STATE AND REGIONAL SUICIDE RATES: A NEW LOOK AT AN OLD PUZZLE

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ABSTRACT: *U.S. suicide rates vary across the states and are higher in the American West than in other regions. Reasons for these patterns have eluded social scientists. This research note examines whether residential stability and population density as ecological contexts for social integration help explain the patterns. Reflecting Durkheimian reasoning, results suggest that residential stability helps explain both the high Western suicide rate and state suicide rates more generally. Final remarks address the theoretical and empirical implications of the findings.*
Keywords: suicide, residential stability, population density, Durkheim

Suicide rates vary widely across the United States and exhibit a distinct regional pattern. In what has been called "a sharp east-west divide" (Breault 1994:19), the Western states have the highest suicide rates and the Eastern states the lowest.

These differences remain a theoretical and empirical puzzle. Focusing on variation in state suicide rates and the East-West divide, scholars have offered several explanations, many of them derived from Durkheim's *Suicide.* However, mixed findings leave it unclear why suicide rates vary across the states and why the American West has the highest regional rate. This research note attempts to understand these differences by emphasizing two neglected areal variables in the study of suicide: residential stability and population density.

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Sociological Perspectives, **Vol. 56, Issue 2, pp. 287–297, ISSN 0731-1214, electronic ISSN 1533-8673.**
 DOI: 10.1525/sop.2013.56.2.287.

UNDERSTANDING STATE AND REGIONAL SUICIDE RATES

Suicide rates differ greatly across the states. In 2009, the latest year for which data were available at the time of this writing, the highest rate, 22.5 in Montana, was 3.5 times greater than the lowest rate, 6.4 in New Jersey. Of note, the West has had the highest regional suicide rate at least since the nineteenth century (Lester 1996), and this pattern still holds today (McIntosh 2012).

These variations have puzzled health officials and scholars. According to a Centers for Disease Control and Prevention (CDC 1997:789) report, reasons for the regional pattern are "unknown," and do not reflect regional differences in sociodemographics or firearm ownership. Scholars considering these variations have relied heavily on insights drawn from Durkheim's *Suicide*. As is well known, Durkheim attributed group suicide rates to group levels of social integration and moral regulation and famously concluded that "suicide varies inversely with the degree of integration of the social groups of which the individual forms a part" (Durkheim 1897/1952:209). In line with Durkheim, scholars of suicide highlight the importance of social ties for social integration and social regulation (Breault 1986; Johnson 1965; Maimon and Kuhl 2008; Pescosolido and Georgianna 1989; Stack 2000b; van Tubergen, Grotenhuis, and Ultee 2005; Wray, Colen, and Pescosolido 2011).

According to Durkheim, geographical differences in suicide rates are largely a function of the social integration of groups comprising particular locations (see Baller and Richardson 2002; Breault 1986), and not of aspects of the locations themselves. Reflecting this emphasis, scholars have sought to understand geographical differences in suicide by examining geographical differences in various measures of group social integration. In particular, they commonly find inverse associations between suicide and family and religious integration (typically measured as divorce and church membership, respectively) in the United States and elsewhere (see Stack 2000b for a review). Moreover, studies of the U.S. regional pattern cite the West's lower family and religious integration as an important reason for its higher suicide rate (Baller and Richardson 2002; Breault 1986; CDC 1997; Lester 1995a, 1996). Variation in family and religious integration thus seems to help explain both state and regional variation in U.S. suicide rates.

However, this conclusion may be premature. First, several ecological studies find little or no effect of religious integration on suicide net of appropriate controls (Bainbridge 1989; Girard 1988; Lester 1987). Although the ecological association between suicide and divorce is more robust, some scholars question whether this association survives when other measures of social integration are taken into account (Norström 1995; Stafford and Gibbs 1988) and whether the association reflects effects of divorce itself, the marital problems leading to divorce, or personal factors that might make both divorce and suicide more likely (Kunce and Anderson 2002; Lester 1995b; Stack 2000b). Relatedly, Breault (1994:19) argues that the inverse association between suicide and family and religious integration is a coincidental geographical artifact that becomes spurious once East-West region is controlled.

Residential Stability and Population Density

In view of these problems, we propose that two population-based factors may be relevant for explaining state suicide rates generally and the regional pattern more specifically.

The first is residential stability. Because areas with low residential stability (high population turnover) have more newcomers and temporary residents, they are thought to lack stable social ties and, in turn, to have lower social integration (Stark, Doyle, and Rushing 1983). For the same reasons, they are also thought to have weakened social institutions. Thus, marriage is said to weaken because residential instability impairs friendships, extended kinship ties, and other social networks, all of which normally provide the social support and social controls that help keep marriages intact; religion is said to weaken because residential instability impedes church membership as congregants join and leave in rapid fashion (Breault and Kposowa 1987; Glenn and Shelton 1985; Stark et al. 1983). In line with Durkheimian reasoning, areas with lower residential stability should have higher suicide rates because they have weakened social ties and weakened social institutions. Despite the potential relevance of residential stability, suicide studies have treated it primarily as a control variable for testing the effects of religious and/or family integration (Baller and Richardson 2002; Breault 1986; Stark et al. 1983).

The second potentially relevant population-based factor is population density. As Pope (1976) argued, Durkheim recognized that the rate of social interaction varies with the number of people in an area and in turn influences the strength of collective sentiments and thus the degree of social integration. However, Durkheim did not use population density in his analysis of suicide rates. Contemporary suicide studies have similarly neglected population density as a theoretical construct, despite some attention to suicide in rural areas (e.g., Frankel and Taylor 1992; Hempstead 2006; Judd, Cooper, Fraser, and Davis 2006; Levin and Leyland 2005; Zekeri and Wilkinson 1995). Low population density should produce higher suicide rates for at least two reasons. First, and as many writers have noted, population density affects social interaction: all things equal, low population density reduces social interaction (Fischer 1982; Kowalski, Faupel, and Starr 1987; Putnam 2000; Wilkinson 1984). Second, low population density is also associated with fewer "weak ties," which are "vital for an individual's integration into modern society" (Granovetter 1983:203; Wilkinson 1984). Low-density areas lacking weak ties are, according to Granovetter (1983:202), likely to be more "fragmented and incoherent." Because of their lack of social interaction and weak ties, then, low-density areas should have lower social integration and higher suicide rates. A similar argument may be made for areas with low residential stability. Because of their high population turnover, these areas are also likely to have reduced weak ties and, as a result, lower social integration and higher suicide rates.

Hypotheses

This discussion suggests some possible answers to the puzzle of state and regional variation in U.S. suicide rates. Turning first to the regional variation, Western states have traditionally experienced greater population change (Winkler,

Field, Luloff, Krannich, and Williams 2007) and also have relatively low population density overall. This leads us to hypothesize that residential stability and population density should mediate the West's higher suicide rate (Hypothesis 1). Across the states, residential stability and population density should also be inversely associated with higher suicide rates (Hypothesis 2). Recalling our theoretical discussion of residential stability and weakened social institutions, we further predict that family and religious integration partially mediate the association of residential stability with state suicide rates (Hypothesis 3).

METHODS

The data for this analysis are all measured at the state level for the continental states; unless otherwise specified, all variables used in the analysis come from the 2000 U.S. Census. The dependent variable is *state suicide rates*, as reported by the National Center for Health Statistics for 2001.

The primary independent variables are *residential stability* and *population density*. To measure residential stability, two Census variables—the percentage change in the number of households between 1990 and 2000 (reverse-coded), and the percentage of the population over age five who lived in the same house a year earlier—were standardized and then summed (alpha = .83) (Crutchfield, Geerken, and Gove 1982; Stark et al. 1983); higher scores on this measure indicate greater stability. Population density was measured by a Census measure (logged) of population per square mile; higher scores on this measure indicate greater density. A regional variable, *West*, of the eleven Census-defined Western continental states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) and the thirty-seven remaining non-Western states was also created (1 = West, 0 = non-West). Regarding the two other key predictor variables, the percentage of those aged fifteen and over who are currently divorced (*divorce*) was used as a measure of family integration, while adjusted percentages of adherents of religious congregations (*religious adherence*) according to the 2000 Religious Congregations and Membership Study (RCMS; Finke and Scheitle 2005) were used to measure religious integration.

Controls include sociodemographic variables identified in the suicide literature as likely correlates of suicide (for reviews, see Stack 2000a, 2000b). These include median family income (logged), median age, percent African American (logged), percent Native American (dichotomized at the 67th percentile because of extreme skewness; 1 = high, 0 = low), percent male, and percent Catholic, as measured by the RCMS. An additional control was firearm ownership, which denotes the percentage of individuals living in households with firearms, as measured by the 2001 Behavioral Risk Factor Surveillance System (Miller, Lippmann, Azrael, and Hemenway 2007).[1]

To model suicide, we considered several analytical techniques. Our final models use Poisson regression, which is typically used for count-style dependent variables, but is appropriate when using rates with small incidences (Osgood 2000). We see no evidence of overdispersion ($\mu < sd$) in the dependent variable; nonetheless, we specify robust standard errors and use the Huber/White/Sandwich linearized estimator of variance to relax assumptions of the variance and mean of

the dependent variable traditionally used in Poisson regression. It should be noted that we also logged the rate of suicide and estimated OLS regression models. Because the results are substantively similar, we only show the Poisson models.

RESULTS

Table 1 presents the correlation matrix (Pearson's *r*) to provide an initial look at density/stability, suicide, and controls. As expected, residential stability and population density are both inversely related with state suicide rates, and more strongly so than any variable but divorce. In other key bivariate results, the West has lower residential stability and population density than the non-West and also a higher suicide rate. Also expected, divorce and religious adherence are positively and inversely associated, respectively, with suicide; divorce is also inversely associated with residential stability and population density, while religious adherence is positively associated with residential stability.

Table 2 presents the Poisson regression results.[2] Column 1 presents the results for a baseline equation including the West dummy variable and the controls. The association between Western region and suicide is robust net of several model controls. To test Hypotheses 1 and 2, Column 2 adds residential stability and population density to the baseline equation. The coefficient for West reduces by half and loses statistical significance. A separate, unreported analysis found that residential stability accounted for this mediation and that population density played no role in it. These results partially support Hypothesis 1's expectation that both residential stability and population density should mediate the West's higher suicide rate.

Column 2 also shows that residential stability is inversely associated with state suicide rates (with the highest net association in a separate unreported analysis) but that population density is not so associated. These results partially support Hypothesis 2's expectation that both these factors should be inversely associated with state suicide rates.

To test Hypothesis 3, Column 3 adds divorce and religious adherence as measures of family integration and religious integration, respectively. In their presence, the effect of residential stability reduces in size by about one-fourth while remaining statistically significant. A separate unreported analysis found that divorce accounted for this entire reduction. These results partially support Hypothesis 3's expectation that divorce and religious adherence mediate the association of residential stability with state suicide rates. Even with these two measures of social integration added, residential stability continues to show a strong net association with state suicide rates.

Overall, the bivariate and multivariate results are fairly consistent with expectations from the earlier theoretical argument. Residential stability mediated the West's higher suicide rate, supporting Hypothesis 1, though population density played no role in this mediation. Residential stability, but not population density, proved to be a significant predictor of state suicide rates, partially supporting Hypothesis 2. Finally, divorce but not religious adherence as respective measures of family integration and religious integration helped mediate the association of residential stability with state suicide rates, partially supporting Hypothesis 3.

TABLE 1
Correlation Matrix

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Suicide rate												
2. Residential stability	–.628***											
3. Population density	–.754***	.445**										
4. West	.555***	–.644***	–.504***									
5. Divorce	.697***	–.641***	.396**	.436**								
6. Religious adherence	–.385**	.381**	.121	–.410**	–.590***							
7. Median family income	–.572***	.162	.547***	–.044	–.383**	–.073						
8. Median age	–.054	.428**	.209	–.384**	.095	–.322*	–.009					
9. % African-American	–.448***	.072	.635***	–.465***	–.139	.266*	.079	–.057				
10. % Native-American	.530***	–.529***	–.610***	.771***	.225	–.180	–.107	–.341**	–.517***			
11. % Catholic	–.466***	.443***	.371**	–.106	–.394**	.234	.517***	.249*	–.151	–.140		
12. % male	.508***	–.616***	–.653***	.693***	.277*	–.590***	.032	–.496***	–.525***	.683***	–.165	
13. Firearm ownership	.617***	–.176	–.777***	.116	.296*	.018	–.734***	–.094	–.324*	.260*	–.647***	.290*

Note: Pearson's *r*, one-tailed tests.
*$p < .05$. **$p < .05$. ***$p < .001$.

TABLE 2
Poisson Regression of Regional and State Suicide Rates on Predictor and Control Variables

	1			*2*			*3*		
	b		*SE*	*b*		*SE*	*b*		*SE*
West	.184	***	.058	.092		.066	.056		.070
Residential stability				–.059	***	.016	–.043	*	.017
Population density				–.005		.037	–.007		.036
Divorce							.035	†	.019
Religious adherence							.000		.002
Median family income	–.829	***	.244	–.593	*	.242	–.509	*	.231
Median age	.037	***	.011	.031	**	.012	.022		.015
% African-American	–.014		.019	–.036		.023	–.037		.026
% Native-American	.012		.042	–.003		.041	.028		.044
% Catholic	–.004	†	.002	–.001		.002	–.001		.003
% Male	.133	**	.046	.029		.047	.022		.047
Firearm ownership	–.001		.002	.004		.004	.003		.004
Constant	3.718		3.118	6.769	*	3.102	6.030	*	3.008
R^2		.110			.119			.121	

Note: Unstandardized coefficients, b; standard errors, SC; two-tailed tests.
†$p < .10$. *$p < .05$. **$p < .05$. ***$p < .001$.

As discussed earlier, some prior work has questioned the importance of family and religious integration for ecological suicide rates. The results of Column 3 in Table 2 tend to support this skepticism. Neither divorce nor religious adherence is associated with state suicide rates, although the association for divorce comes close to statistical significance ($p < .10$). When residential stability and population density are removed from Column 3's equation (separate, unreported analysis), the unstandardized coefficient for divorce rises from .035 to .062 and achieves statistical significance ($p < .001$), with almost all of this rise achieved by the removal of residential stability. In line with the earlier theoretical discussion that posited residential stability as logically prior to family integration, this result indicates that ecological work on divorce and suicide needs to control for residential stability to rule out possible spuriousness.

CONCLUSION

The state variation in suicide rates and the American West's relatively high suicide rate have long been noted but not well understood. To help clarify this geographical puzzle, this article focused on two areal variables, residential stability and population density, that receive insufficient theoretical attention in suicide research. The results for residential stability, but not population density, supported theoretical expectations. Residential stability mediated the West's higher regional suicide rate and was inversely associated with state suicide rates. As such, residential stability appears to help explain the geographical puzzle: The West has a

high regional suicide rate in part because it has a low regional level of residential stability, and states have higher or lower suicide rates in part because of their level of residential stability.

Certain limitations of this study should be noted. In view of the ecological fallacy (Robinson 1950) and possible selectivity factors (Agerbo, Sterne, and Gunnell 2007), a first issue concerns the relevance of ecological correlates for understanding individual suicides (Kunce and Anderson 2002). Although this study appropriately tested the relevance of two ecological factors, residential stability and population density, the relevance of these factors for individual suicides needs to be assessed with individual data. A related issue concerns the proper level of aggregation for suicide research (Cutchin and Churchill 1999; Neumayer 2003). In particular, states may be too heterogeneous for proper testing of ecological factors, and smaller levels of aggregation may be preferable. In this regard, it is encouraging that the relatively few county-level studies using residential stability and population density as controls report inverse associations with suicide rates (Breault 1986; Kowalski et al. 1987; Stark et al. 1983). Finally, because our data are cross-sectional, we can make no definitive claims about the causal relationship between residential stability, population density, and suicide.

Although these issues suggest some caution, the article's results do indicate the importance of residential stability for understanding regional and state suicide rates and point to avenues for further work. Residential stability and population density were featured in the Chicago school's human ecology approach, which emphasized that social and physical aspects of communities affect their levels of deviance and other problems independent of the composition of the groups living in the communities. Arguing that "*there must be something about places as such that sustains crime*," Stark (1987:893, his emphasis) integrated residential stability, population density, and other areal social and physical traits into his theory of deviant places. Coupled with recent findings on the importance of areal levels of concentrated disadvantage and racial inequality for suicide (Burr, Hartman, and Matteson 1999; Kubrin, Wadsworth, and DiPetro 2006), the article's results suggest that it might be possible to develop a theory of suicidal places to parallel the theory of deviant places. Future efforts should work toward the development of such a theory.

Acknowledgments: At the time this work was completed, Jason N. Houle was a Robert Wood Johnson Foundation Health & Society Scholar at the University of Wisconsin–Madison in Madison, Wisconsin. The authors thank the Robert Wood Johnson Foundation Health & Society Scholars program for its financial support.

NOTES

1. Despite mixed evidence, unemployment is often positively associated with suicide rates (Stack 2000a). Accordingly, state unemployment rates for 2000 were examined in a preliminary analysis. This variable was not associated with suicide at a significant level in either the bivariate or multivariate analysis, and its inclusion in the multivariate analysis did not alter the results reported in the text.
2. In assessing multicollinearity, benchmarks of .90 for correlations among predictor variables and 10 for variance inflation factors (VIFs) are often used as indicators of serious

multicollinearity (Belsley, Kuh, and Welsch 1980; O'Brien 2007). A few bivariate correlations reported in the text are relatively high, as might be expected of ecological variables, but fall short of the .90 benchmark for correlations. In the regression equations in Columns 2 and 3, the VIF for population density was 10.64, slightly exceeding the benchmark of 10 for this computation. However, the results of these equations were virtually identical when population density was excluded from them. Population density was thus retained in the equations to avoid specification error (O'Brien 2007). Overall, then, multicollinearity does not appear to be a serious problem, but some caution should be used in interpreting results.

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