Replication of a Research Claim from O'Brien & Noy (2015), from *American Sociological Review*.

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Claim Summary

The claim selected from O'Brien & Noy (2015) is that, although the post-secular perspective entails high levels of science knowledge as well as favorable views of science and religion, when scientific and religious perspectives conflict (e.g. evolution), the post-secular latent class almost unanimously aligned their views with particular religious accounts. This reflects the following statement from the paper's abstract: "Overall, most individuals favor either scientific or religious ways of understanding, but many scientifically inclined individuals prefer certain religious accounts." Participants' responses to the General Social Survey (GSS) were submitted to a latent class analysis that resulted in a three-class solution characterized as representing traditional, modern, and post-secular perspectives on science and religion. Following this assignment, two-tailed t-tests were used to compare responses between the three groups; for the purposes of the SCORE project, the focal test is the comparison between the Traditional and Post-Secular groups on the question concerning evolution ('Human beings developed from earlier species of animals', yes or no). Members of the post-secular category were significantly less likely than members of the traditional group to respond that humans evolved from other animals (3 percent, significant at $p < 0.05$ on a two-tailed test, see Table 2, rightmost column). We replicate this study using the GSS years not included in the original survey. All variables remain the same.

Replication Criteria

Respondents with a post-secular perspective on science and religion will have significantly different responses than respondents with a traditional perspective on science and religion to the question asking whether humans evolved from other animals. This will be shown by a two-tailed t-test ($p<.05$) with post-secularists having significantly different values to the question that humans evolved from other animals than the traditionalists.

Replication Result

To conduct this analysis, I first had to assign labels (traditional, modern, post-secularists) to the classes developed through the Latent Class Analysis. I assign these labels using these criteria:

1. The modern category will have the weakest religious beliefs and high scores for science literacy and attitude questions.

2. The traditionalist category will have strong religious beliefs and low scores for all science literacy and attitude questions.

3. The post-secular category will have strong religious beliefs and high scores for many science and literacy questions, but not all.

The classes found in my analyses differ for responses to variables regarding opinions of science (advfront, toofast, nextgen). For these variables, modernists were not consistently the group with the highest values, as found in the original paper. However, the central indicators of religiosity and knowledge of science closely matched the results from the original paper. For this reason, the categories found in my analyses still reflect the classes interpreted by the original paper.

All Possible Observations Years
The replication using years 2006, 2008, 2010, 2012, 2014, 2016, and 2018 included 5,260 observations, which met the stage 1 threshold of 153 observations defined by the power analysis. The results of a two-sample t-test comparing the mean value for responses to the question, "Human beings, as we know them today, developed from earlier species of animals. (Is that true or false?)" show post-secularists (mean =.04, std. error = .01) have significantly (t-statistic = 21.78, degrees of freedom = 3,345, p = .0000 by Stata16) different rates of correct responses, compared to traditionalists (mean = .35, std. error = .01). Thus, this replication of the claim was successful according to the SCORE criteria. The claim selected for the original study yielded a negative Cohen's d in the focal test, corresponding to 75%. The replication yielded a negative Cohen's d in the focal test (79%), corresponding to an effect in the same pattern compared to the original study.

Same Years as Original Study
The replication using years 2006, 2008, and 2010 included 2,991 observations, which met the stage 1 threshold of 153 observations defined by the power analysis. The results of a two-sample t-test comparing the mean value for responses to the question, "Human beings, as we know them today, developed from earlier species of animals. (Is that true or false?)" show post-secularists (mean =.02, std. error = .01) have significantly (t-statistic = 16.03, degrees of freedom = 1,875, p = .0000 by Stata16) different rates of correct responses, compared to traditionalists (mean = .32, std. error = .01). Thus, this replication of the claim was successful according to the SCORE criteria. The claim selected for the original study yielded a negative Cohen's d in the focal test, corresponding to 75%. The replication yielded a negative Cohen's d in the focal test (77%), corresponding to an effect in the same pattern compared to the original study.

Years Following the Original Sample
The replication using years 2012, 2014, 2016, and 2018 included 2,269 observations, which met the stage 1 threshold of 153 observations defined by the power analysis. The results of a two-sample t-test comparing the mean value for responses to the question, "Human beings, as we know them today, developed from earlier species of animals. (Is that true or false?)" show post-secularists (mean =.04, std. error = .01) have significantly (t-statistic = 16.57, degrees of freedom = 1,436, p = .0000 by Stata16) different rates of correct responses, compared to traditionalists (mean = .41, std. error = .02). Thus, this replication of the claim was successful according to the SCORE criteria. The claim selected for the original study yielded a negative Cohen's d in the focal test, corresponding to 75%. The replication yielded a negative Cohen's d in the focal test (90%), corresponding to an effect in the same pattern compared to the original study.

Methods and Materials
The following materials are publicly available on the OSF site:

- A **data dictionary** that describes the variables used, provided as an excel document:
  - DataDictionaryOBrien_AxxeEdits_20200910.xlsx
- The **codebook** for the original dataset:
  - GSS_Codebook.pdf
- A preregistration describing the analyses and how variables were manipulated:
  - O'Brien_AmSocioRev_2015_7X54_93k7 (Ramljak_Axxe)

- Two files that contain the **analytic data** used to reproduce the analyses:
  - GSS.replication.RDS
  - GSSreplication.dta
- Code used to produce the above data files, both using R markdown files:
  - OBRIEN.code.rmd
  - OBRIREN.code_AxxeEdits.rmd
- A file containing the **analytic code**, made in Stata 16:
  - OBrienReplication_OSF_Axxe_20201012.do
- The **output** from the Stata analyses:
  - OBrienReplicaiton_Axxe_20201012.txt

Deviations from the preregistration

I thank a reviewer for recommending testing the model fit for varying numbers of latent classes using Bayern Information Criterion. I include this in the analysis code; however, each result suggests that 4 classes fit the data better than 3 classes. The original authors show similar results in their online supplement (found here), but decide to use 3 classes due to the results of Lo-Mendell-Rubin likelihood ratio tests. That test is currently unavailable in Stata.

The inferential criteria in the preregistration suggests that the replication relies on the result of a one-tailed test (given the post-secularists will have significantly lower values than the traditionalists); however, the SCORE project team requires all results be shown as a two-tailed test therefore this document only provides the results of the two-tailed test.

Deviations from the Original Study

To conduct the Latent Class Analysis, the original studies uses MPlus, while this study uses the Lclass extension to the GSEM package in Stata 16. Otherwise, this study contains results from the same GSS years used in the original paper (2006, 2008, 2010), years not used by the original paper (2012, 2014, 2016, 2018), and a combined analysis with all eligible years from the GSS (2006, 2008, 2010, 2012, 2014, 2016, 2018). The central replication point reflects the years not used in the original study.

I tested the analytic sample my code produces using the same years as the original study. I found that my sample contains 90 more respondents than the original study. It is unclear how the original authors decided to remove those observations. I do not believe this difference changes the outcome of the focal hypothesis test.

Citation

O'Brien, T. L., & Noy, S. (2015). Traditional, Modern, and Post-Secular Perspectives on Science and Religion in the United States. *American Sociological Review*, *80*(1), 92–115. https://doi.org/10.1177/0003122414558919

Smith, Tom W., Davern, Michael, Freese, Jeremy, and Morgan, Stephen L., General Social Surveys, 1972-2018 [machine-readable data file] /Principal Investigator, Smith, Tom W.;

Co-Principal Investigators, Michael Davern, Jeremy Freese and Stephen L. Morgan;

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