SOCIAL INTEGRATION, IMITATION, AND THE GEOGRAPHIC PATTERNING OF SUICIDE

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One of sociology's defining debates centers on explanations of the geographic patterning of suicide. This classic debate is revisited using techniques of spatial analysis and data for two geographies: late nineteenth-century French departments, and late twentieth-century U.S. counties. Results of the French analysis contradict Durkheim's claim that "imitation" plays no role in shaping the geographic patterning of suicide. Suicide rates for northern and southern French departments cluster geographically even when the clustering of multiple dimensions of social integration is controlled. These findings are replicated in a contemporary analysis of nonwestern U.S. counties. Results for the American West, however, support the Durkheimian view that suicide clusters in geographic space only because important structural predictors of suicide, including measures of social integration, do so as well. These discrepant findings are reconciled and it is concluded that the geographic patterning of suicide is shaped by both social integration and imitation.

IN HIS CLASSIC ANALYSIS of suicide, Durkheim ([1897] 1951) observes that suicide rates cluster in geographic space. He attempts to explain this clustering by referring to the geographic patterning of social integration and regulation. Because maps of suicide rates and various measures of integration and regulation showed considerable overlap, Durkheim concludes that high suicide rates cluster in geographic space only because weak social integration and regulation also cluster in that same space.

Durkheim ([1897] 1951) attempts to rule out competing explanations of the geographic patterning of suicide, including those based on "imitation." Tarde, a contemporary of Durkheim, was a vocal advocate of imitation explanations.[1] Tarde (1903) argues that many shared behaviors and beliefs are adopted through imitation. To the extent that the risk of suicide is affected by news of suicides in neighboring areas, imitation will shape the geographic patterning of suicide. These opposing views on the importance of imitation fueled a lively debate between Durkheim and Tarde (Tarde 1904).

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[1] As discussed below, Tarde (1903) employs a fairly broad notion of imitation. He argues that imitation is present "when a man . . . reflects the opinions of others, or allows an action of others to be suggested to him" (p. *xiii*).

Much of the sociological literature on suicide emphasizes social integration and regulation explanations, suggesting that Durkheim won this debate (Breault 1986; Ellison, Burr, and McCall 1997; Kposowa, Breault, and Singh 1995; Pescosolido and Georgianna 1989; Stack 1982, 1990a; Trovato 1998). Unfortunately, this literature largely abandoned the use of geographic approaches to the study of suicide (Wasserman and Stack 1995).[2] This is unfortunate because place continues to be relevant for a wide variety of phenomena (Baller et al. 2001; Land, Deane, and Blau 1991; Tolnay 1995; Tolnay, Deane, and Beck 1996).

It was not until the 1970s that the study of imitation and suicide was seriously reconsidered (Phillips 1974). Several researchers used time-series analysis to examine the effects of elite suicides on subsequent U.S. suicide rates. Their results showed that U.S. suicide rates often increase following the suicide of a celebrity (Bollen and Phillips 1982; Gould and Shaffer 1986; Phillips 1982; Phillips and Carstensen 1986; Stack 1987, 1990b).

Our work departs from this literature in two ways. First, we examine the spatial, rather than the temporal, patterning of suicide. In other words, we ask if suicide rates cluster across geographic space rather than through time. Second, instead of assessing the consequences of elite suicides, we assess the effects of all suicides. While a temporal design may be ideal for detecting the imitative effects of elite suicides, a spatial design is better suited to studying the imitative effects of all suicides. Suicides of nonelites may produce local or geographically bounded imitation not detectable in a national time-series analysis.

Both Tarde (1903) and Durkheim ([1897] 1951) suggest that imitation effects, if present, manifest themselves in the geographic patterning of phenomena. Their agreement on this point justifies our use of spatial analysis to evaluate their opposing views on the importance of imitation in a study of suicide. If the clustering of the observed suicide rate can be fully accounted for by the clustering of important structural predictors of suicide, including multiple measures of social integration, Durkheim's perspective gains support. On the other hand, if the clustering of suicides remains once the clustering of important predictors is controlled, imitation explanations, consistent with Tarde's view, gain support.

The merit of these perspectives is assessed using suicide and covariate data for late nineteenth-century French departments, the same geography studied by Durkheim (Durkheim [1897] 1951). We then attempt to replicate the French results using data for late twentieth-century U.S. counties. U.S. counties are examined because their size is comparable to that of French departments, and they have been the focus of important research on the effects of social integration and regulation on suicide (Breault 1986; Pescosolido and Georgianna 1989).

To accomplish our investigation, we employ modern techniques of exploratory and multivariate spatial analysis. These techniques, not available when Durkheim and Tarde debated this issue nearly 100 years ago, have two valuable features. First, the clustering of suicide rates can be assessed by statistics and significance tests. Second, by testing for clustering among model residuals, we can test the Durkheimian claim that the clustering of social integration and regulation accounts for the clustering of suicide. Both features of our method allow us to improve upon Durkheim's rather crude spatial analysis, which relied entirely on the visualization of rates plotted on maps.

IMITATION

Tarde was an important early advocate of imitation explanations. He argues that imitation is present "when a man . . . reflects the opinions of others, or allows an action of others to be suggested to him" (1903:*xiii*). For Tarde, imitation is a powerful force capable of spreading beliefs and behaviors throughout a collectivity. He offered the following analogy to describe the process: "If a stone falls into the water, the first wave which it

[2] Wasserman and Stack (1995) tested for clustering of the suicide rates for U.S. states and Louisiana parishes, using circa-1980 data, and concluded that suicide rates do not cluster in space. We extend their work using similar methods but different geographies with both historical and contemporary data.

produces will repeat itself in circling out to the confines of its basin" (1903:17).

Definitions of imitation provided by contemporary scholars complement Tarde's notion. Akers (1994) notes, "Imitation refers to the engagement in behavior after the observation of similar behavior in others. Whether or not the behavior modeled by others will be imitated is affected by the characteristics of the models, the behavior observed, and the observed consequences of the behavior" (p. 99). English and English (1958) define imitation as "action that copies the action of another more or less exactly, with or without intent to copy" (p. 253). In his discussion of theories of contagion, Wheeler (1966) explains that English and English's definition encompasses a wide variety of influences, including "contagion, conformity and social pressures, and social facilitation" (p. 183). These definitions, consistent with Tarde's notion, imply that imitation refers to a wide variety of factors that contribute to the copying of another's behavior.

Durkheim ([1897] 1951:129) enters this definitional debate, arguing that there can be no mediating factors between the "representation" of a behavior and its "execution" by others. In other words, for imitation to be present, behavior must be an "automatic reflex" that "results directly from the mere sight of an act, with no other mental intermediary" ([1897] 1951:128). Durkheim argues, "It is one thing to share a common feeling, another to yield to the authority of opinion, and a third to repeat automatically what others have done" (p. 129). For Durkheim, only the third instance is imitation.

We suggest that this narrow conceptualization allowed Durkheim to more easily dismiss the effects of imitation. In our view, his notion of imitation is too exclusive. We prefer the more inclusive notions of imitation offered by Tarde, Akers, and English and English. In our view, imitation is best conceptualized as the direct and indirect effects of the representation of, or knowledge of, another's behavior. The presence of mediators, such as the consideration of consequences, does not preclude imitation effects. This notion of imitation can be used to explain the geographic patterning of suicide.

The Tardeian perspective suggests that imitation will cause suicide rates to exhibit a particular geographic pattern. Because barriers to imitation increase as a function of distance, imitation of suicide should cause suicide rates to cluster in geographic space. More specifically, imitation of those who commit suicide should create the clustering of high suicide rates. Conversely, imitation of those who reject suicide should produce the clustering of low suicide rates. We rely upon the Tardeian tradition; we predict that imitation will produce suicide clustering above and beyond any clustering created by social integration and regulation, discussed below.

SOCIAL INTEGRATION AND REGULATION

In stating his ideas on suicide, Durkheim ([1897] 1951) observed that suicides cluster in geographic space. In his view, however, the cause of this clustering is not imitation. Durkheim explains:

> Certain authors have felt that they might appeal to imitation whenever two or more contiguous [French] departments showed an equally strong tendency to suicide. Yet this diffusion within a single region may well spring from an equal diffusion of certain causes favorable to the development of suicide, and from the fact that the social environment is the same throughout the region. (P. 133)

Thus, Durkheim predicts that the clustering of suicide is largely determined by the clustering of social integration and regulation variables. These factors will account for the clustering of suicide to the extent that they cluster in geographic space and are powerful predictors of suicide.

Durkheim ([1897] 1951) describes social integration as follows:

> [T]he state of integration of a social aggregate can only reflect the intensity of the collective life circulating in it. It is more unified and powerful the more active and constant is the intercourse among its members. (P. 202)

Thus, the extent of social ties in a collectivity determines its level of social integration (Pescosolido and Georgianna 1989). For Durkheim, insufficient social integration creates individualism and egoistic suicide. He attempts to document the existence of

egoistic suicide by comparing maps of family density and suicide. This visual inspection of the two maps suggested that family integration provides protection against egoistic suicide.

The second important social cause of suicide for Durkheim is inadequate regulation:

> [In the regulated state,] each in his sphere vaguely realizes the extreme limit set to his ambitions and aspires to nothing beyond. . . . Thus, an end and goal are set to the passions. . . . This relative limitation and the moderation it involves, make men contented with their lot. ([1897] 1951:250)

In the unregulated state, humans suffer from their inability to satisfy increasingly ravenous appetites. This unregulated condition, referred to as anomie, leads to anomic suicide. Durkheim argues that members of high social classes are more likely to experience anomie. In support of this, he compares a map of French department wealth to that of suicide and concludes that the two variables are positively related (Durkheim [1897] 1951).

Subsequent researchers have suggested that Durkheim's distinction between integration and regulation is problematic because adequate levels of regulation cannot exist without adequate levels of integration (Johnson 1965; Pope 1976). We agree, and thus focus on social integration in the subsequent discussion and tests of Durkheim's theory of suicide.

Durkheim ([1897] 1951) predicts that both insufficient and excessive levels of social integration produce high suicide rates. Excessive integration results from an environment where the interests of the group dominate those of the individual and contributes to altruistic suicide. In modern society, integration rarely reaches excessive levels (Johnson 1965). Accordingly, we emphasize the effects of weak social integration on the geographic patterning of suicide.

We rely upon the Durkheimian perspective to predict that the clustering of social integration will account for the clustering of suicide. More specifically, weak social integration should produce the clustering of high suicide rates. Conversely, strong integration should produce the clustering of low suicide rates. In other words, the Durkheimian perspective predicts that any relationship among suicide rates of contiguous areas is spurious. Accordingly, this relationship should disappear once the social integration of neighboring areas is controlled.

HYPOTHESES

We test two competing hypotheses. First, the Tardeian hypothesis:

Hypothesis 1: The geographic clustering of suicide rates will be significant, even after the geographic clustering of important structural predictors is controlled.[3]

Second, the Durkheimian hypothesis:

Hypothesis 2: The geographic clustering of suicide rates will be fully accounted for by the geographic clustering of important structural predictors of suicide.

DATA AND VARIABLES

FRENCH DEPARTMENTS

Suicide rates per 1,000,000 persons for French departments, 1872 to 1876, were drawn from Morselli (1903:43). A map of French departments was scanned from this source (Morselli 1903, table 3). This scanned image was used to create a digital map for analysis. The following departments were excluded because their geographic boundaries were altered by the outcome of the Franco-Prussian War: Bas-Rhin, Haute-Rhin, Meurthe and Moselle, Belfort (Terr. de), and Vosges. The island of Corse was

[3] Allowing the Tardeian hypothesis to stand is a necessary but not sufficient condition for claiming that imitation drives the geographic patterning of suicide. Explanations other than imitation could account for this result. For example, suicide rates of neighboring areas may lead to suicide prevention efforts that have the unintended consequence of aggravating the suicide problem. While this type of mechanism relies on the spread of information about suicides, it does not involve influences that flow directly among decedents. Further, news of suicides in neighboring areas could cause coroners to be a little quicker to assign suicide as the cause of death for decedents who actually died of accidental or unknown causes.

also excluded, leaving 83 departments for analysis.

Three measures of *social integration* are used in the French analysis. A measure of 1872 migration involves the number of residents born outside each department per 100 residents (LeBras and Todd 1981:444–45; Watkins 1991:148). This measure was reverse coded to indicate residential stability. The number of divorces in 1896 per 100,000 couples was reverse coded to indicate marital stability (LeBras and Todd 1981:432–33). The number of ordained clergy in 1876 per 100,000 persons is also included (LeBras and Todd 1981:430–31); because late nineteenth-century France was predominantly Catholic, the ordained clergy rate essentially measures both percent Catholic and percent church adherents.[4]

In addition to measuring the presence of social ties to others, these three indicators of social integration may account for efforts by religious persons, lifelong friends, and spouses to conceal real suicides. Such efforts may have produced appreciable cause-of-death misclassification (Gillis 1994). Therefore, our measures help to remedy systematic measurement error in the dependent variable that may produce spurious indications of the clustering of suicide rates. In sum, these indicators of social integration should be negatively related to the suicide rate because ties to others should prevent suicides and also may cause some real suicides to be recorded as accidents or deaths with unknown causes.

Several *control variables* are employed in the French analysis. To measure socioeconomic status, we rely upon the classic demographic transition theory and use measures of income, age structure, and fertility (Freedman 1979). According to the logic of this theory, low fertility, an older age structure, and higher incomes should coexist. More specifically, we use the following measures to indicate socioeconomic status: (1) per capita income, measured for 1864 (Delefortrie and Morice 1959:214–16); (2) percent aged 15 or younger (reverse coded), measured for 1864 (Delefortrie and Morice 1959:208–10); and (3) births per 100 females (reverse coded), measured for 1860 to 1862 (Tugault 1975:24–25). We also include two measures that distinguish urban departments from rural ones: (1) percent urban, measured for 1872 (Tugault 1975:98–99); and (2) population size, measured for 1872 (Tugault 1975:98–99). To control for the effects of medical infrastructure and/or the effects of grief over child deaths, we include a measure of infant mortality, measured for 1861 (LeBras and Todd 1981: 470–71).

The validity and reliability of social, economic, and demographic data for late nineteenth-century France are generally regarded as sound, especially when compared with other data from the same time period (Gillis 1989, 1994, 1996; McQuillan 1984; Watkins 1991). Further, based on factor analytical and other results, the measures used here exhibit appreciable construct and criterion-related validity (DeVellis 1991). Finally, the ill effects of measurement error should be minimized by the use of multiple measures of social integration and composite measures for model controls.

The spatial lag of the suicide rate indicates imitation. This is simply the average suicide rate of each department's neighbors. More formally, the spatial lag is:

$$\Sigma_j w_{ij} s_j, \tag{1}$$

where w_{ij} is an element of a row-standardized spatial weights matrix, and s_j is the suicide rate of each department's neighbors as identified by the spatial weights matrix (Anselin 1995a). Subscript i refers to a particular department; subscript j refers to that department's neighbors. The spatial weights matrix defines the range of interaction across space. For our work, the range of interaction should be based on the likely "reach" of news about suicide. We use a first-order contiguity spatial weights matrix. These weights identify neighboring departments as those that share a common boundary line. Alternative weights were considered but not used. The geographic reach of news about suicide in late nineteenth-century France was unlikely to extend beyond each department's immediate neighbors.

[4] In some cases, independent variables are measured later in time than the dependent variable. This should have little impact on the analysis because the geographic patterning of social and demographic variables is slow to change.

U.S. Counties

To determine if the French results hold true in contemporary America, we analyze 1990 data for U.S. counties. Islands and all Alaskan and Hawaiian counties were excluded. To be consistent with the French analysis, spatial variables in the U.S. analysis are also based on a first-order contiguity spatial weights matrix.

Suicide data for the United States were drawn from the National Center for Health Statistics mortality files (National Center for Health Statistics 1989, 1990, 1991). Suicide deaths were identified using cause-of-death codes E950 to E959. The numerator of the suicide rate is the three-year averaged suicide count for 1989, 1990, and 1991. This average count was divided by the 1990 population figure.[5]

Several measures of *social integration* are used in the U.S. analysis. Percentage of males aged 15 and older who are divorced was reverse coded to indicate marital stability. Residential stability is measured as the percentage living in the same household in the census year and five years earlier. Marital stability, residential stability, and three measures of religiosity indicate social integration in the United States.

Percent church adherents and percent Catholic are established measures of religious integration.[6] Because of the diversity of the contemporary American religious landscape, we also include a control for religious homogeneity, which indicates the probability that two randomly selected church adherents belong to the same denomination. While not part of Durkheim's theory of suicide, we follow Ellison et al. (1997), who rely on the concept of homophily to argue that meaningful social ties are more easily formed in areas where individuals share the same religious beliefs. This view suggests that religious homogeneity and the suicide rate will be negatively related. Following Iannaccone (1991), this measure is constructed by dividing each denomination's adherent count by the total number of adherents. These ratios are squared and then summed.[7]

A number of *control variables* are employed in the U.S. analysis. Median family income (logged) and the percentage of the civilian labor force that is unemployed are included. Controlling for percent black adjusts for the undercounting of black church adherents. Percent Native American is controlled to account for the high suicide rates of Native American populations.[8] Population density (logged) and median age are also included. Data provided by the Glenmary Research Center (Bradley et al. 1992) and the U.S. Census Bureau's *USA Counties* CD-ROM for 1996 (U.S. Bureau of the Census 1996) were used to compute the independent variables for the U.S. analysis.

METHOD

Our spatial analysis is composed of five steps: (1) Clustering of the suicide rate is assessed. (2) Baseline models of suicide rates

[5] Suicide counts for U.S. counties were generated by aggregating individual suicides to the county level according to each decedent's county of residence. In order to merge data from multiple sources, some counties had to be combined. A list of combined counties is available on request from the authors.

[6] Church adherence is examined instead of church membership because denominational reporting of adherence data is more complete. In some counties, the number of church adherents exceeded the census population count. In these cases, values of percent church adherents were constrained to equal 100. Stark (1987) and Finke and Stark (1989) noted that Jewish and black church adherents were undercounted in these adherence data. Ellison et al. (1997) remedied the latter problem by controlling for percent black. We control for percent black in our analysis. Stark (1987) argued that the count of Jewish adherents should be inflated by 10 percent to remedy the former problem. Ellison et al. (1997) used this correction and replicated their results without it. Accordingly, this correction was not used here.

[7] One county had no church adherents. The homogeneity score for this county was set to zero.

[8] One of the most dramatic cases of suicide clustering on a Native American reservation occurred on the Wind River Reservation in Wyoming in 1985. Over a one and one-half month period, nine Shoshone and Arapaho Indians committed suicide. All died by hanging. Coleman (1987) argued that alcohol, unemployment, and imitation contributed to these deaths.

are developed that include multiple measures of social integration. (3) Dividing the French and U.S. geographies into meaningful subregions allows us to control for spatial heterogeneity—the French North and South, and the American West and non-West, are meaningful subregions.[9] (4) Residual clustering of the suicide rate is assessed by testing for clustering among OLS regression residuals. This is the clustering of the suicide rate that remains once the clustering of measured independent variables is controlled. (5) In the presence of significant residual clustering, a specification search is conducted to determine the type of spatial effect, spatial lag or spatial error, that best represents the spatial dependence in the data (Anselin 1988; Anselin and Bera 1998).

Substantively, the spatial lag model implies that neighboring values of the dependent variable influence one another. Therefore, interpretations of spatial effects, such as imitation, are typically reserved for spatial lag effects (Anselin and Bera 1998; Baller et al. 2001).[10] Spatial error effects identify clustering of unmeasured internal structural predictors of suicide (Anselin and Bera 1998; Baller et al. 2001). In the present work, these unmeasured variables could refer to dimensions of social integration, such as political integration.

Importantly, only a positive and statistically significant spatial lag effect, estimated in a model that makes some adjustment for spatial heterogeneity and controls for the clustering of social integration, is consistent with imitation processes and the Tardeian (1903) perspective. The presence of such an effect would allow Hypothesis 1 to stand, while suggesting rejection of Hypothesis 2, derived from the Durkheimian ([1897] 1951) perspective.

Techniques of Spatial Analysis

Clustering of the suicide rate is assessed both globally and locally. Global clustering refers to the average amount of clustering throughout the geography; local clustering refers to the relationship between a given suicide rate and the average of neighboring rates. The formal expression of global Moran's I is:

$$I = \frac{\sum_i \sum_j w_{ij}(s_i - S)(s_j - S)}{\sum_i (s_i - S)^2}, \qquad (2)$$

where S is the average suicide rate in the geography. The other variables were defined above in equation 1. A positive and signifi-

[9] As Anselin (1988) explains, spatial heterogeneity and spatial effects consistent with imitation processes can be observationally equivalent. To illustrate, consider the hypothetical situation in which the effects of marital stability on suicide differ significantly across French regions. In such a situation, estimating a national model that forces a single coefficient to represent the effects of marital stability in all regions would cause regression residuals within regions to be more similar than they should be. This spurious similarity could be mistaken for a spatial effect consistent with imitation explanations. Therefore, it is necessary to test for spatial effects while adjusting for heterogeneity.

The ideal adjustment is to estimate region-specific multivariate models that permit regional interactions for all independent variables and spatial effects. For France, the effects of the Franco-Prussian War, the 1870–1871 Siege of Paris, the start of the Third Republic, and the unsuccessful 1871 Paris Commune revolt against the Third Republic produced substantial social disintegration (Fortescue 2000). These effects were felt most strongly in northern France. To adjust for these events and other instances of spatial heterogeneity, we estimate separate models for northern and southern French departments. Other work points to the uniqueness of northern and southern France (Morselli 1903). Northern departments are those located in, and to the north of, the Pays de la Loire, Centre, Bourgogne, and Franche Comte regions.

For the U.S. analysis, western counties are modeled separately from nonwestern counties. This distinction is meaningful because social integration is consistently lower in the American West, with the exception of Utah (Ellison et al. 1997; Lester 1996–1997). Further, western counties are larger than nonwestern counties, which may cause spatial effects to be weaker in the American West. Following the U.S. census definition of region, western counties are those located in the states of Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Arizona, New Mexico, and Utah.

[10] Using a similar logic, Gillis (1994) found a positive and significant longitudinal relationship between late nineteenth-century French suicide rates and their temporal lags, suggesting the presence of imitation over time.

cant global Moran's I value indicates clustering.[11] A drawback of the global Moran's I statistic is that the clustering of high suicide rates cannot be distinguished from the clustering of low rates. Both appear as positive spatial autocorrelation.

The Moran Scatterplot Map complements the global measure, as the clustering of high and low rates can be distinguished in the map (Anselin 1995b). This map is based on the local Moran's I statistic. The formal expression of this variant is:

$$I_i = \left(\frac{z_i}{\sum_i z_i^2} \right) \sum_j w_{ij} z_j, \qquad (3)$$

where z refers to the suicide rate of particular departments/counties in mean-deviation form. Tests of significance are also based on a permutation approach (Anselin 1995a).

The Moran Scatterplot Map presents two kinds of information: (1) Shaded departments/counties have suicide rates that are significantly related to neighboring rates, based on the significance of the local Moran's I statistic; and (2) a color scheme indicates the nature of the relationship between each department's/county's rate and neighboring rates. Departments or counties with high suicide rates, and whose neighbors also have high rates, are shaded dark gray and are labeled "high-high." Those with low suicide rates, and whose neighbors also have low rates, are shaded light gray and are labeled "low-low." Our interest is in clustering; therefore, indications of local negative spatial autocorrelation that would be labeled "high-low" or "low-high," are not shaded.

The multivariate segment of the analysis begins with OLS regressions of suicide rates. Clustering among the residuals of these models is examined using an adjusted Moran's I statistic, designed for OLS residuals (Anselin 1995a). Unfortunately, this statistic is not useful for determining the kind of spatial model to run in the presence of significant residual clustering. There are at least two alternatives: the spatial lag model, and the spatial error model (Anselin 1988; Anselin and Bera 1998). Again, substantive interpretations of spatial effects, such as imitation, are commonly reserved for the lag model.

We determine the presence of lag and error processes empirically. Lagrange Multiplier and Robust Lagrange Multiplier tests are used to distinguish spatial error and spatial lag processes (Anselin et al. 1996). Essentially, these tests assess the relative sizes of two covariances. The first covariance involves model residuals and neighboring values of the dependent variable, $\text{cov}[e_i,y_j]$. The second involves model residuals and neighboring values of model residuals, $\text{cov}[e_i,e_j]$. The larger of the two covariances determines, in part, the spatial regression model to be estimated. If the former is larger, the lag model is preferred; if the latter is larger, the error model is preferred. The lag model is more consistent with imitation explanations because of the influence of y_j, the neighboring suicide rate.

The spatial lag model, in matrix form, is:

$$y = \rho Wy + XB + E, \qquad (4)$$

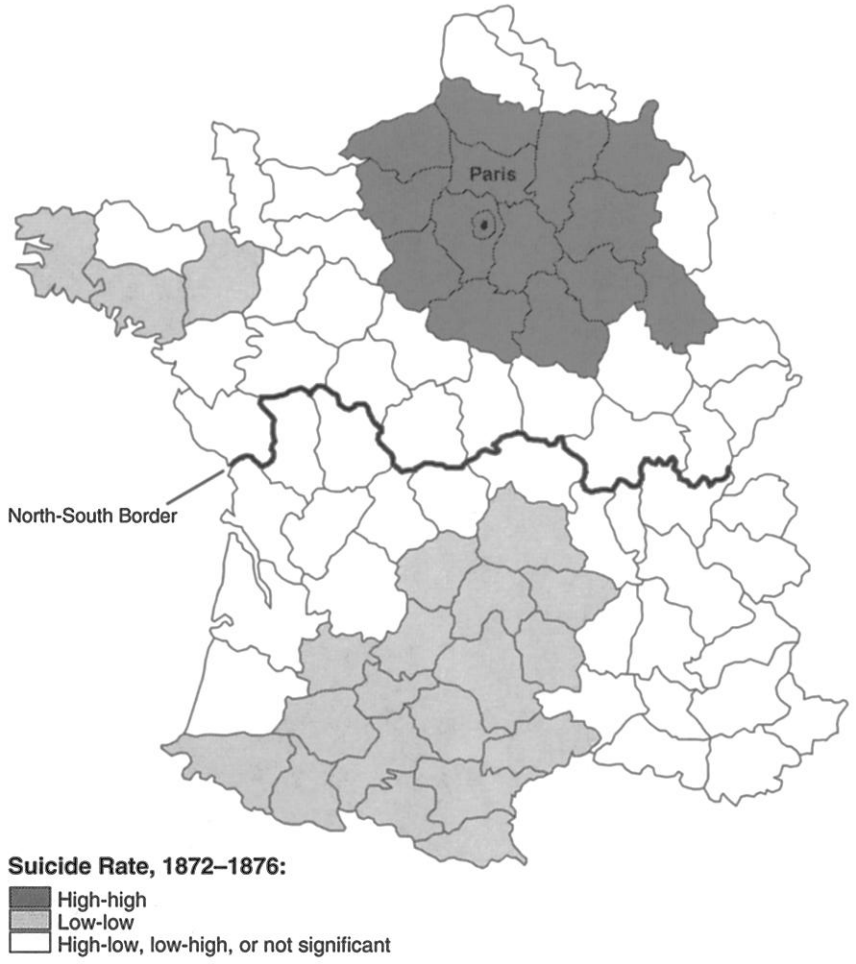
where ρ is the spatial lag coefficient, and W is a full spatial weights matrix. The spatial error model, in matrix form, is:

$$y = XB + \varepsilon, \qquad (5)$$

where $\varepsilon = \lambda W\varepsilon + E$, and λ is the spatial error coefficient. Maximum-likelihood estimation is employed in the French analysis, which requires the use of a full spatial weights matrix that contains N-squared elements, where N = 83. The number of U.S. counties prohibited our use of maximum-likelihood estimation in the U.S. analysis. In its place, we use an instrumental variable, two-stage estimator to correct for the endogeneity of the spatially lagged dependent variable.[12]

[11] Inference is conducted using a "permutation" approach (Anselin 1995a). Permutation involves generating a reference distribution of 999 Moran's I values. Observed I values that fall outside the 95 percent confidence interval of this distribution are significant.

[12] The spatial lags of all independent variables are used as instruments (Kelejian and Robinson 1993). Land and Deane (1992) show that maximum likelihood estimation and various two-stage estimators are interchangeable. Generalized-moments estimation is used for the U.S. spatial error model (Anselin 1995a; Kelejian and Prucha 1999). Generalized-moments estimation yields a lambda coefficient that can be thought of as a spatial nuisance parameter for which no infer-



Map 1. Moran Scatterplot Map of Suicide Rates for French Departments, 1872 to 1876

RESULTS

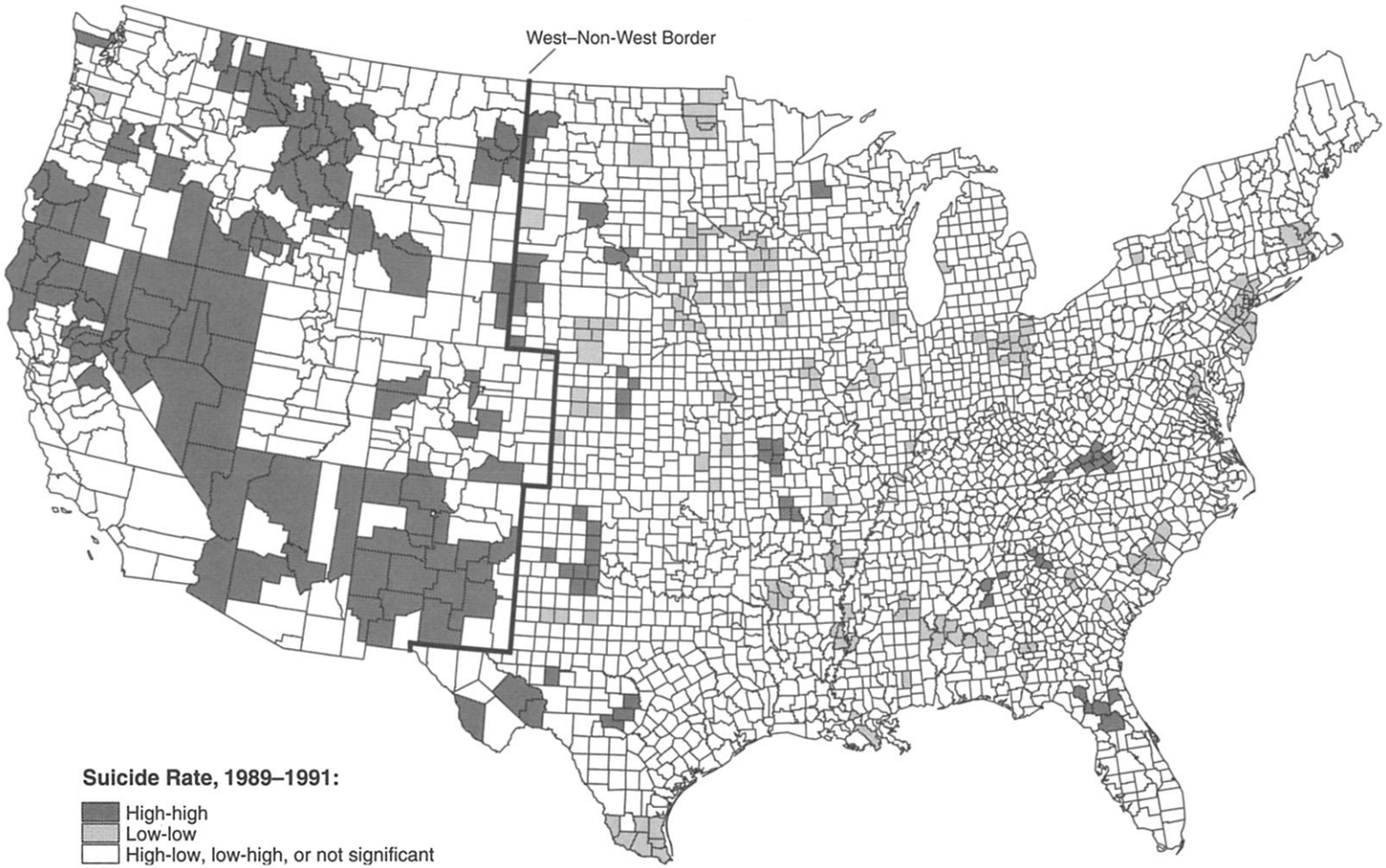
Clustering of the Suicide Rate

Global Moran's I for 1872–1876 French department suicide rates is .749. This value is significant at the $p < .05$ level. Global Moran's I for 1989–1991 U.S. county suicide rates is .152. This value is also significant at the $p < .05$ level. These findings indicate significant clustering of the suicide rate in both geographies and both times.

Map 1 presents a Moran Scatterplot Map of 1872–1876 French department suicide rates that identifies local clustering of high and low rates. The region centered on Paris exhibits significant clustering of high suicide rates. Clustering of low rates is found in the Bretagne region, located in the northwestern peninsula, and throughout the South and Southwest of France. Map 1 also shows the dividing line used to distinguish northern from southern departments.

Map 2 is a Moran Scatterplot Map of 1989–1991 suicide rates for U.S. counties. High rates of suicide are clustered in the American West, with the notable exception of the state of Utah. Other significant clusters of high suicide rates are located in the western tip of Virginia and in northern Florida. Clustering of low rates can be seen

ence is pursued. The significance of lambda is inferred from the Lagrange Multiplier and Robust Lagrange Multiplier tests that show that the error model provides a better fit to the data than a lag or OLS model. Regarding spatial model fit, a pseudo R-squared statistic is used: the squared correlation between the predicted and observed values of the dependent variable (Anselin 1995a).



Map 2. Moran Scatterplot Map of Suicide Rates for U.S. Counties, 1989 to 1991

in Ohio, parts of the South, throughout the Great Plains, and in the area centered on New York City. Map 2 also differentiates western from nonwestern counties.

Results of this exploratory spatial data analysis indicate that Durkheim's casual observation that suicide rates cluster in geographic space was correct—suicide rates cluster significantly in both geographies. In addition, visual inspection of Maps 1 and 2 suggest that the North and South of France, and the West and non-West of the United States, are meaningful subregions.

Baseline Models of Suicide Rates

The baseline models control for the clustering of social integration while minimizing multicollinearity. Measures of religious, marital, and community ties are included as separate items in the French baseline model. Because of high intercorrelations among the remaining variables, factor analysis of these variables was performed. Two dimensions are present among the controls: (1) Socioeconomic status is composed of income per capita, the crude fertility rate (reverse coded), and the percentage of the population aged 15 or younger (reverse coded); and (2) population structure is composed of population size and percent urban. Infant mortality did not load on either dimension. Items were standardized and summed to create the indices. In sum, the French baseline model consists of two indices (socioeconomic status and population structure), the infant mortality rate, residential stability, marital stability, and the ordained clergy rate. Variance inflation factors were inspected and all were less than 4, indicating that multicollinearity is not a serious problem (Gujarati 1995).

Multicollinearity is a concern in the baseline model for the United States because percent church adherents, percent Catholic, and religious homogeneity are included as separate items. The effects of these measures were simultaneously estimated in models that controlled for residential stability, marital stability, median family income (logged), percent unemployed, percent black, percent Native American, population density (logged), and median age. An inspection of variance inflation factors showed that all were less than 4, indicating that these measures of religious integration can be included as separate items and that composite measures for model controls are not needed. Therefore, the baseline model for the United States includes five separate measures for social integration and the aforementioned control variables.

Table 1. Unstandardized Coefficients from the Spatial Regression of Suicide Rates on Selected Independent Variables: Northern and Southern Departments in France, 1872 to 1876

Independent Variable	North[a]	South
Residential stability	−2.337*	−2.058*
	(1.364)	(1.129)
	[−.225]	[−.267]
Marital stability	−9.577**	−4.698*
	(3.165)	(2.317)
	[−.493]	[−.293]
Ordained clergy rate	−2.734*	−.308
	(1.581)	(.683)
	[−.147]	[−.033]
Spatial lag (ρ)	.344**	.686***
	(.144)	(.095)
	[.270]	[.531]
Spatial error (λ)	N.A.	N.A.
Number of departments	40	43
R^2	.805	.816

Note: Numbers in parentheses are standard errors; numbers in brackets are standardized coefficients; N.A. stands for "not applicable."

Models also control for socioeconomic status, population structure, infant mortality, and an intercept. The spatial lag term was created using a first-order contiguity spatial weights matrix. The pseudo R-squared statistic refers to the squared correlation between the observed and predicted values of the dependent variable.

[a] Northern departments are those located in, and to the north of, the Pays de la Loire, Centre, Bourgogne, and Franche Comte regions (see Map 1).

*$p < .05$ **$p < .01$ ***$p < .001$ (one-tailed tests)

Multivariate Spatial Results

Multivariate results for late nineteenth-century France are presented in Table 1. In both northern and southern France, significant residual clustering of the suicide rate is found. The proper remedy in each case is the spatial lag model. Therefore, these results provide consistent support for the Tardeian per-

spective and allow Hypothesis 1 to stand: The geographic patterning of late nineteenth-century French suicide rates supports imitation explanations. These results question the Durkheimian view of the role of imitation, and suggest that Hypothesis 2 should be rejected.

There is reason to believe that imitation played an important role in determining the spatial patterning of late nineteenth-century French suicide rates. In addition to the effects of word-of-mouth transmission, Gillis (1994:393) argues that the French media, including newspapers, novels, and other periodicals, became increasingly sensationalistic during the nineteenth century. Weber (1986) argues, "In the last third of the nineteenth century . . . a new kind of newspaper appeared, aimed at a mass circulation to be gained by attracting a new kind of reader with reporting that was lively, racy, piquant, poignant, stirring, appealing, and generally sensational" (p. 27). Further, historians argue that the French, and even the English, media affected the French suicide rate as early as the late eighteenth-century (Merrick 1989).

While the foregoing suggests imitation among suicide decedents, the lag effects shown in Table 1 could also indicate imitation of efforts to conceal suicides. While possible, we are skeptical of this latter interpretation. The geographic clustering of efforts by lifelong friends, spouses, and religious persons to conceal suicides should be controlled for by our measures of residential stability, marital stability, and the ordained clergy rate. Such concealment efforts should be higher where populations are more sedentary, where marriage is more prevalent, and where there are more ordained clergy. Therefore, by controlling for multiple measures of social integration, not only do we test Durkheim's claim that integration protects against suicide, but we also control for the clustering of efforts to conceal suicides. The significant negative effects of marital stability, residential stability, and the ordained clergy rate in the North (Table 1) most likely indicate both processes. And because the spatial lags are significant even after these measures are controlled, imitation among suicide decedents seems all the more likely.

Table 2. Unstandardized Coefficients from the Spatial Regression of Suicide Rates on Selected Independent Variables: Western and Nonwestern U.S. Counties, 1989 to 1991

Independent Variable	West[a]	Non-West
Residential stability	−.189*	−.019
	(.099)	(.025)
	[−.150]	[−.022]
Marital stability	−.701*	−.574***
	(.353)	(.099)
	[−.130]	[−.136]
Percent church adherents	.041	−.004
	(.046)	(.009)
	[.074]	[−.011]
Percent Catholic	−.098*	−.001
	(.050)	(.011)
	[−.111]	[−.002]
Religious homogeneity	10.957***	2.556**
	(3.357)	(1.090)
	[.218]	[.051]
Spatial lag (ρ)	N.A.	.299*
		(.139)
		[.063]
Spatial error (λ)[b]	.113	N.A.
Number of counties	409	2,651
R^2	.160	.098

Note: Numbers in parentheses are standard errors; numbers in brackets are standardized coefficients; N.A. stands for "not applicable."

Models also control for median family income (logged), percent unemployed, percent black, percent Native American, population density (logged), median age, and an intercept. The spatial lag and error terms were created using a first-order contiguity spatial weights matrix. The pseudo R-squared statistic refers to the squared correlation between the observed and predicted values of the dependent variable.

[a] Western counties are those located in the states of Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Arizona, New Mexico, and Utah (see Map 2).

[b] Inference is not pursued for spatial error coefficients. Significance is inferred from the specification search that showed that the spatial error model provides a better fit to the data than an OLS or spatial lag model.

*$p < .05$ **$p < .01$ ***$p < .001$ (one-tailed tests)

Western and nonwestern U.S. county suicide rate models are presented in Table 2. Residual clustering of the suicide rate is significant in both regions. For the American non-West, residual clustering is best repre-

sented by a spatial lag term. This finding replicates the French results and supports the Tardeian view of the importance of imitation. However, for the American West, a spatial error process is found. This implies that the clustering of unmeasured structural predictors, rather than an influence of neighboring suicide rates, accounts for the remaining clustering of the suicide rate. This result in the West is consistent with the Durkheimian perspective and with Hypothesis 2: Suicide rates of the American West cluster in space only to the extent that the internal structural predictors of suicide also cluster in space.

Note the social integration effects shown in Table 2.[13] The effects of marital stability are significantly negative in both regions, suggesting that marital integration continues to provide important protection against suicide. Further, the effects of both residential stability and percent Catholic in the West are significantly negative. These effects support Durkheim's ([1897] 1951) general theory of social integration and suicide.

Religious homogeneity and the suicide rate are positively and significantly related in both regions. Ellison et al. (1997) also find positive effects of this variable on 1980 suicide rates for western and southern metropolitan statistical areas. Contrary to the prediction that homogeneity creates social integration, we speculate that religious heterogeneity may be integrative for at least two reasons. First, denominational alternatives may prevent dissatisfied churchgoers from abandoning organized religion. Second, denominational splits that produce religious heterogeneity may enhance social integration within resulting denominations as group boundaries are clarified. Therefore, the positive effects of religious homogeneity might actually be consistent with Durkheim's theory of suicide. The precise mechanisms underlying the effects of religious homogeneity should be explored in future research.

In sum, the preponderance of the evidence suggests that Durkheim's dismissal of imitation was premature, if not erroneous. Our results for the North and South of France and the nonwestern United States indicate that the geographic patterning of suicide supports imitation explanations. Only the model for the American West supports Durkheim's ([1897] 1951) explanation. The balance of the evidence suggests that hypothesis one, derived from the Tardeian perspective, should be allowed to stand; hypothesis two, derived from the Durkheimian perspective, should be rejected.

CONCLUSIONS

Our work has tested the Durkheimian ([1897] 1951) and Tardeian (1903) views of social integration, imitation, and the geographic patterning of suicide. The analysis began with an exploratory spatial analysis that revealed significant clustering of the suicide rate across French departments and U.S. counties. These results support Durkheim's rather casual observation that suicide rates cluster in geographic space. Multivariate spatial results for northern and southern France and the nonwestern United States support the Tardeian perspective that emphasizes the importance of imitation. Had Durkheim had access to modern techniques of spatial analysis he would have been forced to reconsider his rejection of imitation explanations. However, results for the American West do support the Durkheimian view that suicide rates cluster in geographic space only because the internal structural predictors of suicide, including multiple

[13] Suicide rates in counties with small populations exhibit variance instability, making them difficult to predict. Consistent with this, the pseudo R-squared values shown in Table 2 are low. To illustrate variance instability, envision a county whose true suicide rate is 1/20. Assume this county only has five persons in it. If we observe the rate for this county over four years, we will find rates of zero in three years and a rate of 1/5 in the fourth year. The zero rates are underestimates, while the 1/5 rate is an overestimate of the true rate. To isolate the effects of variance instability on model fit from the effects of poor measures, a sample of the most heavily populated counties, those with 1990 populations greater than or equal to 100,000, was examined. A national OLS model was estimated using the U.S. baseline model; an R-squared value of .598 was found. This value is consistent with prior macro-level empirical work on suicide rates, and suggests that the measures used in the U.S. analysis are sound. Indications of poor model fit are due to variance instability, which makes the rates in lightly populated counties difficult to predict.

measures of social integration, also cluster in space.

At least two factors may explain the different spatial effects found for the American West and non-West. First, it may be more difficult to find imitation effects when larger units are examined. This could explain the absence of a lag effect for the American West. Second, differential identification theory may explain the regional difference (see Stack 1987). This theory predicts that imitation is stronger where identification with others is higher. If integration is an important condition for identification, it can be assumed that identification is higher in the American non-West. If this assumption is correct, identification with others could explain the nonwestern spatial lag effect. On the other hand, relatively weak identification with others may explain the absence of a lag effect in the West. This suggests that as social integration weakens and individuals withdraw from community life, their susceptibility to imitative suicide decreases. Therefore, weak social integration may produce countervailing effects on the suicide rate. In other words, while increasing the suicide rate, weak social integration may also slightly decrease it as isolated individuals receive less news about suicide, or experience such news in a less personal way.

Interestingly, regional differences in the French analysis are also consistent with differential identification theory. The spatial lag effect in the South, shown in Table 1, is significantly stronger than that in the North. Recall that social integration was stronger in the French South. War and political change produced net effects that were especially disintegrative for northern France. As with the U.S. results, these French results suggest that imitation effects are stronger where social integration is higher. Future research should more explicitly examine the interactive effects of social integration and imitation.

We conclude that the geographic patterning of suicide is affected by both social integration and imitation. We offer this conclusion for three reasons. First, there is evidence to suggest that imitation is an important determinant. Second, the significant effects produced by our measures of social integration undoubtedly account for some clustering of the suicide rate. Finally, using differential identification theory, we suggest that imitation effects may be stronger where social integration is higher. Therefore, both the Durkheimian and Tardeian perspectives are valid to an important degree.

In sum, our results suggest that Durkheim's claim that imitation plays no role in the geographic patterning of suicide should be rejected. Using the logic of Durkheim's own spatial analysis, we find that the clustering of social integration cannot fully account for the clustering of suicide. Importantly, this result does not constitute negative evidence against Durkheim's general theory of suicide. Our own results suggest that social integration provided, and continues to provide, important protection against suicide.

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