

See discussions, stats, and author profiles for this publication at: <http://www.researchgate.net/publication/279642865>

Negative Stereotypes Cause Christians to Underperform in and Disidentify With Science

ARTICLE in SOCIAL PSYCHOLOGICAL AND PERSONALITY SCIENCE · DECEMBER 2015

Impact Factor: 2.56 · DOI: 10.1177/1948550615598378

READS

292

4 AUTHORS, INCLUDING:



Zhen Hadassah Cheng

University of Oregon

4 PUBLICATIONS 1 CITATION

SEE PROFILE



Azim Shariff

University of Oregon

39 PUBLICATIONS 1,145 CITATIONS

SEE PROFILE

Negative Stereotypes Cause Christians to Underperform in and Disidentify with Science

Cite As:

Rios, K., Cheng, Z.H., Trotton, R.R., & Shariff, A.F. (In press). Negative Stereotypes Cause Christians to Underperform in and Disidentify with Science. *Social and Personality Psychological Science*.

For Peer Review

Abstract

Despite Christians being a religious majority in the U.S., relatively few pursue higher education and careers in science. Our studies show that stereotypes about Christians being less competent in science than other groups are recognized by both Christians and non-Christians, and are openly endorsed by non-Christians (Study 1). Our studies further demonstrate that when these stereotypes become salient, Christians are less interested in and identified with science (Study 2), and underperform on science-relevant tasks (Studies 3-5), compared to non-Christians. Even subtle contextual cues that bear more or less relevance to science are sufficient to compromise Christians' scientific task performance, particularly among the highly religious (Study 5). When these stereotypes are explicitly removed, however, performance differences between Christians and non-Christians disappear. These results suggest that Christians' awareness of the negative societal stereotypes about their group's scientific competence may be partially responsible for the underperformance and underrepresentation of Christians in scientific fields.

Key Words: religiosity; scientific performance; negative stereotypes; social identity threat; stereotype threat

Although over 90% of Americans report believing in God (Gallup, 2011), religious believers account for only 25% of natural science faculty at elite American universities (Calhoun, Aronczyk, Mayrl, & VanAntwerpen, 2007). In general, there are lower proportions of religious believers among science than humanities faculty (Gross & Simmons, 2009). What explains these discrepancies? Given concerns about the dearth of American students who ultimately pursue scientific careers (Moss-Racusin, van der Toorn, Dovidio, Brescoll, & Handelsman, 2012), the lack of diversity of students and faculty in the sciences (CEOSE, 2014), and America's low scientific literacy (on which religious believers trail non-believers; Sherkat, 2011), understanding the reasons is critical.

Previous psychological explanations have focused on two differences between religious believers and non-believers: intelligence, and intuitive versus analytical thinking styles. For instance, a recent meta-analysis found that religiosity and intelligence test performance are inversely correlated (Zuckerman, Silberman, & Hall, 2013). Other studies point to a disjuncture between thinking styles that involve faith and intuition on one hand, and scientific and analytical thinking on the other hand. Consistent with this disconnection, religious believers use intuition more than do non-believers (Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Shenhav, Rand, & Greene, 2012). In addition, experimentally inducing people to adopt an analytical mindset decreases subsequent religious belief (Gervais & Norenzayan, 2012). Therefore, religious believers' underrepresentation in science is often explained as a product of their presumed lower intelligence, an incompatibility between intuitive and analytical thinking styles, or both.

We propose an additional, novel factor: negative societal stereotypes about the scientific competency of Christians (who comprise 94% of religious Americans; Gallup, 2012), and about the perceived incompatibility between Christianity and science, may cause Christians to disengage from and underperform in scientific disciplines. The detrimental effects of negative stereotypes on academic identification and performance in have been documented across many groups, including women in science (Cheryan, Plaut, Davies, & Steele, 2009; Murphy, Steele, & Gross, 2007), African Americans in academics (Steele & Aronson, 1995), and low-SES individuals in higher education (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). In these studies, increasing the salience of one's group membership or the stereotype itself exacerbates the stereotyped behaviors. For example, African Americans asked to indicate their ethnicity on a demographic questionnaire subsequently underperform on standardized test questions and disidentify with academics (Steele & Aronson, 1995). Additionally, women underperform on mathematics tests when led to believe there are gender differences in math ability (Dar-Nimrod & Heine, 2006; Spencer, Steele, & Quinn, 1999), and they demonstrate reduced scientific interest and performance when exposed to cues suggesting that women do not belong in science (Cheryan et al., 2009; Inzlicht & Ben-Zeev, 2000; Murphy et al., 2007).

These stereotypes need not be personally endorsed for such effects to emerge; indeed, the mere awareness that others may endorse the stereotypes is sufficient to undermine academic performance and identification (Steele, 1997). Furthermore, the impact of negative stereotypes has been shown even for majority groups that are not generally stigmatized in society as a whole. European American men, for instance, are

susceptible to underperformance in mathematics when compared to Asian Americans (Aronson, Lustina, Good, Keough, Steele, & Brown, 1999) and in athletics when compared to African Americans (Stone, Lynch, Sjomeling, & Darley, 1999).

If Christians disengage from and underperform in science due to their perception of negative stereotypes about Christians and science, these stereotypes may ultimately deter them from scientific disciplines and careers, thereby perpetuating the original stereotypes. Critically, however, when these negative stereotypes are removed, Christians may identify as much with science and perform as well on science-relevant tasks as non-Christians, just as women exhibit equivalent scientific identification and performance to men when stereotypic cues about gender and science are removed (e.g., Cheryan et al., 2009; Murphy et al., 2007; Spencer et al., 1999).

Across five studies, we tested both Christians' and non-Christians' awareness of negative stereotypes about Christians in science (Study 1), as well as the impact of such stereotypes on scientific identification (Study 2) and performance (Studies 3-5). We focused on Christians both because they constitute the majority of religious believers in the U.S. (Gallup, 2012), and because some preliminary evidence suggests that Christians – unlike other religious groups (e.g., Jews, Muslims) – tend to be stereotyped as less competent than warm (Fiske, Cuddy, Glick, & Xu, 2002).¹ We sought to collect data from approximately 200 participants in Study 1 (which tested stereotype content) and 30 participants per cell in Studies 3-4 (which tested effects of stereotypes on Christians' performance; equivalent sample sizes were obtained in similar studies: Dar-Nimrod & Heine, 2006; and Mrazek, Chin, Schmader, Hartson, Smallwood, & Schooler, 2011). In Studies 2 and 5, we stopped data collection at the end of the semester.

Study 1

Method

Participants. Two hundred and two U.S. residents (102 women; $M_{\text{age}} = 34.95$, $SD = 12.09$; 99 Christians, 103 non-Christians), recruited from Amazon's Mechanical Turk (mTurk) website, participated online in exchange for \$.50. Thirty-three participants were omitted for failing a basic attention check item, leaving 169 in the final sample.

Procedure and Materials. After providing demographics and their religious affiliation, participants rated four groups—atheists, Christians, Jews, and Muslims—in random order on societal stereotypes. Specifically, they rated on a scale from -3 (e.g., “less competent than the average person”) to 3 (e.g., “more competent than the average person”) whether the group was stereotyped to be higher or lower than the average person in terms of overall competence, competence at science, trust in science, and warmth.

To assess whether participants actually endorsed societal stereotypes about the four groups, participants subsequently rated their personal beliefs about each group using the same scales and characteristics.

Results and Discussion

One sample t -tests revealed that participants perceived Christians to be stereotyped as low in scientific competence and trust in science compared to the scale midpoint ($ps < .001$). However, they perceived no stereotype about Christians' general competence ($p > .250$) and perceived Christians to be stereotyped as high in warmth ($p < .001$), suggesting that the negative stereotypes were specific to science (see Table 1, Figure 1). Notably, both Christians ($M_{\text{competence}} = -.65$, $SE = 1.66$, $p < .005$; $M_{\text{trust}} = -.92$, $SE = 1.71$, $p < .001$) and non-Christians ($M_{\text{competence}} = -1.31$, $SE = 1.30$, $p < .001$; $M_{\text{trust}} = -$

1.89, $SE = 1.26$, $p < .001$) recognized the societal stereotypes of Christians as low in competence in and trust of science. Paired-samples t -tests comparing Christians to each of the target groups revealed that Christians were also perceived to be stereotyped as lower in scientific competence ($ts < -2.75$, $ps < .001$) and trust in science ($ts < 3.16$, $ps < .010$) than Jews, Muslims, and atheists.

Regarding personal beliefs about Christians, Christian participants believed their own group to be as competent in ($M = .14$, $SE = 1.47$, $p > .250$) and trusting of science ($M = -.18$, $SE = 1.69$, $p > .250$), but more generally competent ($M = .68$, $SE = 1.42$, $p < .001$) and warmer ($M = 1.04$, $SE = 1.59$, $p < .001$), than the average person. Non-Christians, by contrast, personally believed Christians were less competent in ($M = -.84$, $SE = 1.31$, $p < .001$) and trusting of science ($M = -1.46$, $SE = 1.34$, $p < .001$), less generally competent ($M = -.34$, $SE = 1.11$, $p = .004$), and equally warm ($M = .02$, $SE = 1.24$, $p > .250$), compared to the average person (see Figure 2).

Study 2

Study 1 shows the general awareness of negative stereotypes about Christians in science. Furthermore, non-Christians personally believe that Christians are inferior at and distrustful of science, suggesting that the stereotypes are both pervasive and socially acceptable. In Study 2, we tested the possibility that these stereotypes may influence Christian college students' own feelings about science, just as women's and minorities' feelings about science can be affected by stereotypes about their groups (Cheryan et al., 2009; Murphy et al., 2007).

Method

Participants. One hundred psychology undergraduates (39 men, 61 women; $M_{age} = 19.36$, $SD = 1.88$; 62 Christians, 35 non-Christians, 3 unspecified) completed a laboratory study for credit. Participants reported their religious affiliation in a pre-screening survey. Three participants who suspected that the news article was not real and three participants whose religious affiliation was unspecified were dropped from analyses, as was one outlier with an extreme Cook's D score of .10 (5 SD above the mean). The remaining 93 participants were randomly assigned to the high-threat ($n = 34$), low-threat ($n = 28$), or no-article ($n = 31$) condition.

Procedure and Materials. The study was described as assessing the relationship between identity, interests, and abilities. Participants in the high-threat [low-threat] condition first read an article allegedly published by the local newspaper, presented as "background information." The article described the results of a bogus poll suggesting that most students at the university (78%) believed Christians were bad [good] at science. Participants in the no article condition received the dependent measures without reading an article.

Next, participants completed a 20-item self-reported measure of their identification with science, adapted from Marsh and O'Neil (1984; e.g., "I have never been very excited about science" [reverse-coded]; "I am quite good at science").

Results and Discussion

We predicted that Christians would identify less with science than non-Christians after reading that Christians were stereotyped as bad at science, but not after reading that Christians were stereotyped as good at science. We had no a priori predictions about the control (no-article) condition.

A 3 (condition: high-threat vs. low-threat vs. no article) X 2 (religious identity: Christian vs. non-Christian) ANOVA revealed that Christians ($M = 4.26$, 95% CI: 4.06-4.46) reported weaker identification with science than did non-Christians overall ($M = 4.67$, 95% CI: 4.41-4.94), $F(1, 87) = 6.19$, $p = .015$, $\eta^2 = .07$. However, this main effect was qualified by a two-way interaction, $F(2, 87) = 3.59$, $p = .032$, $\eta^2 = .08$. Simple effects tests indicated that in the high-threat condition, Christians ($M = 3.98$, 95% CI: 3.67-4.30) identified significantly less with science than non-Christians ($M = 4.80$, 95% CI: 4.34-5.26), $F(1, 87) = 8.55$, $p = .004$, $\eta^2 = .09$. This difference also emerged in the control condition (Christians: $M = 4.08$, 95% CI: 3.73-4.43; non-Christians: $M = 4.72$, 95% CI: 4.28-5.16), $F(1, 87) = 5.21$, $p = .025$, $\eta^2 = .06$. In the low-threat condition, there was no significant difference between Christians ($M = 4.72$, 95% CI: 4.28-5.16) and non-Christians ($M = 4.50$, 95% CI: 4.02-4.97), $F(1, 87) = .46$, $p > .250$, $\eta^2 = .01$ (see Figure 3).

Study 3

Study 2 suggests that Christians' science identification tends to suffer unless the anti-science stereotype is explicitly removed – that is, unless Christians are given information suggesting that they are just as competent in science as other groups. Perhaps because of the social acceptability of expressing negative stereotypes about Christians in science (demonstrated in Study 1), Christians may experience a default state of feeling that science is incompatible with their religious identity, similar to low-SES students in higher education (Stephens et al., 2012). Notably, however, Christians identify as much with science as non-Christians when reassured that others do not endorse the negative

stereotypes. We next tested the consequences of these stereotypes for Christians' scientific task performance.

Method

Participants. One hundred and eighty-three mTurk workers (103 men, 80 women; $M_{\text{age}} = 33.5$, $SD = 11.7$; 71 Christians, 112 non-Christians) participated in exchange for \$.50. Eleven participants were omitted: one for taking the study twice, three for completing the study in two minutes or less, five for correctly guessing the hypothesis, and two statistical outliers with Cook's D scores above .035 (more than 3 SD above the sample mean). The remaining 172 participants were retained.

Procedure and Materials. Participants were randomly assigned to either a high-threat condition, in which they read a paragraph stating that Christians perform worse on scientific reasoning tasks than non-Christians ($n = 91$), or a low-threat condition, in which they read a paragraph stating that no performance differences between Christians and non-Christians exist ($n = 81$). The paragraphs were presented in the form of background information (see Spencer et al., 1999).

Next, to measure performance on a task that participants associated with scientific ability, all participants completed an alleged "scientific reasoning test," which involved indicating whether 15 syllogisms (i.e., sets of premises and conclusions) reflected good or poor reasoning (e.g., "*All ghosts are electrified. No cats are electrified. Therefore, no ghost is a cat*"; Markman, Lindberg, Kray, & Galinsky, 2007). The total number of correct solutions served as the dependent measure. Finally, in this study as well as subsequent studies, participants completed a demographic survey and suspicion probe.

Results and Discussion

We predicted that being told there are differences in scientific reasoning ability between religious groups would lead Christian participants to solve fewer syllogisms correctly than non-Christian participants. We expected Christians and non-Christians to perform comparably when told that no differences in scientific reasoning ability exist. We included participant age as a covariate because there were age differences between Christian and non-Christian participants (i.e., Christians were older than non-Christians; $F(1, 168) = 13.50, p < .001$) and (marginally) between conditions (i.e., high-threat participants were older than low-threat participants; $F(1, 168) = 3.35, p = .069$).²

A two-way ANCOVA controlling for age revealed an interaction between Christian identity and threat condition, $F(1, 167) = 3.63, p = .059, \eta^2 = .02$, which – though marginal – was consistent with our hypotheses. Specifically, Christians ($M = 9.71$, 95% CI: 8.92-10.49) underperformed relative to non-Christians ($M = 11.59$, 95% CI: 11.01-12.16) in the high-threat condition, $F(1, 167) = 14.26, p < .001, \eta^2 = .08$, but performed as well as non-Christians in the low-threat condition ($M_{\text{Christians}} = 10.89$, 95% CI: 10.11-11.68; $M_{\text{non-Christians}} = 11.44$, 95% CI: 10.81-12.07), $F(1, 167) = 1.12, p > .250, \eta^2 = .007$ (see Figure 4). Additionally, there was a significant main effect of religious identity (non-Christians outperformed Christians), $F(1, 167) = 11.08, p = .001, \eta^2 = .06$.

Although Study 3 suggests that Christians' awareness of negative stereotypes about their group compromises science-related task performance, it is unclear whether this performance difference emerges even when the stereotypes are not made salient, or only when Christians read information impugning their group's scientific ability. That is, without receiving any information about religious differences in performance, would the mere description of a task as measuring "scientific reasoning" have been sufficient to

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000

elicit Christians' underperformance relative to non-Christians? To address this question, we recruited a separate sample of 213 mTurk workers (117 Christians) to complete the syllogisms without reading any "background information." Similar to the high-threat condition in Study 3, a one-way ANCOVA controlling for age revealed that Christians ($M = 9.97$, 95% CI: 9.55-10.38) solved (marginally) fewer syllogisms correctly than did non-Christians ($M = 10.51$, 95% CI: 10.05-10.97), $F(1, 210) = 2.94$, $p = .088$, $\eta^2 = .01$.

Study 4

Study 3 showed that when Christians believe a task is science-relevant, they underperform compared to non-Christians. That this effect could only be completely mitigated by explicitly removing the anti-science stereotype about Christians speaks to the pervasiveness of this stereotype, and supports the notion that Christians may see scientific tasks as incompatible with their religious identity.

Past research demonstrates that women in male-dominated environments underperform on math problems, but not verbal problems (on which they experience no negative stereotype; Inzlicht & Ben-Zeev, 2000). Because Study 1 showed that Christians perceive themselves as targets of negative stereotypes about scientific but not general competence, we predicted that the negative effects of stereotype on performance should only emerge on tasks that Christians believe to be science-relevant. Thus, in Study 4, we described the task as either scientific or not.

We used the Remote Associates Test (RAT) as our dependent measure because its solution norms are well-established (Dorfman, Shames, & Kihlstrom, 1996). This allowed us to compare performance across relatively easy (45-80% solution rate) and relatively difficult (20-40% solution rate) task items, in order to investigate the

mechanism behind our findings. If Christians' underperformance is anxiety-driven, the performance differences should emerge on difficult stereotypic tasks (which are more likely to trigger arousal) but not easy stereotypic tasks (on which performance would be preserved, and may even see improvement; O'Brien & Crandall, 2003). However, if Christians' underperformance is due to disengagement from science, performance differences should emerge on both difficult and easy stereotypic tasks, as stigmatized group members should see both tasks as incompatible with their identity (see Stephens et al., 2012).

Method

Participants. One hundred and twenty-eight mTurk workers (55 Christians, 72 non-Christians; 58 men, 69 women; $M_{\text{age}} = 35.2$, $SD = 12.7$) participated in exchange for \$.50. Two participants who took the study twice and two statistical outliers whose Cook's D scores (.15 and .07) fell at least 3 SD above the sample mean were omitted, leaving 123 in the final sample.

Procedure and Materials. The procedure was identical to Study 3, with two exceptions. First, to manipulate high or low threat, respectively, we described the task as measuring "scientific reasoning" ($n = 57$) or "intuitive thought" ($n = 66$). We also stated that we were interested in performance differences between Christians and non-Christians, although (unlike in Study 3 but consistent with prior research, e.g., Spencer et al., 1999) we did not specify the expected direction of the differences. Second, rather than solving syllogisms, participants completed 10 RAT items from Kray, Galinsky, and Wong (2006), in which they were given three words (e.g., *golf*, *beans*, *envy*) and had to generate a fourth word related to all of them (*green*). All items were randomized.

Results and Discussion

We predicted that Christians would generate fewer correct solutions than non-Christians in the high-threat (“scientific reasoning”) condition, but not in the low-threat (“intuitive thought”) condition. A two-way ANCOVA controlling for age revealed main effects of age, $F(1, 118) = 26.26, p < .001, \eta^2 = .18$, and Christian identity, $F(1, 118) = 4.10, p = .045, \eta^2 = .03$, as well as the predicted interaction between Christian identity and condition, $F(1, 118) = 4.67, p = .033, \eta^2 = .04$. Simple effects tests indicated that Christians ($M = 6.09, 95\% \text{ CI: } 5.13\text{-}7.05$) performed worse than non-Christians ($M = 7.88, 95\% \text{ CI: } 7.08\text{-}8.68$) when told the task measured scientific reasoning, $F(1, 118) = 8.05, p = .005, \eta^2 = .06$, whereas Christians and non-Christians performed equally well when told the task measured intuitive thought ($M_{\text{Christians}} = 6.94, 95\% \text{ CI: } 6.08\text{-}7.80$; $M_{\text{non-Christians}} = 6.89, 95\% \text{ CI: } 6.13\text{-}7.65$), $F(1, 118) = .01, p > .250, \eta^2 < .01$ (see Figure 5).

Next, we tested whether Christians underperformed on “scientific reasoning” tasks relative to non-Christians regardless of the difficulty of the items (which would suggest that Christians disidentify with science-relevant domains), or whether they underperformed just on difficult items (which would suggest that Christians experience anxiety in science-relevant domains). A 2 (Christian identity) X 2 (threat condition) X 2 (easy vs. difficult items) mixed-model ANCOVA, with repeated measures on the last factor, revealed only a main effect of item difficulty (i.e., participants solved more easy than difficult items correctly), $F(1, 118) = 14.01, p < .001, \eta^2 = .11$, in addition to the effects described above. The 3-way interaction was not significant ($p > .250$). Thus, Christians’ underperformance on “scientific” tasks extends to both easy and difficult

items, suggesting that Christians disengage from any task described as assessing scientific reasoning, and not just from tasks that are particularly difficult.³

Study 5

If stereotypes compromise Christians' scientific abilities in everyday college contexts, then mere contextual cues relevant to science should also trigger underperformance (Cheryan et al., 2009; Murphy et al., 2007). Moreover, because the impact of negative stereotypes is strongest among highly-identified group members (whose group membership is important to their self-concept; Schmader, 2002), religiosity should moderate the effects of such cues. We tested these hypotheses by having participants complete a task in either a Divinity School, which Christians should perceive as compatible with their (religious) identity; or a Physical Sciences building, which Christians should perceive as less compatible with their identity.

Method

Participants. One hundred and seven psychology students (43 men, 64 women; $M_{\text{age}} = 20.88$, $SD = 3.74$) participated in exchange for credit. Pre-screening revealed 39 participants as Christian, and 64 as non-Christian. Four participants did not specify their religious affiliation and were dropped from analyses. Additionally, eleven participants were omitted due to suspicion, and two statistical outliers were excluded because their Cook's D scores (.15 and .16) were more than 5 SD above the sample mean. The final sample thus consisted of 90 individuals.

Procedure and Materials. One week prior to the study, participants completed an online demographic survey, which included five religiosity questions (e.g., "What is the general importance of God in your life?") administered on 11-point scales (1 = *not at*

all, 11 = *extremely*; Preston & Epley, 2009). The day before the study, participants were emailed instructions to take the study in either the Divinity School (low-threat context; $n = 47$) or the Physical Sciences building (high-threat context; $n = 43$). To increase awareness of the context, upon arrival to their assigned building, all participants read an adapted mission statement of the relevant department. Whereas the mission statement for the Divinity School stated that its faculty and students believed religion was reconcilable and compatible with other disciplines in the humanities and sciences, the mission statement for the Physical Sciences division did not mention any non-science disciplines.

Next, participants completed a measure described as a logical reasoning test, which consisted of 10 questions from the former GRE analytical section (e.g., “David ranks seventh from the top and 28th from the bottom in a class. How many students are there in the class?” (a) 36, (b) 35, (c) 34, (d) cannot be determined, (e) none of the above; $M=5.31$, $SD=1.53$).

Results and Discussion

We predicted that Christians’ religiosity would be negatively correlated with the number of questions solved correctly in the high-threat condition, but not in the low-threat condition. In other words, we expected religiosity to moderate the effects of context (Physical Sciences building vs. Divinity School) on Christians’ performance. We expected no such effect for non-Christians.

Because Christians ($M = 7.32$, $SD = 2.73$ on an 11-point scale) and non-Christians ($M = 2.74$, $SD = 1.96$) differed significantly in religiosity, $t(101) = -9.88$, $p < .001$, we analyzed the data as two separate context (0 = Physical Sciences, 1 = Divinity School) x

religiosity (mean-centered) interactions for Christians and non-Christians, using multiple regression (Aiken & West, 1991).⁴

Confirming our hypothesis, a two-way threat context X religiosity multiple regression was significant for Christians ($b = .72$, $SE = .17$), $t(28) = 4.34$, $p < .001$, but not for non-Christians ($p > .250$; see Figure 6). Among Christians, religiosity correlated negatively with performance in the high-threat context ($b = -.63$, $SE = .14$, $t(28) = -4.45$, $p < .001$), and was uncorrelated with performance in the low-threat context, $b = .09$, $SE = .09$, $t(28) = 1.03$, $p > .250$.

General Discussion

These studies demonstrate that increasing the salience of pervasive anti-science stereotypes about Christians (Study 1) can lead Christians to underperform on scientific tasks (Studies 3-5) and disidentify with science (Study 2), especially for the highly religious (Study 5). Although the differences between Christians and non-Christians disappear when the stereotypes are explicitly removed, the overall effects of these stereotypes are pernicious. As with other groups, Christians may face a perpetuating cycle whereby they underperform due to the existing stereotypes, thereby confirming those original stereotypes.

Through what mechanism(s) do the negative effects of these stereotypes emerge? One possibility is that Christians' anxiety about confirming the stereotypes undermines their performance and engagement (Steele & Aronson, 1995). Alternatively, Christians may disidentify with fields perceived not to "match" their religious identity (i.e., science), either because they believe that others stereotype them as not belonging in science (Steele

et al., 2002; Stephens et al., 2012), or because they themselves stereotype their (religious) values as incompatible with science (see Nosek, Banaji, & Greenwald, 2002).

Study 4, in which Christians underperformed on both difficult and easy (presumably less anxiety-inducing) “scientific reasoning” items, seems inconsistent with the anxiety explanation, although future research could test the role of anxiety more directly (e.g., by measuring emotions or working memory prior to the task). Regarding the distinction between other-stereotyping and self-stereotyping, Study 1 demonstrated that Christians did not personally endorse anti-science stereotypes about their group, despite their awareness of the existence of such stereotypes. We thus doubt that self-stereotyping is the *only* reason behind Christians’ underperformance. However, perhaps being reminded of others’ negative stereotypes leads Christians to eventually internalize perceptions of themselves and their group as unscientific.

Unlike women and ethnic minorities, on whom much research about negative intellectual stereotypes has focused, American Christians are a dominant majority group (77% of the population; Gallup, 2012), and not one generally perceived as disadvantaged. Yet context matters; in scientific domains, different proportions and a potentially very different climate exist. Christian underrepresentation in science may be caused by self-selection (choosing not to enter science-related fields) as well as underperformance (not succeeding in said fields), both of which are exacerbated by negative stereotypes.

That Christians constitute such a large proportion of the U.S. population means that factors discouraging their participation in scientific disciplines may vastly impact the potential flow of students into science-related careers. Diagnosing such barriers is a critical step in developing strategies for encouraging more people to pursue their

scientific ambitions. Previous research has found that the pernicious effects of negative stereotypes on academic performance and interest can be mitigated by affirming personal values (Cook, Purdie-Vaughns, Garcia, & Cohen, 2012), increasing feelings of belongingness (Walton & Cohen, 2011), or exposing individuals to counter-stereotypic role models (Marx & Goff, 2005). Future research should tailor such strategies to increase Christians' participation in science. If effective, these strategies would be vital tools for increasing scientific involvement and literacy in American society.

For Peer Review

References

- Aiken, L. S., & West, S. G. (1991). *Multiple Regression: Testing and Interpreting Interactions*. Thousand Oaks, CA: Sage Publications.
- Aronson, J., Lustina, M. J., Good, C., Keough, C., Steele, C. M., & Brown, J. (1999). When white men can't do math: Necessary and sufficient factors in stereotype threat. *Journal of Experimental Social Psychology, 35*, 29-46.
- Calhoun, C., Aronczyk, M., Mayrl, D., & VanAntwerpen, J. (2007). The religious engagements of American undergraduates. *Social Science Research Council*.
- Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*, 1045-1060.
- Committee on Equal Opportunities in Science and Engineering (CEOSE) (2014). Broadening participation in America's science and engineering work force. http://www.nsf.gov/od/iia/activities/ceose/reports/Full_2011-2012_CEOSE_Report_to_Congress_Final_03-04-2014.pdf
- Cook, J. E., Purdie-Vaughns, V., Garcia, J., & Cohen, G. L. (2012). Chronic threat and contingent belonging: Protective benefits of values affirmation on identity development. *Journal of Personality and Social Psychology, 102*, 479-496.
- Dar-Nimrod, I., & Heine, S. J. (2006). Exposure to scientific theories affects women's math performance. *Science, 314*, 435.
- Dorfman, J., Shames, V. A., & Kihlstrom, J. F. (1996). Intuition, incubation, and insight: Implicit cognition in problem solving. *Implicit Cognition, 257-296*.
- Fiske, S. T., Cuddy, A. J. C., Glick, P., & Xu, J. (2002). A model of (often mixed)

stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of Personality and Social Psychology*, 82, 878-902.

Gallup (2011). More than 9 in 10 Americans continue to believe in God.

<http://www.gallup.com/poll/147887/americans-continue-believe-god.aspx>

Gallup (2012). In U.S., 77% identify as Christian. [http://www.gallup.com/poll/](http://www.gallup.com/poll/159548/identify-christian.aspx)

[159548/identify-christian.aspx](http://www.gallup.com/poll/159548/identify-christian.aspx)

Gervais, W. M., & Norenzayan, A. (2012). Analytic thinking promotes religious disbelief. *Science*, 336, 493-496.

Gross, N., & Simmons, S. (2009). The religiosity of American college and university professors. *Sociology of Religion*, 70, 101-129.

Inzlicht, M., & Ben-Zeev, T. (2000). A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science*, 11, 365-371.

Kray, L. J., Galinsky, A. D., & Wong, E. M. (2006). Thinking within the box: The relational processing style elicited by counterfactual mind-sets. *Journal of Personality and Social Psychology*, 91, 33-48.

Markman, K. D., Lindberg, M. J., Kray, L. J., & Galinsky, A. D. (2007). Implications of counterfactual structure for creative generation and analytical problem solving. *Personality and Social Psychology Bulletin*, 33, 312-324.

Marsh, H. W., & O'Neill, R. (1984). Self-description questionnaire III: The construct validity of multidimensional self-concept ratings by late adolescents. *Journal of Educational Measurement*, 21, 153-174.

- Marx, D. M., & Goff, P. A. (2005). Clearing the air: The effect of experimenter race on target's test performance and subjective experience, *British Journal of Social Psychology, 44*, 644-657.
- Moss-Racusin, C. A., van der Toorn, J., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Scientific diversity interventions. *Science, 343*, 615-616.
- Mrazek, M. D., Chin, J. M., Schmader, T., Hartson, K. A., Smallwood, J., & Schooler, J. W. (2011). Threatened to distraction: Mind-wandering as a consequence of stereotype threat. *Journal of Experimental Social Psychology, 47*, 1243-1248.
- Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science, 18*, 879-885.
- Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math=male, me=female, therefore math \neq me. *Journal of Personality and Social Psychology, 83*, 44-59.
- O'Brien, L. T., & Crandall, C. S. (2003). Stereotype threat and arousal: Effects on women's math performance. *Personality and Social Psychology Bulletin, 29*, 782-789.
- Pennycook, G., Cheyne, J. A., Seli, P., Koehler, D. J., & Fugelsang, J. A. (2012). Analytic cognitive style predicts religious and paranormal belief, *Cognition, 123*, 335-346.
- Preston, J. L., & Epley, N. (2009). Science and God: An automatic opposition between ultimate explanations, *Journal of Experimental Social Psychology, 45*, 238-241.
- Schmader, T. Gender identification moderates stereotype threat effects on women's math performance. *Journal of Experimental Social Psychology, 38*, 194-201.

- Shenhav, A., Rand, D. G., & Greene, J. D. (2012). Divine intuition: Cognitive style influences belief in God, *Journal of Experimental Psychology: General*, *141*, 423-428.
- Sherkat, D. E. (2011). Religion and scientific literacy in the United States, *Social Science Quarterly*, *92*, 1134-1150.
- Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, *35*, 4-28.
- Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*, 613.
- Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans, *Journal of Personality and Social Psychology*, *69*, 797-811.
- Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. *Advances in Experimental Social Psychology*, *34*, 379-440.
- Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: how American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, *102*, 1178.
- Stone, J., Lynch, C. I., Sjomeling, M., & Darley, J. M. (1999). Stereotype threat effects on black and white athletic performance. *Journal of Personality and Social Psychology*, *77*, 1213.
- Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves

academic and health outcomes of minority students. *Science*, 331, 1447-1451.

Zuckerman, M., Silberman, J., & Hall, J. A. (2013). The relation between intelligence and religiosity: A meta-analysis and some proposed explanations, *Personality and Social Psychology Review*, 17, 325-354.

For Peer Review

Table 1

Reported stereotypes and personal beliefs by group, Study 1

Stereotypes	Christians	Atheists	Jews	Muslims
N=169	Mean (SD)			
Competence in Science	-1.00 (1.52)***	1.26 (1.46)***	0.59 (1.46)***	-0.59 (1.56)***
Trust of Science	-1.44 (1.56)***	1.78 (1.47)**	.37 (1.45)**	-0.98 (1.48)***
General Competence	-0.06 (1.46)	0.20 (1.50)+	1.07 (1.41)***	-0.56 (1.41)***
Warmth	0.75 (1.64)***	-0.95 (1.56)***	-0.31 (1.52)**	-1.49 (1.43)***
Personal Beliefs	Christians	Atheists	Jews	Muslims
N=169	Mean (SD)			
Competence in Science	-0.38 (1.47)***	.96 (1.47)***	.49 (1.15)***	-.22 (1.28)**
Trust of Science	-.85 (1.64)***	1.58 (1.53)***	.37 (1.21)***	-.53 (1.27)***
General Competence	.14 (1.36)	.46 (1.31)***	.69 (1.16)***	-.15 (1.19)+
Warmth	0.50 (1.50)***	-.12 (1.38)	.12 (1.24)	-.51 (1.38)***

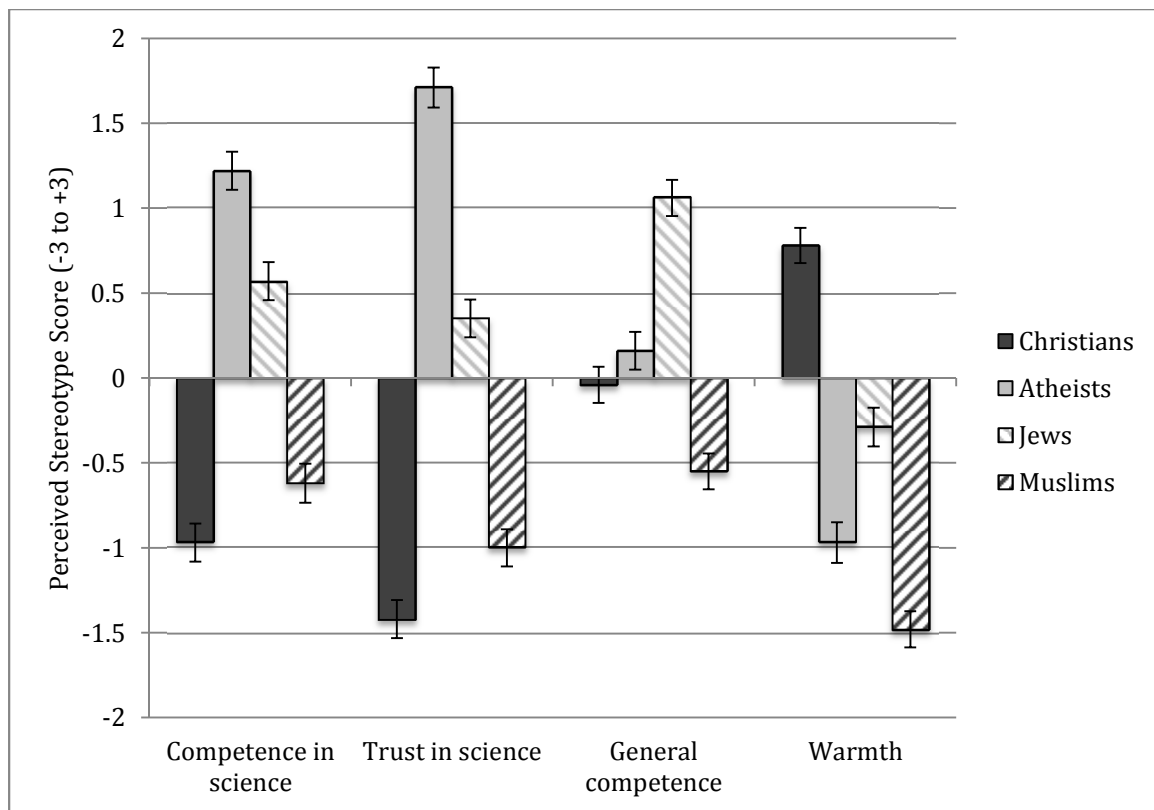


Figure 1. Reported stereotypes associated with each group, Study 1 (error bars represent SEs of means)

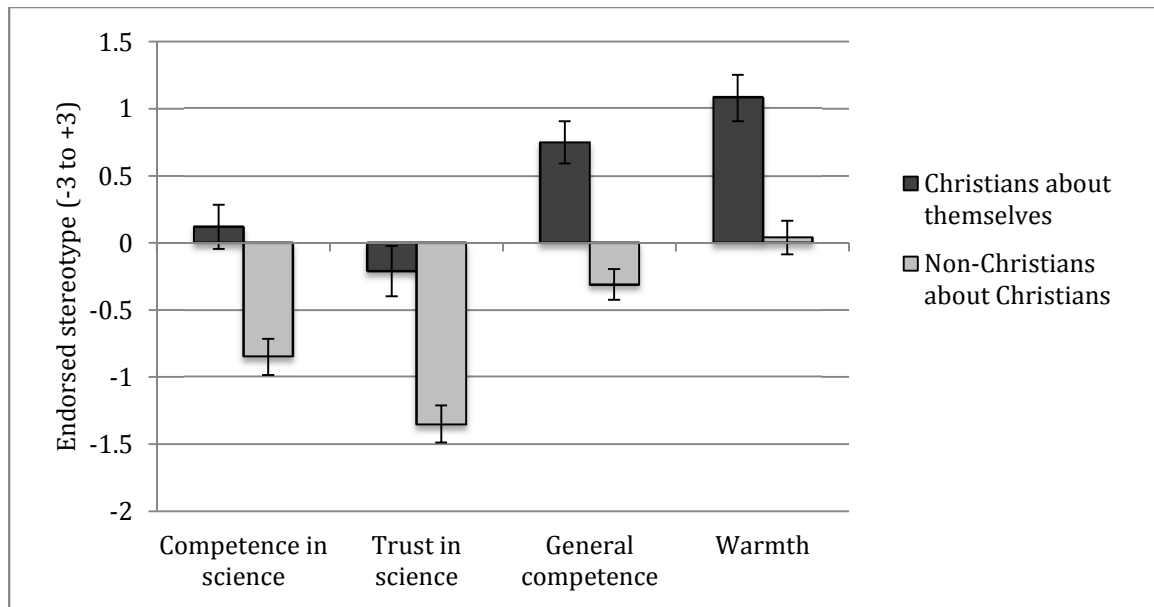


Figure 2. Personal beliefs about Christians by group, Study 1

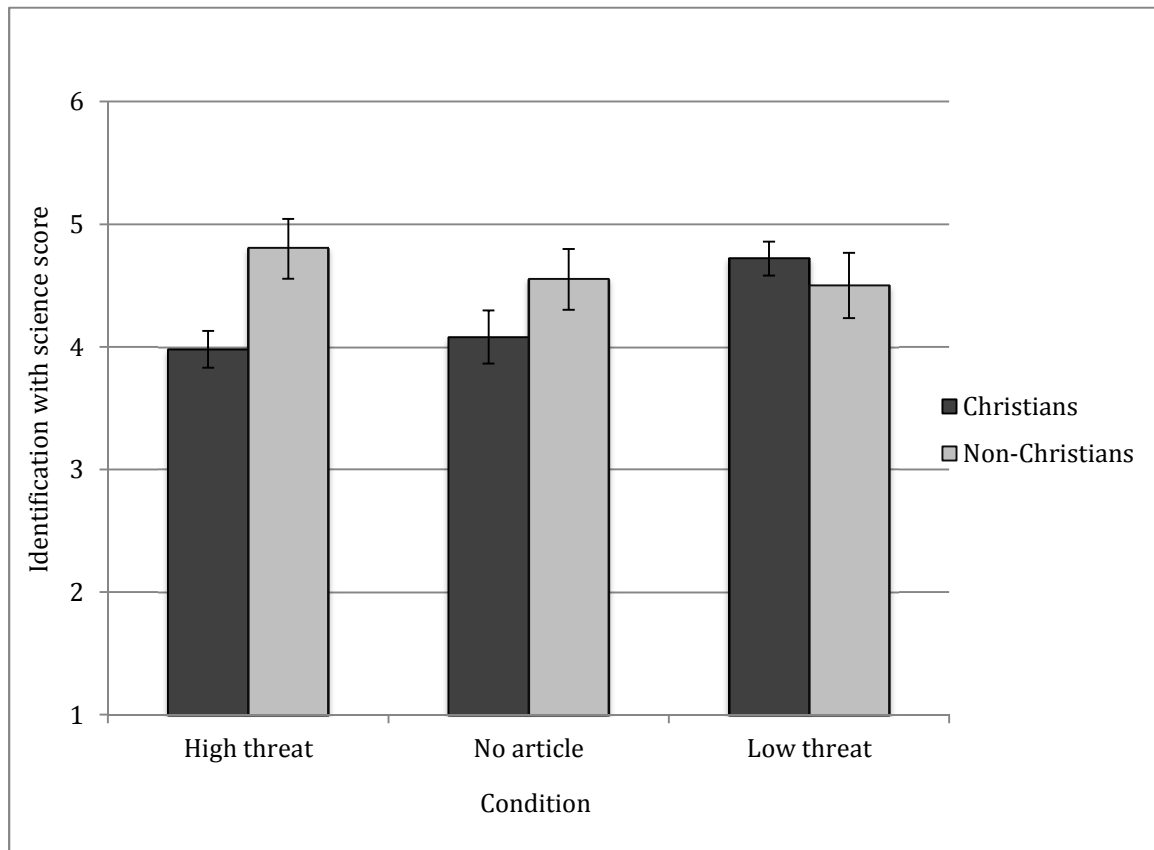


Figure 3. Identification with science as a function of threat condition and Christian identity, Study 2

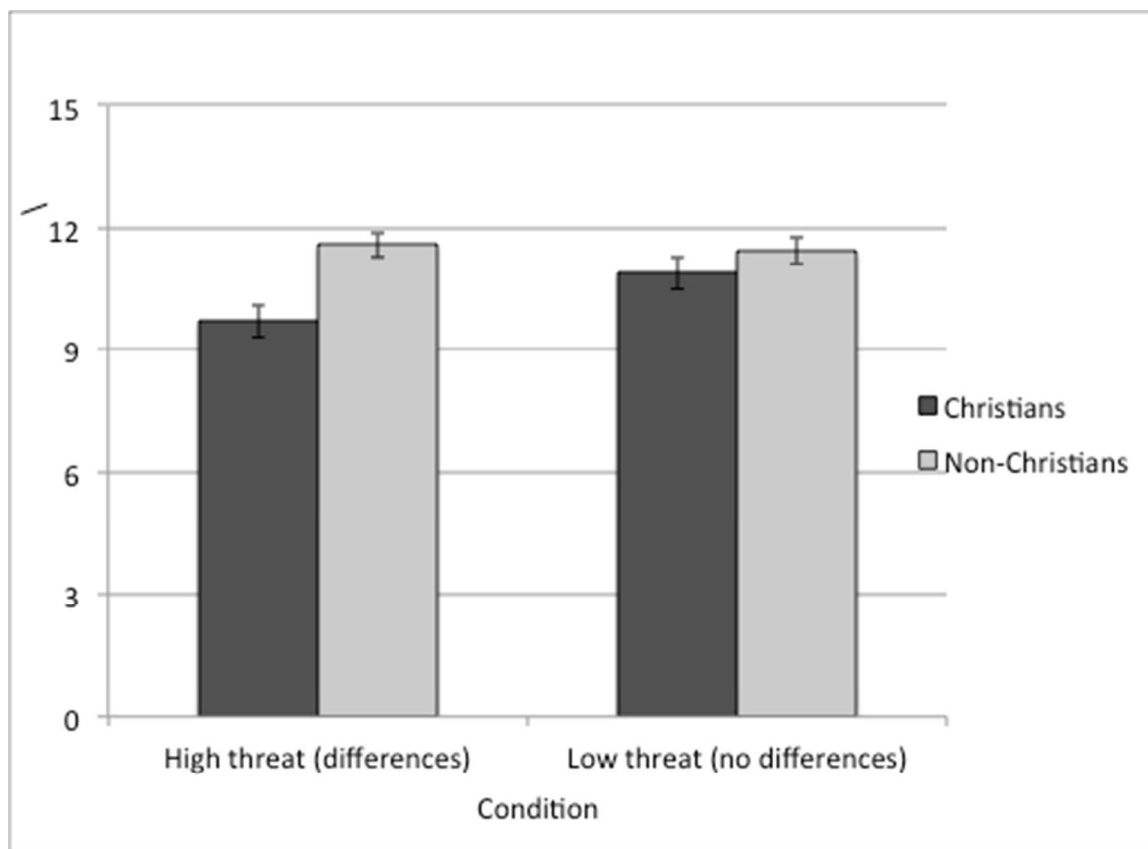


Figure 4. Syllogisms solved (out of 15) as a function of threat condition and Christian identity, Study 4

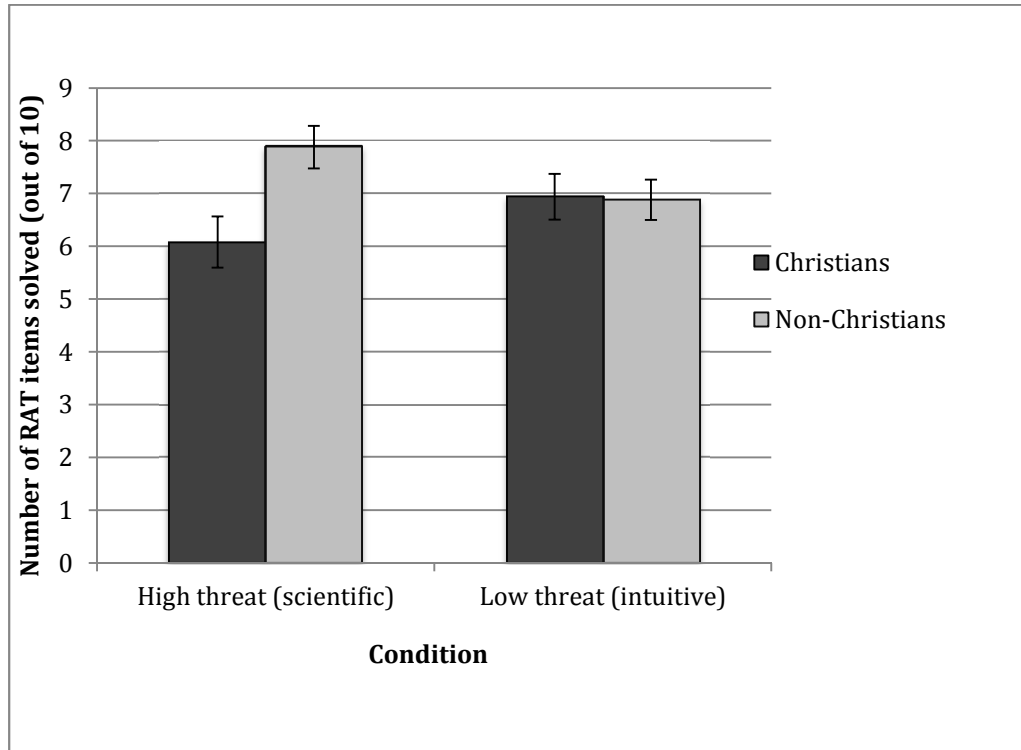
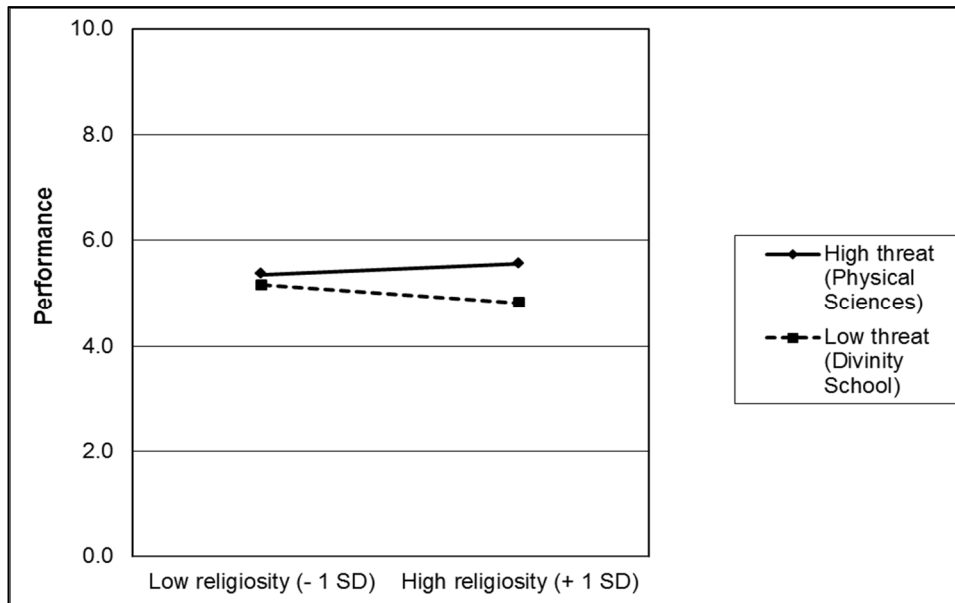


Figure 5. RAT items solved as a function of threat condition and Christian identity, Study

4

Non-Christians:



Christians:

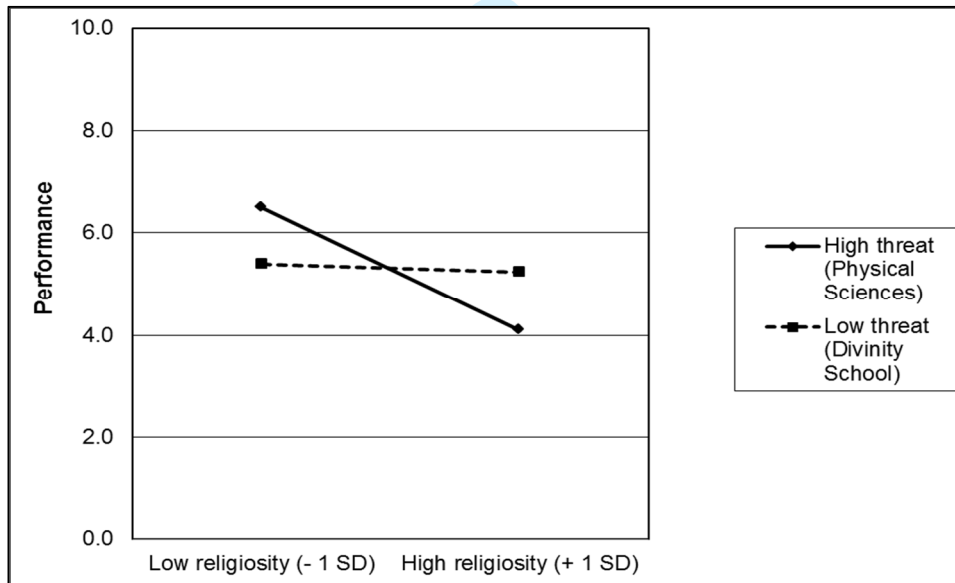


Figure 6. Correct solutions as a function of Christian identity, threat context, and religiosity (+/- 1 SD), Study 5

Footnotes

¹ In Studies 2-4, we asked Christian participants whether they identified as “Catholic” (range from 32% in Study 4 to 55% in Study 2), “Protestant” (range from 26% in Study 3 to 51% in Study 4), or (Studies 3-4) “other” (32% in Study 3, 17% in Study 4). Among Christians, there were no main effects of denomination or interactions with condition on science identification (Study 2) or performance (Studies 3-4) ($ps > .19$). However, given our low statistical power to detect such interactions, and the absence of more fine-grained distinctions, we do not consider these null results conclusive and believe the potential effects of denomination (and related variables such as fundamentalism) warrant future investigation.

² In Studies 3-4, highest education (1 = *some high school*, 6 = *doctorate or professional degree*) was unrelated to either Christian identity or condition ($ps > .250$), and controlling for it did not affect our results.

³ When the easy and difficult items were analyzed separately, the condition X Christian identity interaction was significant for difficult items ($p = .028$) and approached significance for easy items ($p = .109$). Notably, the difference between Christians’ and non-Christians’ performance in the “scientific reasoning” condition was significant for both sets of items ($ps = .012$).

⁴ The three-way interaction between condition, religious identity (0 = non-Christian, 1 = Christian), and religiosity was marginal ($b = .58$, $SE = .32$), $t(82) = 1.85$, $p = .068$, likely because religiosity (on which Christians scored higher than non-Christians) was mean-centered across the entire sample, regardless of religious identity.