	0.110 (.362)	1				
NIQ	**-0.287 (.015)**	**-0.302 (.006)**	**-0.376 (<.001)**	1			
LV12GeoIQ	**-0.301 (.007)**	**-0.260 (.014)**	**-0.434 (<.001)**	**0.853 (<.001)**	1		
RIQ	**-0.291 (.009)**	**-0.253 (.017)**	**-0.414 (<.001)**	**0.867 (<.001)**	**0.981 (<.001)**	1	
GDP (CY)	**-0.303 (.012)**	**-0.287 (.012)**	-0.144 (.086)	**0.583 (<.001)**	**0.588 (<.001)**	**0.616 (<.001)**	1
GDP (5YA)	**-0.298 (.014)**	**-0.283 (.013)**	-0.144 (.084)	**0.578 (<.001)**	**0.589 (<.001)**	**0.616 (<.001)**	**0.995 (<.001)**
			1995				
Homicide (5YA)	**0.950 (<.001)**	1					
Religiosity	-0.075 (.476)	-0.042 (.688)	1				
NIQ	**-0.410 (<.001)**	**-0.351 (.001)**	**-0.416 (<.001)**	1			
LV12GeoIQ	**-0.419 (<.001)**	**-0.381 (<.001)**	**-0.459 (<.001)**	**0.852 (<.001)**	1		
RIQ	**-0.404 (<.001)**	**-0.360 (<.001)**	**-0.454 (<.001)**	**0.867 (<.001)**	**0.979 (<.001)**	1	
GDP (CY)	**-0.362 (<.001)**	**-0.334 (.002)**	-0.112 (.148)	**0.548 (<.001)**	**0.575 (<.001)**	**0.594 (<.001)**	1

GDP (5YA)	**-0.360 (<.001)**	**-0.333 (.002)**	-0.112 (.146)	**0.549 (<.001)**	**0.574 (<.001)**	**0.595 (<.001)**	**0.996 (<.001)**
			2000				
Homicide (5YA)	**0.967 (<.001)**	1					
Religiosity	0.023 (.815)	0.005 (.962)	1				
NIQ	**-0.367 (<.001)**	**-0.377 (<.001)**	**-0.466 (<.001)**	1			
LV12GeoIQ	**-0.360 (<.001)**	**-0.385 (<.001)**	**-0.496 (<.001)**	**0.852 (<.001)**	1		
RIQ	**-0.354 (<.001)**	**-0.371 (<.001)**	**-0.494 (<.001)**	**0.868 (<.001)**	**0.979 (<.001)**	1	
GDP (CY)	**-0.300 (.002)**	**-0.331 (0.001)**	**-0.206 (0.007)**	**0.533 (<.001)**	**0.553 (<.001)**	**0.576 (<.001)**	1
GDP (5YA)	**-0.305 (.002)**	**-0.335 (<.001)**	**-0.223 (.003)**	**0.549 (<.001)**	**0.572 (<.001)**	**0.594 (<.001)**	**0.994 (<.001)**
			2005				
Homicide (5YA)	**0.951 (<.001)**	1					
Religiosity	-0.002 (.981)	0.102 (.182)	1				
NIQ	**-0.403 (<.001)**	**-0.458 (<.001)**	**-0.464 (<.001)**	1			
LV12GeoIQ	**-0.379 (<.001)**	**-0.541 (<.001)**	**-0.511 (<.001)**	**0.852 (<.001)**	1		
RIQ	**-0.371 (<.001)**	**-0.537 (<.001)**	**-0.508 (<.001)**	**0.868 (<.001)**	**0.979 (<.001)**	1	
GDP (CY)	**-0.302 (.001)**	**-0.382 (<.001)**	**-0.229 (.002)**	**0.538 (<.001)**	**0.559 (<.001)**	**0.585 (<.001)**	1
GDP (5YA)	**-0.300 (.001)**	**-0.383 (<.001)**	**-0.230 (.002)**	**0.542 (<.001)**	**0.564 (<.001)**	**0.589 (<.001)**	**0.996 (<.001)**
			2010				
Homicide (5YA)	**0.97 (<.001)**	1					
Religiosity	0.154 (.176)	0.116 (.132)	1				
NIQ	**-0.583 (<.001)**	**-0.451 (<.001)**	**-0.475 (<.001)**	1			
LV12GeoIQ	**-0.574 (<.001)**	**-0.502 (<.001)**	**-0.54 (<.001)**	**0.852 (<.001)**	1		
RIQ	**-0.567 (<.001)**	**-0.493 (<.001)**	**-0.53 (<.001)**	**0.868 (<.001)**	**0.979 (<.001)**	1	
GDP (CY)	**-0.329 (.005)**	**-0.341 (<.001)**	**-0.298 (<.001)**	**0.557 (<.001)**	**0.579 (<.001)**	**0.605 (<.001)**	1
GDP (5YA)	**-0.323 (.005)**	**-0.339 (<.001)**	**-0.293 (<.001)**	**0.551 (<.001)**	**0.572 (<.001)**	**0.598 (<.001)**	**0.995 (<.001)**

Notes. (CY) means current year; (5YA) means five year average. NA means data not available. Correlations with *p*s < .05 displayed in bold typeface.

Supplemental Table 3

Within-Country Associations between Religiosity and Homicide Rates by Average Country IQ With Concurrent GDP and Homicide (Rather Than Five Year Averages)

	Coef	95% CI		SE	*p*
Model 1					
Religion	0.01	-0.07	0.09	0.04	.720
Model 2a					
Religion	-3.48	-5.80	-1.17	1.17	.004
Religion X NIQ	0.04	0.01	0.06	0.01	.003
Model 2b					
Religion	-3.69	-5.92	-1.46	1.13	.001
Religion X LV12GEOIQ	0.04	0.02	0.06	0.01	.001
Model 2c					
Religion	-3.16	-5.20	-1.13	1.03	.003
Religion X RIQ	0.03	0.01	0.05	0.01	.002
Model 3					
Religion	-0.09	-0.20	0.01	0.05	.079
GDP	-0.05	-0.08	-0.02	0.02	.003
Model 4a					
Religion	-2.89	-5.32	-0.47	1.22	.020
Religion X NIQ	0.03	0.00	0.06	0.01	.021
GDP	-0.03	-0.06	0.00	0.02	.082
Model 4b					
Religion	-3.07	-5.18	-0.96	1.07	.005
Religion X LV12GEOIQ	0.03	0.01	0.05	0.01	.005
GDP	-0.03	-0.06	0.00	0.02	.036
Model 4c					
Religion	-2.51	-4.40	-0.62	0.96	.010
Religion X RIQ	0.03	0.01	0.05	0.01	.010
GDP	-0.03	-0.06	0.00	0.02	.032

Notes. Fixed effects linear regressions with robust standard errors used for all models. Homicide and GDP variables were temporally concurrent with the year in which the religiosity data were reported. All models also controlled for historical changes by including a series of dummy-coded time variables representing each of the measurement years (less one).

Cross-checking data with alternate operationalization of violence

Regrettably, there are few reliable cross-national measures of violence. For our main analysis, we selected homicide rates because homicide is defined, detected, and recorded more similarly across nations than other types of crimes (Neopolitan, 1996). However, we were very interested in cross-checking our interaction with an additional measure of violence for two reasons. First, we expect that our interaction likely exists for violence more broadly (not only homicide) and perhaps even other types of non-violent crimes (though we expect at minimum it would vary by type of non-violent crime). Second, as noted by a reviewer and our editor, homicides are a relatively rare form of violence, and so it would be more compelling if there were some evidence of the interaction when analyzing violence more broadly.

It occurred to us that the tourism industry would be interested in compiling a reasonably reliable dataset on the violence of different countries for purposes of advising citizens about which countries can be traveled to safely. We discovered the World Economic Forum's (2017) Executive Opinion Survey, which contains three questions regarding citizens' perceived safety and security of their own country (the extent to which crime and violence impose costs to businesses, the extent to which police can be relied upon, and the extent to which the threat of terrorism imposes costs to businesses). These three items are combined unweighted with the Index of Terrorism Incidence and Homicide Rates (which overlaps with our main dependent variable in the main text, but only contributes 20% of the total safety score) to create a Tourism Safety Score (higher tourism safety indicating lower perceived violence). Full data and description of the methods can be found here: http://reports.weforum.org/travel-and-tourism-competitiveness-report-2017/downloads/.

Admittedly, these data are not ideal. First, they are based largely on perceptions of crime and violence rather than actual incidence, which are subjective and likely influenced by the relative safety of surrounding countries. Second, the report contains data for 141 countries only, which limits our sample size further and raises concerns about the randomness of missing countries (likely, countries that have little tourism). Limitations aside, if these data demonstrate a similar pattern as our main multiverse, this would provide even more compelling support for our proposed interaction.

Correlations. As can be seen in Supplemental Table 4, higher tourism safety was negatively correlated with homicide rates, all three religiosity measures, and income inequality, positively correlated with all three IQ measures, GDP, and educational attainment, and unrelated to population density.

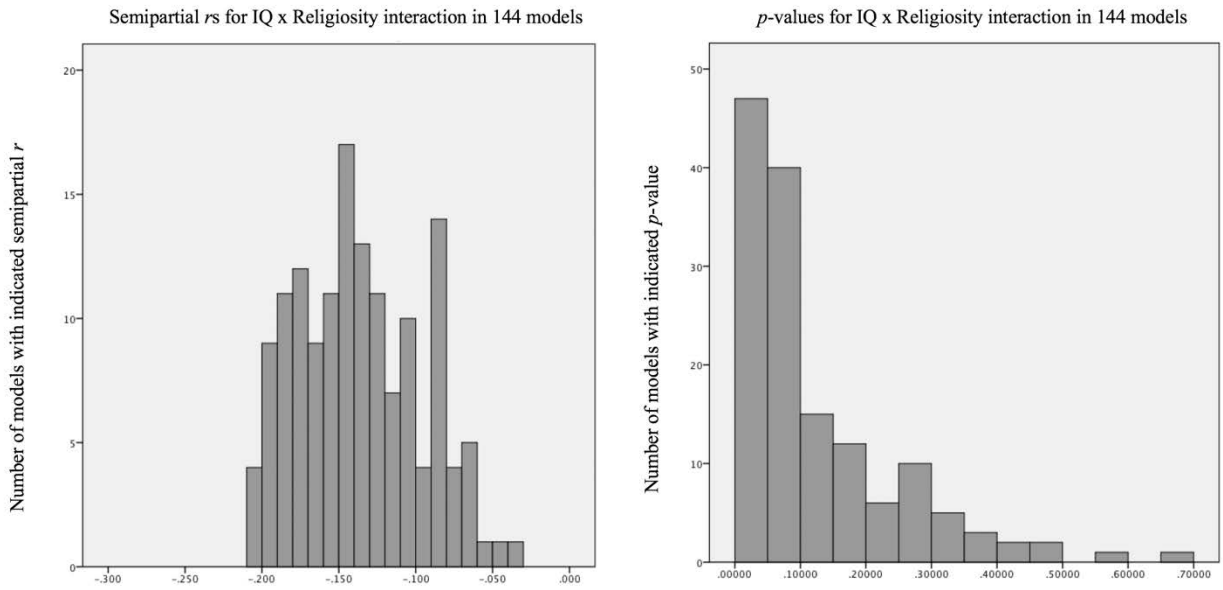
Supplemental Table 4.
Correlations between homicide rates and tourism safety and all other variables.

		Homicide Rate	Tourism Safety
Homicide Rate	*r*	1	-0.569
	p	--	<.001
NIQ	*r*	-0.421	0.515
	p	<.001	<.001
LV12GeoIQ	*r*	-0.378	0.486
	p	<.001	<.001
RIQ (4)	*r*	-0.375	0.501
	p	<.001	<.001
ARDA Religiosity	*r*	0.082	-0.298
	p	0.259	<.001
Pew Religiosity	*r*	0.101	-0.306
	p	0.135	<.001

Gallup Religiosity	*r*	0.244	-0.498
	p	0.003	<.001
GDP	*r*	-0.240	0.578
	p	<.001	<.001
Gini	*r*	0.509	-0.399
	p	<.001	<.001
Population Density	*r*	-0.102	0.153
	p	0.144	0.070
Educational Attainment	*r*	-0.248	0.399
	p	0.001	<.001

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

IQ x Religiosity Interaction. We conducted a 144 model multiverse regressing one of the three operationalizations of religiosity, one of the three operationalizations of IQ, and the relevant interaction (for nine possible interaction terms), first independently and then with every combination of the same four control variables from the main analyses on tourism safety scores (*n*s = 91-141 countries). The interaction effect was smaller, but very similar to the interaction in our main multiverse. The effect sizes for the interaction between religiosity and IQ ranged from very small, semipartial $r = -.034$, to small/medium, semipartial $r = -.206$, with a small/medium average effect size (*M* semipartial $r = -.137$, $SD = .04$). The interaction was statistically significant at $p < .050$ in 33.3% of the models, marginal ($p < .100$) in 60.4% of the models, and $p < .675$ in 100% of the models. See Supplemental Figure 1.



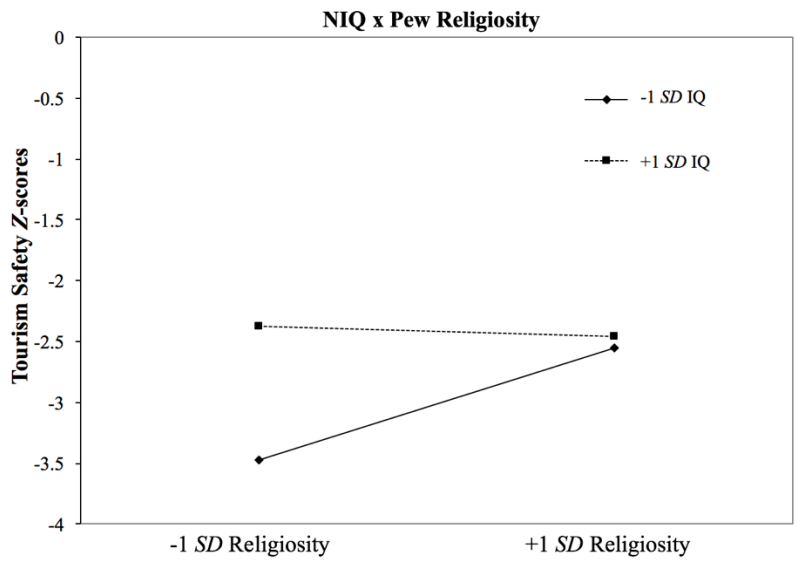
Supplemental Figure 1. Multiverse analysis frequency histograms of semipartial *rs* and *p*-values for the interactions between IQ and religiosity.

Sample model. We selected the model closest to the mean model with all four control variables to expand upon and for purposes of graphing the interaction (NIQ x Pew; See Supplemental Table 5). Note that given the limited sample size, the interaction does not reach statistical significance (p = .117), but the effect size was above the threshold for a small effect (semipartial r = -.133). Neither simple slopes one standard deviation above and below the mean are statistically significant, but Supplemental Figure 2 displays a clear pattern of results consistent with the homicide multiverse: In countries with relatively high average IQ, there was virtually no relationship (or a very slightly negative one) between higher religiosity and tourism safety scores (NIQ x Pew [b = -.04], t = -0.41, p = .683), but in countries with lower average IQ, higher religiosity was associated (non-significantly) with higher safety scores (NIQ x Pew [b = .38], t = 1.39, p = .169).

Supplemental Table 5.

Tourism safety scores regressed on IQ, religiosity, their interaction, and controls.

	F	R^2	*β*	*t*	*p*	95% CI	*Semipartial r*
Sample model for NIQ x Pew religiosity							
Model (*n* = 97)	7.58	0.37			<.001		
IQ (NIQ)			0.25	1.64	0.104	-.05, .57	0.138
Religiosity (Pew)			0.22	1.14	0.259	-.14, .51	0.095
IQ x Religiosity			**-0.28**	**-1.58**	**0.117**	**-.47, .05**	**-0.133**
GDP			0.27	1.77	0.080	-.08, 1.32	0.148
Income Inequality			-0.18	-1.71	0.090	-.39, .03	-0.144
Population Density			0.05	0.51	0.610	-.27, .46	0.043
Education			0.05	0.37	0.710	-.26, .38	0.031



Supplemental Figure 2. Interaction between NIQ x Pew religiosity on (higher) tourism safety with all four controls.

Discussion

The interaction between IQ and religiosity on tourism safety demonstrated a very similar (though weaker) pattern as the interaction between IQ and religiosity on homicide rates. Despite that the interaction was only statistically significant in 22.2% of tested models and marginal in

50% of tested models, it was similar across all models and always in the range of a very small to small/medium effect, with a small/medium average effect. Thus, these results increase our confidence that our hypothesized (and highly supported) interaction between country-level IQ and religiosity on violence is real and meaningful. Indeed, we have scrutinized this interaction in nearly every single way we could conceive of, and it remains robust.

However, given that these data are quite limited and the effect is relatively small, we consider these data confirmatory support for the interaction reported in the main text only, and we do not consider these conclusive support for tourism safety specifically. We have not exposed these analyses to the same level of scrutiny as we did the interaction reported in the main text. In other words, we would not interpret this interaction as indicating that countries relatively low in both IQ and religiosity would be generally unsafe to travel to. Rather, we are quite confident now that such countries have relatively high homicide rates and (possibly) more violence in general.

Galton's Problem Analyses

Please see the subheading Galton's Problem and Spatial Autocorrelation in the main text for a description of what these analyses are and why they were performed.

Supplemental Table 5.
Testing within world region and within majority religion

Controlling for Region	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	9: All	0.234	0.001	101
NIQxPew	9: All	0.258	<.001	103
NIQxGallup	9: All	0.092	0.214	97
LV12xARDA	9: All	0.190	0.005	119
LV12xPew	9: All	0.209	0.002	122
LV12xGallup	9: All	0.081	0.259	111
RIQxARDA	9: All	0.197	0.004	119
RIQxPew	9: All	0.236	<.001	122
RIQxGallup	9: All	0.099	0.172	111
Within Regions				
Europe and Central Asia	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	-0.038	0.778	48
NIQxPew	None	-0.165	0.232	48
NIQxGallup	None	-0.097	0.501	45
LV12xARDA	None	0.178	0.260	50
LV12xPew	None	0.071	0.589	51
LV12xGallup	None	0.018	0.895	45
RIQxARDA	None	0.137	0.247	50
RIQxPew	None	0.090	0.474	51
RIQxGallup	None	0.006	0.964	45
NIQxARDA	1: Gini	0.122	0.554	21
NIQxPew	1: Gini	0.148	0.487	21
NIQxGallup	1: Gini	0.099	0.641	21
LV12xARDA	1: Gini	0.038	0.860	23
LV12xPew	1: Gini	0.036	0.865	23
LV12xGallup	1: Gini	-0.007	0.973	22
RIQxARDA	1: Gini	0.097	0.661	23
RIQxPew	1: Gini	0.079	0.718	23
RIQxGallup	1: Gini	0.027	0.904	22
Middle East and Africa	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	-0.056	0.693	44
NIQxPew	None	0.038	0.763	45

NIQxGallup	None	0.396	0.012	36
LV12xARDA	None	0.017	0.882	66
LV12xPew	None	-0.187	0.078	67
LV12xGallup	None	0.255	0.047	52
RIQxARDA	None	0.012	0.917	66
RIQxPew	None	-0.127	0.241	67
RIQxGallup	None	0.265	0.044	52
NIQxARDA	1: Gini	0.335	0.062	28
NIQxPew	1: Gini	0.143	0.368	28
NIQxGallup	1: Gini	0.141	0.398	25
LV12xARDA	1: Gini	0.457	0.001	42
LV12xPew	1: Gini	0.322	0.013	43
LV12xGallup	1: Gini	0.258	0.056	38
RIQxARDA	1: Gini	0.489	0.001	42
RIQxPew	1: Gini	0.342	0.009	43
RIQxGallup	1: Gini	0.260	0.056	38
South Asia and East Asia Pacific	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	0.493	0.033	20
NIQxPew	None	0.386	0.064	23
NIQxGallup	None	0.211	0.350	19
LV12xARDA	None	0.033	0.850	34
LV12xPew	None	0.044	0.780	39
LV12xGallup	None	0.024	0.910	21
RIQxARDA	None	0.156	0.363	34
RIQxPew	None	0.165	0.286	39
RIQxGallup	None	-0.048	0.822	21
NIQxARDA	1: Gini	-0.047	0.846	18
NIQxPew	1: Gini	-0.059	0.792	20
NIQxGallup	1: Gini	0.450	0.178	18
LV12xARDA	1: Gini	0.163	0.492	22
LV12xPew	1: Gini	0.082	0.704	24
LV12xGallup	1: Gini	-0.131	0.591	18
RIQxARDA	1: Gini	0.181	0.401	22
RIQxPew	1: Gini	0.110	0.583	24
RIQxGallup	1: Gini	-0.118	0.626	18
North and Latin America and Caribbean	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	0.288	0.093	28
NIQxPew	None	0.175	0.292	30
NIQxGallup	None	0.134	0.458	25

LV12xARDA	None	0.194	0.256	35
LV12xPew	None	0.257	0.115	37
LV12xGallup	None	-0.052	0.782	26
RIQxARDA	None	0.209	0.224	35
RIQxPew	None	0.258	0.117	37
RIQxGallup	None	0.010	0.960	26
NIQxARDA	1: Gini	0.122	0.554	21
NIQxPew	1: Gini	0.148	0.487	21
NIQxGallup	1: Gini	0.099	0.641	21
LV12xARDA	1: Gini	0.038	0.860	23
LV12xPew	1: Gini	0.036	0.865	23
LV12xGallup	1: Gini	-0.007	0.973	22
RIQxARDA	1: Gini	0.097	0.661	23
RIQxPew	1: Gini	0.079	0.718	23
RIQxGallup	1: Gini	0.027	0.904	22
Within Religions				
Christian Majority	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	0.269	0.001	88
NIQxPew	None	0.193	0.024	91
NIQxGallup	None	0.152	0.101	78
LV12xARDA	None	0.308	<.001	118
LV12xPew	None	0.197	0.015	124
LV12xGallup	None	0.262	0.007	87
RIQxARDA	None	0.297	<.001	118
RIQxPew	None	0.211	0.009	124
RIQxGallup	None	0.281	0.004	87
NIQxARDA	1: Gini	0.238	0.007	74
NIQxPew	1: Gini	0.124	0.173	74
NIQxGallup	1: Gini	0.057	0.546	71
LV12xARDA	1: Gini	0.236	0.007	87
LV12xPew	1: Gini	0.174	0.049	87
LV12xGallup	1: Gini	0.139	0.149	79
RIQxARDA	1: Gini	0.224	0.010	87
RIQxPew	1: Gini	0.191	0.030	87
RIQxGallup	1: Gini	0.149	0.123	79
Muslim Majority	**Controls**	**semipartial *r***	***p***	***n***
NIQxARDA	None	-0.188	0.248	35
NIQxPew	None	-0.055	0.745	35
NIQxGallup	None	0.021	0.907	31
LV12xARDA	None	-0.071	0.590	45

LV12xPew	None	0	0.998	45
LV12xGallup	None	0.041	0.786	38
RIQxARDA	None	-0.069	0.606	45
RIQxPew	None	-0.01	0.943	45
RIQxGallup	None	0.074	0.616	38
NIQxARDA	1: Gini	-0.136	0.470	24
NIQxPew	1: Gini	-0.117	0.538	24
NIQxGallup	1: Gini	0.053	0.785	23
LV12xARDA	1: Gini	-0.02	0.906	31
LV12xPew	1: Gini	-0.036	0.831	31
LV12xGallup	1: Gini	0.071	0.670	28
RIQxARDA	1: Gini	-0.023	0.894	31
RIQxPew	1: Gini	-0.033	0.844	31
RIQxGallup	1: Gini	0.114	0.480	28

Controlling for Spatial Autocorrelation in *Declines in Religiosity Predict Increases in Violent Crime Among Low IQ Countries Only*

By Scott Claessens

I ran Bayesian multilevel regressions including a Gaussian process to account for spatial autocorrelation between countries. I fitted 18 models in total: all 9 main models with each possible combination of IQ and Religion measures (3 IQ measures x 3 Religiosity measures) and again including all four controls (GDP square root, GINI coefficient, population density, and education). For these models, I calculated pMCMC values (proportion of posterior samples for the interaction parameter below zero), effect sizes as semi-partial rs (square root of Bayesian R square change from adding interaction parameter), and changes in Leave-One-Out Cross-Validation (LOO) from adding the interaction parameter.

The interaction parameter was statistically significant at pMCMC < .001 in 1/18 (5.55%) of these models , pMCMC < .010 in 6/18 (33.33%) of models, pMCMC < .050 in 8/18 (44.44%) of models, pMCMC < .100 in 13/18 (72.22%) of models, and pMCMC < .228 in 18/18 (100%) of models. Effect sizes for these models ranged from neglibile (r = .00) to small (r = .21), with a small average effect size (M semipartial r = .08, SD = .05). Adding the interaction parameter resulted in a significant improvement in LOO (95% CIs excluded 0) in 2/18 (11.11%) of models. Thus, accounting for spatial autocorrelation weakens the interaction effect, but does not abolish it entirely.

There still remain some limitations of these analyses. First, I dealt with missing data via listwise deletion, following the original authors. But this approach is not advised unless data are Missing Completely At Random or sample sizes are sufficiently large. Future analyses of these data could consider approaches like Bayesian imputation or multiple imputation (imputation would work well with the high correlations within IQ and Religiosity variables). Second, no measurement error is included on the IQ variables, despite them being country-level average scores. Including sufficiently large standard errors around these averages into the model would likely reduce the strength of the associations we see.

The R code used for analysis and exact results of all models are available at: https://osf.io/wjg45/. If you use this analysis code, please reference as:

Claessens, S. (2019). Controlling for spatial autocorrelation in "Declines in Religiosity Predict Increases in Violent Crime Among Low IQ Countries Only".

Data Auditor Report

Multiverse Reanalysis of *Declines in Religiosity Predict Increases in Violent Crime Among Low IQ Countries Only*

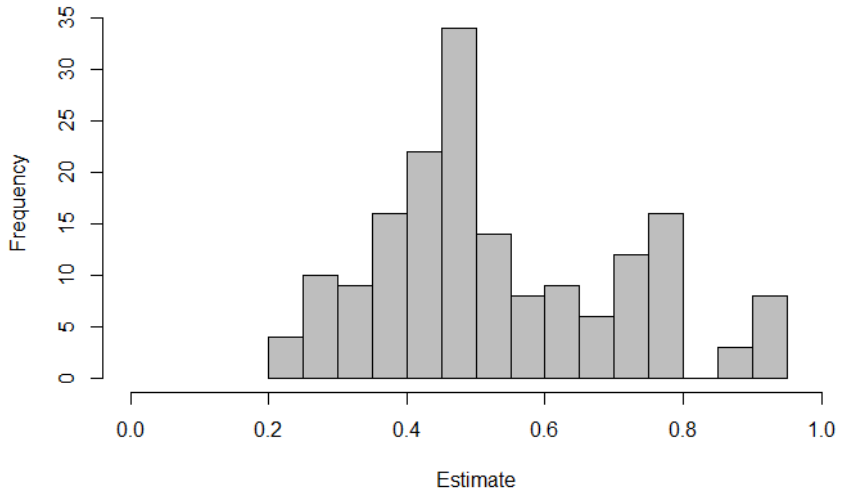
By Cindel J. M. White

A copy of the manuscript and data were provided for an independent attempt to re-create the multiverse analysis reported in Study 2. Original analyses were performed in SPSS, and all re-analyses were performed in R (version 3.4.3, R Core Team, 2017), including rescaling variables (standardizing and dummy coding) from the raw data. The R code used for analysis and exact results of all models are available at: https://osf.io/v79gm/. If you use this analysis code, please reference as:

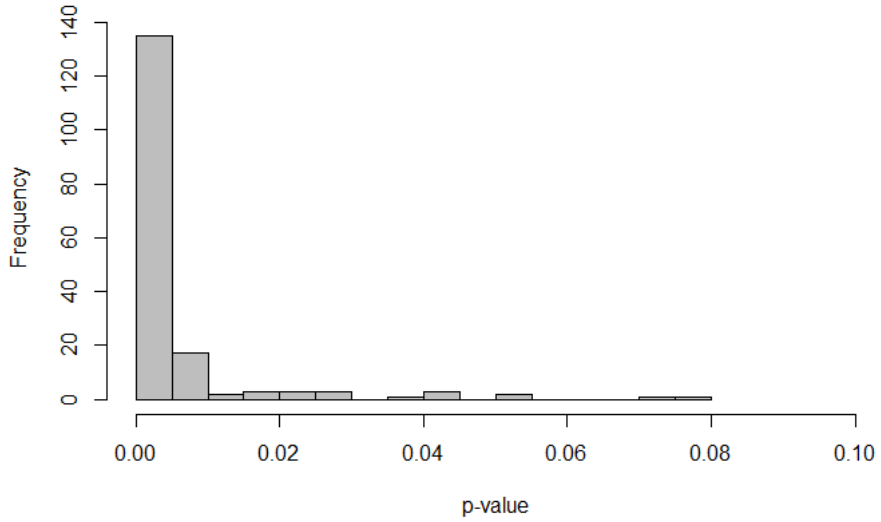
White, C. J. M. (2019). Multiverse reanalysis of "Declines in Religiosity Predict Increases in Violent Crime Among Low IQ Countries Only". doi:10.17605/OSF.IO/V79GM

The first set of re-analyses attempted to replicate the multiverse of 171 regressions summarized in Study 2, in which each country's homicide rate was predicted by (a) one of three operationalizations of religiosity, (b) one of the three operationalizations of IQ, (c) the relevant interaction, and (d) all possible combinations of control variables (including three additional models that included all controls plus, in separate regressions, the interaction between religiosity and GDP, religiosity and income inequality, and religiosity and educational attainment). This resulted in a multiverse of 171 possible regression models. All variables were standardized prior to analysis, except for GDP, which was square root transformed prior to analysis (except for in models that included the interaction between GDP and religiosity, where GDP was also standardized). Missing data was handled through listwise deletion. These analyses indicated an average interaction effect of $b = .53$ (Supplemental Figure 3). Across all analyses, 66.1% of p-values were below .001, 88.9% of p-values were below .01, 97.7% of p-values were below .05 (see Supplemental Figure 4).

Supplemental Figure 3. Standardized interaction effect size across a multiverse of regression models.



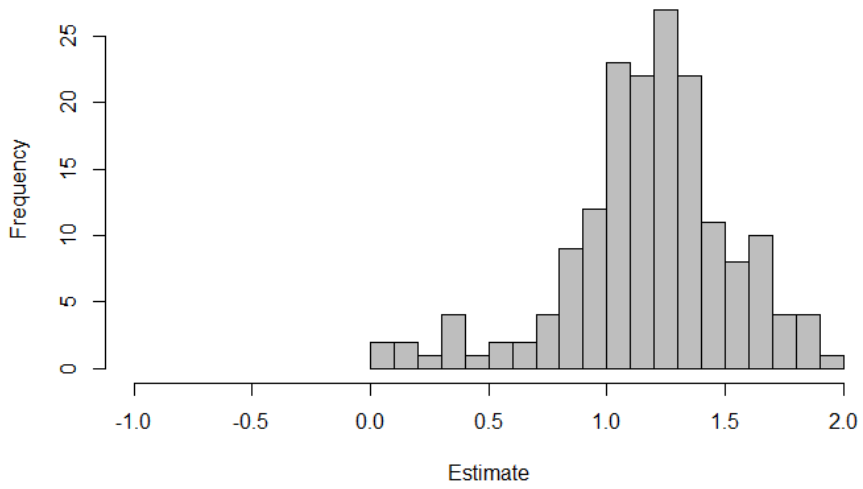
Supplemental Figure 4. P-values across a multiverse of regression models.



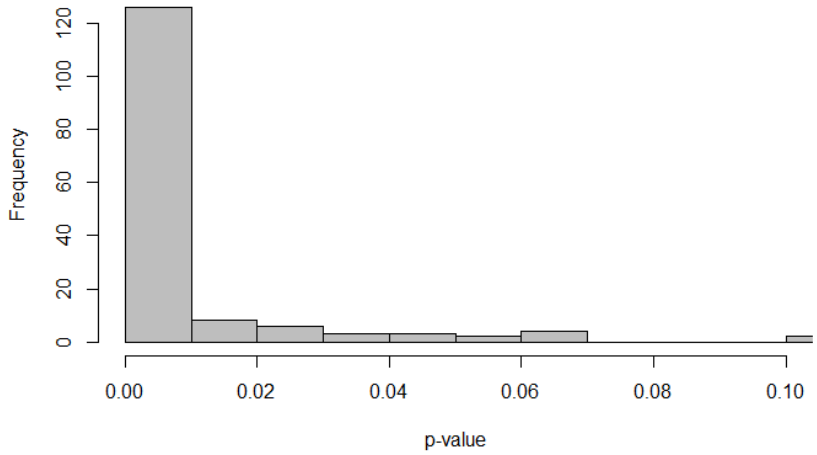
A second set of re-analyses replicated the same 171 combinations of primary and control variables, but used dummy coded indicators of each operationalization of religiosity and IQ (based on a median split: 0 = below median, 1 = above median), rather than a standardized continuous measure of these variables. Control variables were rescaled in the same manner as previously, and missing data was handled through listwise deletion. These analyses indicated an

average interaction effect of *b* = 1.17 (Supplemental Figure 5). Across all analyses, 48.5% of p-values were below .001, 73.7% of p-values were below .01, 85.4% of p-values were below .05 (see Supplemental Figure 6). These two sets of analyses therefore provide strong support for the hypothesized interaction effect's robustness to alternative analysis strategies.

Supplemental Figure 5. Interaction effect size across a multiverse of regression models based on a median split of religiosity and IQ variables.



Supplemental Figure 6. P-values across a multiverse of regression models, based on a median split of religiosity and IQ variables.



Testing Potential Mechanisms

As noted in the main text, we do not know *why* religion appears to have greater utility in deterring violence in countries with relatively low average IQs. We speculated that perhaps having a relatively intelligent society contributes to highly functional group-level institutions and norms which may help regulate behavior even in the absence of religion. We were hesitant to test any specific possible mechanisms for numerous reasons. First, we suspect there are multiple mechanisms that likely are related to one another in multiple, complicated ways. Second, every additional variable included in our models reduces our (already limited) sample of overlapping estimates and adds measurement error. Third, we would not know how to select among the many possible variables we could test. However, two reviewers suggested liberalism or Democracy, and we were aware that Democracy was highly related to one of our explicitly speculated mechanisms: Rule of Law. For these reasons, we decided to test these two variables as potential mechanisms in exploratory analyses.

Method

These analyses were preregistered: http://aspredicted.org/blind.php?x=sq8ph9. We followed this preregistration exactly. Specifically, we planned to run 18 additional regressions, controlling for either Rule of Law or Democracy (separately), in each of the 9 possible full models (controlling for GDP, income inequality, population density, and educational attainment). If and only if adding Rule of Law or Democracy to the models substantially reduced the size of the interaction effect, we would then conduct moderated mediations. We used the World Bank's Rule of Law Index (2019; part of their World Governance Indicators series) and the Economist Intelligence Unit's (2010) Democracy Rankings. As stated in the preregistration, regardless of

how the results turned out, we would consider them only suggestive and not at all conclusive evidence for or against either proposed mechanism.

Results

Despite that stronger Rule of Law consistently significantly predicted lower homicide rates across all nine models (semipartial *r*s = -.180 - -.282, *p*s<.045), adding Rule of Law to the models had little influence on the size of the interaction effect (semipartial *r*s = .133 - .381, *p*s<.137). Unlike Rule of Law, Democracy was not a significant predictor in any models (semipartial *r*s = -.022 - .134, *p*s>.102), but also had very little influence on the size of the interaction effect (semipartial *r*s = .230 - .423, *p*s<.009).

Discussion

As we stated in the preregistration, we do not think these results rule democracy or rule of law out as potential mechanisms. They might suggest, at minimum, that rule of law (or democracy) *alone* probably does not account for the observed interaction effect. However, it is still possible that some combination of variables, including democracy or rule of law might explain the observed interaction effect. Given the consistent effect of rule of law, we hope future researchers will consider this variable in their future explorations of these data, as we do feel this is a very plausible mechanism (if not alone, then perhaps with other variables).

Pre-peer Review Methods and Results of Study 2

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 is no objective best measure of religiosity nor an objective best list of relevant control variables, we conducted a multiverse analysis using three different operationalizations of religiosity and all possible combinations of five control variables. Multiverse analysis reports all (or at least many) of the conceivable statistical models to eliminate researcher degrees of freedom (Steegen, Tuerlinkx, Gelman, & Vanpaemel, 2016). Thus, religiosity was operationalized as the percent of the population affiliated with any religion (Pew Research Center, 2012), the percent of the population that practices 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). Average IQ estimates by country were drawn from Lynn and Vanhanen (2002; 2006; see Study 1 Methods for discussion of the validity of these data). 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, these two sources provide the best available estimates for IQ and homicide rates, and so no other operationalizations of these variables were included in the multiverse analysis.

In all possible combinations, we controlled for various other factors generally regarded to be related to homicide rates: average yearly temperature (The World Bank, 2011), Gross Domestic Product per capita (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 parasite stress (Fincher & Thornhill, 2012).

This produced 96 possible statistical models with 129 to 183 countries for the Pew analyses, 127 to 178 countries for the ARDA analyses, and 118 to 139 countries for the Gallup analyses. All variables were *z*-transformed prior to analysis.[1]

Results

Correlations. As can be seen in the correlation matrix (Table 2), higher homicide rates were associated with lower IQ and GDP and higher income inequality, temperature, and parasite stress. 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 and population density and lower religiosity, income inequality, temperature, and parasite stress. Higher religiosity was positively associated with income inequality, temperature, and parasite stress, negatively correlated with GDP, and unrelated to population density.

[1] Square root transforming GDP (as in Study 1) instead of *z*-transforming did not alter the results.

Table 2.
Correlation matrix for Study 2.

		Homicide Rate	2	3	4	5	6	7	8	9
IQ (2)	*r*	-.386								
	p	<.001								
ARDA Religiosity (3)	*r*	.082	-.501							
	p	.259	<.001							
Pew Religiosity (4)	*r*	.101	-.490	.870						
	p	.135	<.001	<.001						
Gallup Religiosity (5)	*r*	.244	-.723	.715	.730					
	p	.003	<.001	<.001	<.001					
GDP (6)	*r*	-.240	.526	-.255	-.283	-.479				
	p	<.001	<.001	<.001	<.001	<.001				
Income Inequality (7)	*r*	.509	-.485	.340	.184	.505	-.369			
	p	<.001	<.001	<.001	.031	<.001	<.001			
Population Density (8)	*r*	-.102	.222	-.041	-.106	-.103	.377	.088		
	p	.144	.003	.579	.125	.220	<.001	.303		
Temperature (9)	*r*	.328	-.692	.502	.471	.725	-.346	.522	.075	
	p	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.330	
Parasite Stress	*r*	.328	-.676	.394	.296	.708	-.576	.561	-.132	.695
	p	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.071	<.001

Bold indicates traditional standards of statistical significance.

Multiverse analysis. In 96 separate regressions, homicide rates were regressed on one of the three operationalizations of religiosity, IQ, and the interaction, independently and with every possible combination of the five control variables, excluding listwise. As can be seen in Figure 1, across all possible models, the effect sizes for the interaction between religiosity and IQ ranged from small, semipartial r = .11, to medium/large, semipartial r = .39 (Cohen, 1992), with a small to medium average effect size (*M* semipartial r = .24, *SD* = .07). The interaction was statistically significant ($p < .05$) in 83.3% of all possible models and marginal ($p < .10$) in 87.5% of all possible models. The interaction in all ARDA models, semipartial *r*s = .26-.39, *p*s < .001, and all Pew models, semipartial *r*s = .21-.28, *p*s < .001-.004, was statistically significant at *p*s < .005.[2] Only in the Gallup models (which had the fewest included countries) did the interaction occasionally fail to reach statistical significance, but it was always within the range of a small to medium effect size, semipartial *r*s = .11-.27, *p*s < .001- .177.[3]

[2] ARDA and Gallup religiosity were skewed, so analyses were re-run omitting countries more than 3 SDs below the mean (Czech Republic, Estonia, and South Korea for ARDA, and these three plus Japan for Pew). This did not affect the effect size or statistical significance of the IQ by ARDA religiosity interaction with or without controls, semipartial *r*s = .28-.36, *p*s < .001, nor the IQ by Pew religiosity interaction with or without controls, semipartial *r*s = .22, *p*s < .004.

[3] 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 average IQ or low religiosity and low average IQ), we performed median splits on religiosity and IQ and cross-checked the interactions in 2 x 2 ANOVAs. All three interactions (IQ by ARDA, Pew, and Gallup) were statistically significant, *p*s < .001, with medium to large effect sizes, η_p^2s = .124-.202. 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 groups on homicide rates, *p*s > .197 (nor were the differences in the same direction across the three measures of religiosity).

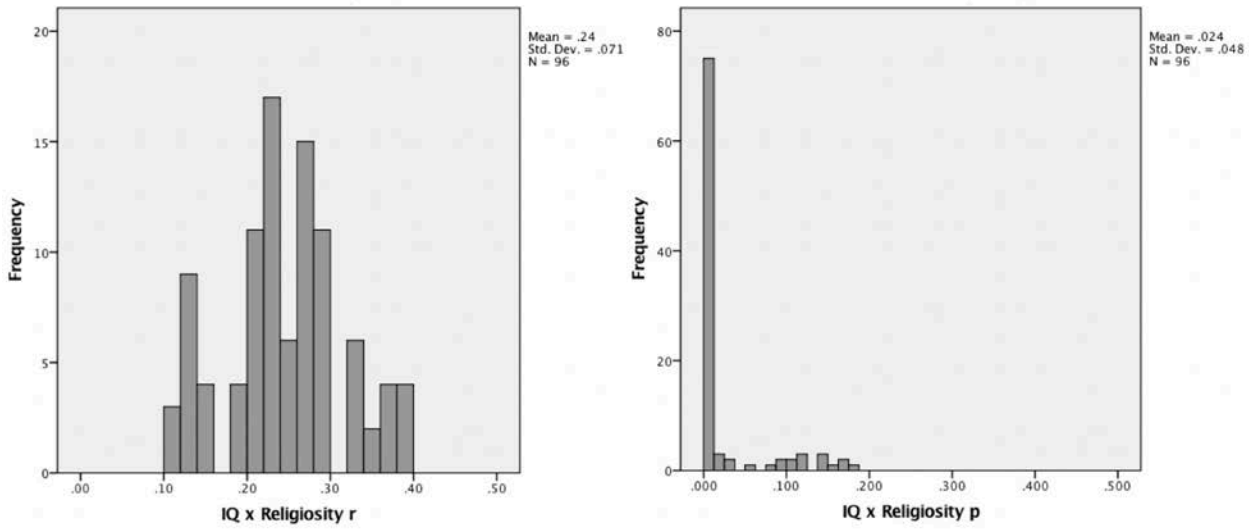


Figure 1. Multiverse analysis histograms of semipartial *rs* and *p*-values for the interaction between religiosity and IQ.

These main analyses were also cross-checked with Lynn and Meisenberg's (2010) data, which had a more limited sample, but also contained an IQ data quality variable, which was included as an additional control. With these data, the IQ by ARDA religiosity interaction was significant without controls (n = 101; semipartial r = .30, p < .001) and with all controls (n = 74; semipartial r = .23, p = .012), the IQ by Pew religiosity interaction was significant without controls (n = 104; semipartial r = .19, p = .027) and with all controls (n = 74; semipartial r = .26, p = .005), and the IQ by Gallup religiosity interaction was significant without controls (n = 91; semipartial r = .21, p = .029) and with all controls (n = 70; semipartial r = .23, p = .013). In every case, the IQ by religiosity interaction effect size was in the small to medium range (very similar to the results of the multiverse analysis).

Sample model. Because the Pew results produced the most moderate estimates of the religiosity x IQ effect size, we expanded this model for purposes of graphing the interaction. In a stepwise regression (n = 129 countries), homicide rates were regressed on Pew religiosity, IQ, and the interaction first, and then again controlling for GDP, Gini, population density, average

yearly temperature, and parasite stress, excluding listwise. As can be seen in Table 3, higher average IQ significantly predicted lower homicide rates (semipartial r = -.43), p < .001, which maintained a small but not statistically significant effect size with covariates (semipartial r = -.12), p = .103. Higher religiosity also predicted lower homicide rates without covariates (semipartial r = -.30), p < .001, and with covariates (semipartial r = -.26), p = .001.

Consistent with our hypothesis, there was a small to medium significant IQ by religiosity interaction without covariates (semipartial r = .27), p = .001, and with covariates (semipartial r = .22), p = .004. 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 ≈ 96), there was a small relationship between higher religiosity and lower homicide rates (b = -.19), t = -2.14, p = .035, but in countries with lower average IQ (IQ ≈ 73), this relationship was much larger (b = -.91), t = -3.39, p = .001. It may be worth noting that although all included variables except population density were correlated with homicide rates, only religiosity, the IQ by religiosity interaction, and income inequality remained significant predictors of homicide rates in the full model, each of which had small to medium effect sizes. The relationship between lower GDP and higher homicide rates was small to non-existent (semipartial r = -.05), p = .469, and the relationships between average yearly temperature and parasite stress with homicide rates were virtually zero (semipartial rs < .01), ps > .902.

Table 3.
Homicide rate regressed on IQ, Pew religiosity, their interaction and relevant controls in the initial multiverse.

	F	R^2	*β*	*t*	*p*	95% CI	*Semi-partial r*
Homicide Rate (Model)	13.62	.245			<.001		
IQ			-.495	-5.511	<.001	-.737, -.347	-.427

Religiosity			-.616	-3.843	<.001	-.907, -.290	-.298
IQ x Religiosity			**.523**	**3.460**	**.001**	**.172, .633**	**.268**
Homicide Rate (Model)	8.30	.354			<.001		
IQ			-.217	-1.644	.103	-.523, .048	-.120
Religiosity			-.567	-3.488	.001	-.863, -.238	-.255
IQ x Religiosity			**.466**	**2.951**	**.004**	**.118, .599**	**.216**
GDP			-.080	-.726	.469	-.404, .187	-.053
Gini			.372	3.925	<.001	.198, .601	.287
Population Density			.029	.369	.713	-1.72, 2.51	.027
Temperature			.012	.096	.924	-.263, .289	.007
Parasite Stress			.019	.121	.903	-.300, .339	.009

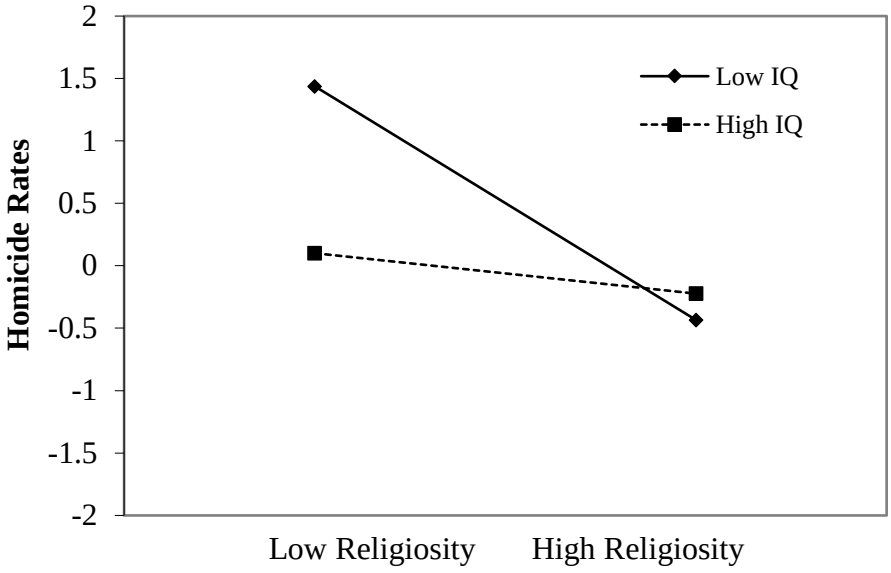


Figure 2. Interaction between IQ and religiosity on homicide rates with controls in Study 2.

Additional References

(only those not included in the main text but cited in supplement)

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