sociological science

Supplement to:

Hout, Michael, and Claude S. Fischer. 2014. "Explaining Why More Americans Have No Religious Preference: Political Backlash and Generational Succession, 1987–2012." Sociological Science 1: 423-447.

Developing a Counterfactual Model

THE counterfactual approach directs attention to a specific quantity — the expected difference between a person's outcome if their score on a causal variable was positive and that person's outcome if their score on that causal variable was neutral or negative (Morgan and Winship 2007).[1] A positive value on a causal variable is usually called a "treatment;" a neutral or negative value might be called "control" but we reserve that word for control variables in a multivariate analysis.

To get farther, we need some notation. Following a convention in the literature we suppose that every person i has two possible outcomes, the only they would experience in the "treatment" condition, $y_i^{(1)}$, and the one they would experience if neutral or untreated, $y_i^{(0)}$. The superscripts 1 and 0 indicate treatment and neutral, respectively. The effect of treatment on person i is the theoretical difference: $\delta_i = (y_i^{(1)} - y_i^{(0)})$. The average treatment effect is the expected difference between the two outcomes: $\delta = E(y_i^{(1)} - y_i^{(0)})$.

Most data sets contain observations on one but not both of the theoretically possible outcomes, either $y_i^{(1)}$ or $y_i^{(0)}$. To make clear the distinction between the theoretically possible outcomes and the observed conditions, we define a dummy variable D_i equal to 1 for treatment and 0 otherwise to indicate what was actually observed. An observational study in which the observations are all $(y_i^{(1)}|D_i = 1)$ and $(y_i^{(0)}|D_i = 0)$ provides no cases that would let us calculate the difference (δ_i) or the average treatment effect $\delta = E(y_i^{(1)} - y_i^{(0)})$. Even when we do observe both, as in a panel study, one occurs before the other.

In cross-sectional data, we seek *conditions* that will make the difference between the two observable conditional means $E(y_i^{(1)}|\ conditions, D_i = 1)$ and $E(y_i^{(0)}|\ conditions, D_i = 0)$ equal to the expected value of the difference δ. That will be true if the observed conditional means are good proxies for their unobserved counterparts; formally:

$$E(y_i^{(1)}|\ conditions, D_i = 1) = E(y_i^{(1)}|\ conditions, D_i = 0) \quad \text{and} \tag{A.1a}$$

$$E(y_i^{(0)}|\ conditions, D_i = 1) = E(y_i^{(0)}|\ conditions, D_i = 0) \tag{A.1b}$$

It is also true in the degenerate case in which the expected conditional means are equal whether the person is treated or not, implying that $\delta = 0$:

$$E(y_i^{(1)}|\ conditions, D_i = 1) = E(y_i^{(0)}|\ conditions, D_i = 1) \quad \text{and} \tag{A.2a}$$

$$E(y_i^{(1)}|\ conditions, D_i = 0) = E(y_i^{(0)}|\ conditions, D_i = 0) \tag{A.2b}$$

In cross-sectional data, causal inference is suspect because the coefficients from otherwise ap-

[1] This appendix draws heavily on Morgan and Winship (2007); see the original and their forthcoming second edition for details and clarifications. This is our interpretation of their work, and we are responsible for any errors of omission or commission we may have committed.

propriate models rely on observed variables to specify the conditions. As we can neither be sure we have exhausted the list of appropriate variables nor that we have specified the functional form linking those variables to the outcome correctly, we look to other quasi- and natural experiments to get more leverage on causal inference.

Panels offer hope for better causal inference because they give us data on both $y_i^{(1)}$ and $y_i^{(0)}$ for some cases. For those cases, we do not have to rely on the difference in expected values, we can observe the difference itself. The familiar fixed effects estimate takes that approach directly: $\hat{\delta}_{fixed} = E(y_i^{(1)} - y_i^{(0)} \mid (D_{it} - D_{it'}) \neq 0)$ where t and t' are different waves of the panel study. The fixed effects estimator eliminates time-invariant unobserved variables that might bias a cross-sectional estimate. But there are still conditions that must be met in order for $\hat{\delta}_{fixed} = \delta$ to be true. Sequence must not matter, that is, $E(y_i^{(1)} - y_i^{(0)} \mid (D_{it} - D_{it'}) = 1) = E(y_i^{(1)} - y_i^{(0)} \mid (D_{it} - D_{it'}) = -1)$. That condition can be tested. More problematic, experiencing a change in treatment must be independent of the expected outcome of the change, that is, $(D_{it} - D_{it'}) \perp \delta$. In randomized controlled trials, the design makes independence a reasonable assumption because people do not chose if and when treatment occurs. In observational studies, it seems likely that some people will choose or avoid treatment because of what they expect δ to be.

To avoid that Morgan and Winship (2007) invite us to think about a situation in which we initially observe everyone untreated, that is, $D_{i0} = 0$ for all i. We could then drop the never-treated cases (the ones for which $D_{it} = 0$ for all t), and estimate $\hat{\delta}_{treat} = E(y_i^{(1)} - y_i^{(0)} \mid (D_{it} = 1$ for any t. That works if there is no trend in y. If y is changing over time, though, $\hat{\delta}_{treat} > \delta$. We need a method for removing the change in y over time from the estimate of $\hat{\delta}_{treat}$. They recommend a statistical model with time and treatment as predictors of y. To separate the effect of treatment from the underlying trend in y, they introduce a distinction between assignment to treatment and treatment itself. Assignment (D_i^*) does not vary over time but treatment D_{it} does; interacting D_i^* with time t allows for different trends among the ever-treated and never-treated:

$$\begin{aligned} logit(y_{it}) = \mu + \delta_{model} D_{it} + \beta D_i^* + \tau t \\ + \gamma D_i^* t + \nu_i + \epsilon_{it} \end{aligned} \quad \text{(A.3)}$$

where ν_i is a random variable $N(0, \sigma_\nu^2)$ that captures time-invariant attributes of i that are uncorrelated with D or D^*, and ϵ_{it} is a random variable logistic(0, $\pi^2/3$) uncorrelated with any other variable in the model.

We modify the Morgan and Winship (2007) counterfactual panel model two ways to accommodate the facts that the time trend in religious affiliation may not be linear (although it appears to be in Figure 1) and in the GSS panel we may have more than one treatment changing between waves. It is also true that some people are in the treated condition when they are first observed; the statistical adjustments in the model are sufficient to accommodate that contingency. We also regard "moderate" as the neutral condition, and allow both being liberal and being conservative to work as political treatments. Thus our model is:

$$\begin{aligned} logit(y_{it}) = \mu + \delta_{lib} Lib_{it} + \delta_{con} Con_{it} \\ + \gamma_{lib} Lib_i^* + \gamma_{con} Con_i^* + \textstyle\sum_t \tau_t T_t \\ + \textstyle\sum_t \tau_{lib,t} T_t Lib_i^* + \sum_t \tau_{con,t} T_t Con_i^* \\ + \textstyle\sum_{k=1}^K \beta_k Z_{kit} + \nu_i + \epsilon_{it} \end{aligned} \quad \text{(A.4)}$$

where T_t is a dummy variable equal 1 in year t and 0 otherwise, t = 2006, 2008, 2010, or 2012; the Zs are covariates some of which vary over time, some of which do not. We consider competing treatments by adding additional Ds and D^*s:

$$\begin{aligned} logit(y_{it}) = \mu + \\ \delta_{1lib} Lib_{it} + \delta_{1con} Con_{it} + \textstyle\sum_{j=2}^J \delta_j D_{jit} \\ + \gamma_{1lib} Lib_i^* + \gamma_{1con} Con_i^* + \textstyle\sum_{j=2}^J \gamma_j D_{ji}^* \\ + \textstyle\sum_t \tau_{1t} T_t + \sum_t \tau_{2lib,t} T_t Lib_i^* \\ + \textstyle\sum_t \tau_{2con,t} T_t Con_i^* + \sum_t \sum_j \tau_{jt} D_j^* T_t \\ + \textstyle\sum_{k=1}^K \beta_k Z_{kit} + \nu_i + \epsilon_{it} \end{aligned} \quad \text{(A.5)}$$

The causal inference literature introduced the idea of causal heterogeneity, in particular, the

idea that the effect of a treatment might be bigger for those who typically seek it than for those who typically avoid it (Morgan and Winship 2007: 42-50). Morgan and Winship consider the case of Catholic schools as an example. The parents and students who choose Catholic schools might do so because they expect to get more out of the experience than a randomly selected public-school student would. Thus a treatment has three, not one, kind of effect: the average treatment effect (ATE), the average effect of the treatment on the treated (ATT), and the average effect of the treatment on the controls (ATC). The δs in equations [A.4] and [A.5] are best thought of as ATTs because δ_{model} is the conditional difference between the responses with and without treatment only among people who were ever treated.

References

Morgan, Stephen L. and Christopher Winship. 2007. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*. New York: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511804564

Table A1. Codes for Personal Characteristics in Multivariate Models

Characteristic	Source	#	Codes
Religious origin	Self-report	1	No religion
		0	Otherwise
Gender	Interviewer report	1	Woman
		0	Man
Black	1973-1998: Interviewer	1	Black
	2000-2012: Self-report	0	Otherwise
Latino	1973-1998: Self-reported ethnicity	1	Latino
	2000-2012: Self-reported Hispanic origin	0	Otherwise
Chinese or Japanese	1973-1998: Self-reported ethnicity	1	Chinese or Japanese
	2000-2012: Self-reported race or ethnicity	0	Otherwise
Nativity	Self-report	1	United States
		0	Elsewhere
Education	Self-report	4	Advanced degree
		3	College degree
		2	Some college
		1	High school diploma
		0	No credential
Marital status	Self-report (combining current marital status and ever-divorced status)	4	Married once
		3	Remarried
		2	Widowed
		1	Divorced or separated
		0	Never married
Parental status	Self-report	1	One or more children ever born
		0	None
Year of birth	Self-report	–	Single years (1900-1987) or 5-year intervals (1900-1904, . . . , 1985-1987)
Region	Recoded from address (census division)	4	Pacific
		3	Mountain
		2	South
		1	Midwest
		0	Northeast
Liberal views	Self-scored [from showcard]	2	Extremely liberal (1) or liberal (2)
		1	Slightly liberal (3)
		0	Other (4-7)
Conservative views	Self-scored [from showcard]	2	Extremely conservative (7) or conservative (6)
		1	Slightly conservative (5)
		0	Other (1-4)

Notes: The baseline category for each variable is coded zero.

Table A2: Coefficients from Selected Models of Religious Preference: Persons 25 Years Old and Over, 1973-2012

	Model					
		Cohort dummies		Multilevel model		
Independent variable	Null	Baseline	Personal	Personal	Generation	Generation′
Year (sheaf)	1.000	0.369	0.367	0.384	0.336	0.332
	0.049	0.059	0.058	0.049	0.049	0.049
Year of birth						
Variance σ^2_ν		0.529	0.317	0.302	0.005	0.010
				0.112	0.003	0.005
Dummy variables:						
1900-1904		-1.368	-1.232			
		0.284	0.293			
1905-1909		-1.116	-0.931			
		0.187	0.193			
1910-1914		-1.385	-1.219			
		0.170	0.177			
1915-1919		-1.002	-0.841			
		0.127	0.130			
1920-1924		-1.188	-0.987			
		0.117	0.125			
1925-1929		-0.984	-0.824			
		0.113	0.120			
1930-1934		-0.847	-0.797			
		0.105	0.109			
1935-1939		-0.849	-0.728			
		0.097	0.102			
1940-1944		-0.451	-0.394			
		0.079	0.084			
1945-1949		-0.161	-0.133			
		0.068	0.072			
1950-1954		0.000	0.000			
		—	—			
1955-1959		-0.028	-0.119			
		0.068	0.073			
1960-1964		-0.024	-0.166			
		0.073	0.079			
1965-1969		0.262	0.076			
		0.077	0.083			
1970-1974		0.365	0.164			
		0.082	0.091			
1975-1979		0.623	0.338			
		0.096	0.110			
1980-1984		0.651	0.356			
		0.119	0.130			
1985-1987		0.914	0.633			
		0.222	0.261			
Cohort-level explanatory variables						
Autonomy over obedience					0.094	0.104
					0.050	0.044
Sex and drugs not wrong					0.320	0.299
					0.092	0.078
Reject God and the Bible					0.034	0.048
					0.070	0.061
Person-level explanatory variables						

	Dummy variables			Multilevel model		
Independent variable	Null	Baseline	Personal	Personal	Generation	Generation′
Raised with no religion			2.179	2.162	2.145	2.147
			0.080	0.067	0.067	0.067
Black			-0.333	-0.349	-0.353	-0.353
			0.067	0.058	0.058	0.058
Hispanic			-0.425	-0.403	-0.418	-0.417
			0.086	0.071	0.071	0.071
Chinese or Japanese			0.487	0.610	0.603	0.606
			0.153	0.134	0.134	0.134
Woman			-0.607	-0.622	-0.625	-0.625
			0.038	0.034	0.034	0.034
Education × religious origin:						
No credentials or raised			0.000	0.000	0.000	0.000
with no religion			—	—	—	—
High school diploma			-0.210	-0.231	-0.244	-0.245
			0.065	0.060	0.060	0.060
Some college			-0.055	-0.058	-0.072	-0.070
			0.067	0.060	0.060	0.060
College degree			0.117	0.092	0.079	0.080
			0.075	0.065	0.064	0.064
Advanced degree			0.382	0.361	0.357	0.360
			0.083	0.072	0.072	0.072
Marital history:						
Married once			-0.402	-0.430	-0.420	-0.422
			0.069	0.067	0.067	0.067
Remarried			-0.041	-0.094	-0.077	-0.078
			0.088	0.080	0.080	0.080
Widowed			-0.479	-0.537	-0.470	-0.469
			0.112	0.099	0.099	0.099
Divorced or separated			-0.064	-0.092	-0.069	-0.066
			0.077	0.062	0.062	0.062
Never married			0.000	0.000	0.000	0.000
			—	—	—	—
Parent			-0.177	-0.205	-0.207	-0.209
			0.074	0.060	0.060	0.060
Married parent			-0.346	-0.311	-0.301	-0.298
			0.099	0.085	0.085	0.086
Region of the country						
Northeast			-0.458	-0.474	-0.474	-0.474
			0.067	0.053	0.053	0.053
Midwest			-0.573	-0.622	-0.624	-0.624
			0.062	0.051	0.051	0.051
South			-0.867	-0.919	-0.922	-0.921
			0.062	0.050	0.050	0.050
Mountain			-0.224	-0.245	-0.246	-0.244
			0.080	0.069	0.069	0.069
Pacific			0.000	0.000	0.000	0.000
			—	—	—	—
Constant	0.030	-1.163	0.073	-0.181	-0.293	-0.302
	0.112	0.143	0.175	0.190	0.141	0.140

Note: $N = 47{,}092$ for all models. Cases weighted for design effects and the number of adults in the household. Standard errors below coefficients. The sheaf coefficient for year in the null model equals 1.0 by construction. Cohort variance is not a parameter in models with cohort dummies; variance calculated from the coefficients. The Generation′ model replaces five-year cohorts with single-year cohorts. Education coefficients only apply to people raised in a religious tradition. *Source*: Authors' calculations from General Social Surveys, 1973-2012.

Table 3. Disposition of Cases: General Social Survey Panels, 2006-2012

	2006-2010		2008-2012	
Outcome	*f*	%	*f*	%
Selected for panel study	2,000	100	2,023	100
Completed three interviews	1,276	64	1,295	64
Refused second interview	404	20	379	19
Refused third interview	211	11	244	12
Left the United States	5	<1	17	1
Left household setting	32	2	27	1
Died	72	4	61	3

Notes: The 2006 GSS had 4,510 respondents; 2,000 were randomly selected for the 2006–2010 panel study. All 2,023 people first interviewed in 2008 were enrolled in the 2008–2012 panel study.
Source: Release notes from the first two completed General Social Survey Panels.

A4: Coefficients from Four Counterfactual Models of Religious Preference: Adults, United States, 2006-2012

	Model			
	Asymmetrical		Symmetrical	
Independent variable	All	Raised in a religion	All	Raised in a religion
Treatment variables				
Political views	—	—	-0.369	-0.335
			0.090	0.099
Liberal	0.321	0.312		
	0.129	0.142		
Conservative	-0.362	-0.292		
	0.140	0.154		
Attends religious services	-2.217	-2.194	-2.224	-2.193
	0.261	0.291	0.261	0.291
Married	-0.369	-0.315	-0.362	-0.309
	0.270	0.301	0.270	0.300
Selection variables				
Liberal political views	0.759	0.755		
	0.398	0.435		
Conservative political views	-0.202	-0.312		
	0.414	0.451		
Political views			-0.428	-0.470
			0.342	0.372
Attend religious services	-2.704	-2.891	-2.670	-2.864
	0.428	0.490	0.426	0.488
Married	0.299	0.369	0.260	0.333
	0.410	0.456	0.408	0.453
Time variables				
2006	0.000	0.000	0.000	0.000
	—	—	—	—
2008	0.571	0.640	0.441	0.564
	0.330	0.362	0.281	0.307
2010	0.573	0.606	0.511	0.551
	0.333	0.364	0.284	0.309
2012	0.586	0.559	0.414	0.435
	0.410	0.447	0.359	0.389
Selection × interactions				
Liberal × 2006	0.000	0.000		
	—	—		
Liberal × 2008	-0.889	-0.838		
	0.433	0.472		
Liberal × 2010	-0.589	-0.648		
	0.431	0.471		
Liberal × 2012	0.165	0.088		
	0.532	0.576		
Conservative × 2006	0.000	0.000		
	—	—		
Conservative × 2008	0.521	0.631		
	0.472	0.513		
Conservative × 2010	0.396	0.496		
	0.459	0.499		
Conservative × 2012	-0.667	-0.430		
	0.574	0.622		

	Asymmetrical		Symmetrical	
Independent variable	All	Raised in a religion	All	Raised in a religion
Political × 2006			0.000	0.000
			—	—
Political × 2008			0.729	0.748
			0.383	0.417
Political × 2010			0.514	0.592
			0.373	0.407
Political × 2012			-0.352	-0.223
			0.469	0.506
Attend × 2006	0.000	0.000	0.000	0.000
	—	—	—	—
Attend × 2008	0.090	0.274	0.055	0.243
	0.392	0.435	0.390	0.433
Attend × 2010	-0.319	-0.180	-0.346	-0.201
	0.395	0.438	0.393	0.436
Attend × 2012	-0.700	-0.611	-0.715	-0.615
	0.513	0.568	0.510	0.564
Married × 2006	0.000	0.000	0.000	0.000
	—	—	—	—
Married × 2008	-0.455	-0.721	-0.425	-0.698
	0.357	0.392	0.354	0.388
Married × 2010	-0.221	-0.416	-0.197	-0.391
	0.359	0.394	0.356	0.390
Married × 2012	-0.093	-0.273	-0.061	-0.249
	0.455	0.497	0.452	0.494
Covariates				
Religious origin: none	3.068		3.054	
	0.268		0.267	
Woman	-1.284	-1.445	-1.276	-1.439
	0.206	0.229	0.206	0.229
Black	1.002	0.632	1.015	0.644
	0.321	0.357	0.319	0.355
Latino	-0.631	-0.624	-0.627	-0.617
	0.385	0.415	0.384	0.414
Born in the U.S.A.	0.155	0.321	0.158	0.329
	0.368	0.422	0.367	0.421
Education				
No credentials	0.000	0.000	0.000	0.000
	—	—	—	—
High school diploma	-0.755	-0.537	-0.741	-0.528
	0.315	0.352	0.314	0.351
Some college	-0.390	-0.219	-0.387	-0.217
	0.317	0.354	0.317	0.353
College degree	-0.066	0.188	-0.054	0.202
	0.351	0.392	0.350	0.390
Advanced degree	0.603	0.910	0.620	0.935
	0.402	0.443	0.400	0.442
Year of birth				
1900–1925	-2.893	-2.675	-2.921	-2.700
	1.241	1.347	1.240	1.345
1926–1935	-0.019	-0.112	-0.009	-0.097
	0.507	0.556	0.505	0.555

	Asymmetrical		Symmetrical	
Independent variable	All	Raised in a religion	All	Raised in a religion
1936–1945	-0.102	-0.182	-0.109	-0.190
	0.419	0.456	0.418	0.456
1946–1955	0.000	0.000	0.000	0.000
	—	—	—	—
1956–1965	0.250	0.089	0.246	0.085
	0.338	0.370	0.337	0.369
1966–1975	1.118	0.986	1.106	0.975
	0.343	0.377	0.342	0.376
1976–1990	2.028	1.920	2.030	1.919
	0.337	0.373	0.336	0.372
Region of the country				
Northeast	0.000	0.000	0.000	0.000
	—	—	—	—
Midwest	0.374	0.270	0.380	0.277
	0.318	0.349	0.318	0.349
South	-0.234	-0.176	-0.244	-0.185
	0.302	0.328	0.301	0.327
Mountain	1.506	1.685	1.491	1.675
	0.407	0.446	0.405	0.445
Pacific	0.692	0.793	0.700	0.800
	0.346	0.382	0.345	0.381
Constant	-2.749	-3.106	-2.584	-2.955
	0.631	0.707	0.609	0.683
Within-person variance				
$\ln \sigma_\nu^2$	2.286	2.414	2.281	2.410
	0.114	0.132	0.114	0.131
Number of observations	7,366	7,366	6,827	6,827
Number of persons	2,553	2,553	2,457	2,457

Note: Standard errors below coefficients.

Source: Authors' calculations from General Social Survey panels, 2006-2012.