A GIS-based spatial analysis on neighborhood effects and voter turn-out: a case study in College Station, Texas

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Abstract

This paper examines individual voter turn-out and its putative relationship with voting outcomes at the voting precinct level. Via a GIS-based address matching procedure, we were able to georeference individual voters (registered voters who casted their votes) and non-voters (those registered voters who did not cast their votes) for three recent local referenda in College Station, Texas. We then conducted a scale-sensitive, second-order spatial analysis for the spatial distribution of voter turn-outs, followed by a spatial clustering analysis of the voting results using Getis–Ord’s $G_i$ statistic. We found that the extent of neighborhood effects in local elections is heavily influenced by the voter turn-out. If voter turn-out is clustered at intermediate and large scale, voting results tend to be clustered and also exhibit a sharp polarization between high and low values. If voter turn-out tends to be uniform/regular at intermediate scales but randomly distributed at both small and large scales, there appears to be less clustering in the voting results and thus lack of the neighborhood effect. If the voter turn-out pattern is mixed-uniform/regular at the small scale, random at the intermediate scale, but clustered at the large scale, the voting results show a stronger neighborhood effect. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Neighborhood effects; GIS; Ripley’s $K$-function; Electoral geography

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Introduction

Since the seminal study by Key (1949) and its introduction into electoral geography by Cox (1968, 1972) and Reynolds (1974), the neighborhood/contextual effect has been an enduring topic in political geography and political science (Wolfe & Burghardt, 1978; O’Loughlin, 1981; Johnston, 1983; Books & Prysby, 1991; Zuckerman, Valentino, & Zuckerman, 1994; Eagles, 1995; Huckfeldt & Sprague, 1995; Agnew, 1996; Zuckerman, Kotler-Berkowitz, & Swaine, 1998; McAllister et al., 2001). Basically, the concept of neighborhood effects is constructed on the assumption that social interaction within locales, particularly (though not exclusively) residential communities, affects people’s political and voting behavior. Despite the doubts expressed by some scholars regarding the contextual effect (King, 1996) and the role of location and space in elections (Dunleavy, 1979), voluminous empirical literature seem to offer credible evidence to support the existence of neighborhood/contextual effects in national elections using a combination of survey and aggregated election data (McAllister & Studlar, 1992; Pattie & Johnston, 2000; Johnston et al., 2000; Johnston, 2001). The studies reported in the literature so far are based either on ecological data aggregated to different geographical scales (Scanlan, 1977; Taylor & Johnston, 1979; Sprague, 1982; Dorling, 1995) or individual data from surveys (Johnston, 1986; Rose & McAllister, 1990). It is very well documented that results of spatial analysis based upon ecological data are contingent upon the aggregation (scale) level and boundary configurations (zoning)–more popularly known as the modifiable areal unit problem (MAUP) (Frank & Cheylan, 2001). A survey approach can help mitigate such problems as recently demonstrated by Shin (2001). In the electoral geography literature so far, no studies have attempted to use geocoded individual voter data from actual elections because of early technical difficulties of handling individual voter data. Not surprisingly, we still have little knowledge on the relationship between actual voter turn-outs and the neighborhood effects in electoral geography. Now GIS technology has matured enough to handle individual level data, we can develop new ways to conduct GIS-based spatial analysis in electoral research.

The objectives of this paper are two-fold. First, we want to explore the applicability of GIS-based spatial analytical procedures to handle individual level data derived from address matching. In doing so, we want to demonstrate the potential of these techniques in electoral studies to political geographers and political scientists. Second, we want to examine the impacts of actual voter turn-out on the neighborhood effect. We hypothesize that neighborhood effects manifest themselves in different ways according to the spatial distribution of voter turn-out.

This paper is organized into five sections. After a brief introduction, study area and research background are introduced in the second section. The third section presents a GIS-based spatial analysis methodology. The fourth section discusses the results. The last section contains concluding remarks.
Study area and background

Our case study involves analysis of voter turn-out and voting results during three recent referenda in the city of College Station, Texas. College Station is home to Texas A&M University (TAMU), the land-grant college of the state, with 42,000 students. College Station is the southern part of the Bryan/College-Station SMA with approximately 160,000 residents in 2000. Unlike its neighboring city Bryan, College Station has been planned and zoned since the city was chartered in 1938. Even before the modern era of comprehensive land use planning the development of College Station was at the hands of a relatively small number of developers. The city’s street plan, except in a few older areas, is thus relatively well designed and thoroughfare width is appropriate to traffic density. Residentially, College Station is thus an interesting example of the impact of the pre-urban cadaster on the development process (Ward, 1962). Problems with the street plan in one older area, however, led the city into the bitterest political fight in its history thus far.

The State of Texas allows local electors to circulate petitions to place special initiatives on the ballot. The charter of the City of College Station mandates that referenda must be held when the city proposes major expenditures on infrastructure and municipal services. The charter also allows voters to initiate referenda on any topic through an initiative process. In such cases, petitions for referenda must be submitted by five electors and “signed by qualified electors of the city equal in number to at least twenty-five (25) percent of the number of votes cast at the last municipal election”. The charter further specifies that there shall appear on each petition the names and addresses of five electors, who, as a committee of the petitioners, shall be regarded as responsible for the circulation and filing of the petition. Attached to each separate petition paper there shall be an affidavit of the circulator thereof that he, and he only, personally circulated the foregoing paper” (The City of College Station Charter, Article X). Confusingly, a slightly different process exists to allow petitions to recall city councilors. Recall initiatives require the “signatures of qualified electors of the City equal in number to at least forty (40) percent of the total number of votes cast for the office in question at the last regular municipal election at which the office in question was filled” (The City of College Station Charter, Article X). Recall initiatives are further restricted by a rule stating that the petitioner has to collect the appropriate number of signatures in 30 days. At the last recall initiative the City Secretary interpreted the rules from the initiative petition process to mean that only the petitioner(s) could carry the petition. The complexity of this series of rules and the variable interpretation of them has caused several political problems in College Station. College Station thus serves as an ideal study area for examining local elections and their spatial manifestations.

Three local referenda are covered in our study. (1) In 1995 the City Council initiated a referendum that asked for the issuance of $10 million in tax bonds for infrastructure. These bonds were to reconstruct, improve, and extend existing streets, and to construct and improve sidewalks, traffic signals, and necessary drainage. They were also to fund the acquisition of 3.5 acres of land for municipal service facilities. (2) In 1997 voters initiated a referendum to prevent the city council proceeding with
the construction of a City Convention Center. (3) In 1999 voters initiated a refer-
endum to reopen Munson Avenue, a city street closed by council action because of
high levels of nuisance through traffic, especially late at night, in one of the city’s
oldest residential areas. City surveys indicated some 8000 vehicles per day on Mun-
son Avenue, a street with a design goal of 1000. Whether to re-open or keep Munson
Avenue permanently closed has been a major contentious issue among local residents
in College Station.

Data and methods

The paucity of data at an ecological scale approximating that of the neighborhood
communities in which social interaction occurs is widely acknowledged among elec-
toral geographers. To be meaningful in electoral studies, voting data should be
reported at scales below that of constituency in order to act as a surrogate for the
neighborhood communities within which interaction takes place and neighborhood
effects are felt. The voting precincts in our study area approximate fairly closely to
neighborhoods. Although voting precincts may not be good surrogate for neighbor-
hood in large cities, they coincide with most of the major residential subdivisions
in College Station.

The actual voter lists for the past three referenda and the voting results at the
precinct level were obtained from the City Secretary’s office. Voters in Texas must
sign the electoral roll each time they vote so that election officials can check their
eligibility. For the purpose of baseline comparison, we also geocoded those voters
who registered but did not cast their votes (referred to as non-voters) during the
three referenda. The electoral roll contains each voter’s address. To geocode each
voter who casted their votes during the past three referenda, we used the address
matching module in ArcView GIS.

Address matching

Address matching creates a geocoded digital point data layer by address. It requires
two data layers: a matchable street network file and a list of addresses to be matched
with the street network. A matchable street network is a digital street data layer with
all the topological and street address information encoded in the data file. We
obtained our street network data from the City of College Station’s Year 2000 Master
GIS data files in ArcView 3.1 file format. Street segments are encoded with a node
at each end. Each node contains the address range of that segment. Address matching
finds the correct segment and estimates the individual voter’s position on the seg-
ment. For example, John Doe lives at 175 Spring Street in College Station. The
address matching routine locates the Spring Street segment that has nodes numbered
below and above 175. If the segment has a low-numbered node of 100 and a high-
numbered node of 200, the address 175 will be located three-quarters of the way to
the 200 node.

Different address matching programs have different tolerances for spelling and
numbering conventions. ArcView was able, on average, to match 87% of the voters by street address. Unmatched voters were due to either incomplete/incorrect addresses or multiple voters at the same address. An interactive manual procedure was used to encode unmatched voters in the voter data layer. The same procedure is used to geocode non-voters.

Once the voter and non-voter information were geocoded via address matching, we mapped individual voter distribution and voting results at the precinct-level for the past three referenda. To examine the spatial patterns of actual voter distribution, we then conducted a second-order voter distribution analysis using Ripley’s K-function.

**Ripley’s K-function for point pattern analysis**

Ripley’s K-function is a scale-sensitive, second-order, spatial analysis tool that detects spatial distribution patterns at different scales (Moeur, 1995; Diggle, 1983; Upton & Fingleton, 1985). Second-order point pattern analysis has been applied in urban geography (Getis, 1983), ecology (Getis & Franklin, 1987; Hasse, 1995), and epidemiology (Gatrell, 1995). Second-order spatial analysis equips political geographers with a new analytical technique to conduct scale-sensitive analysis in electoral studies.

Ripley’s K(d) analysis is a statistical tool for analyzing the spatial patterns of any phenomenon whose spatial locations are measured as points. It considers point locations in a closed plane (usually a fixed-area rectangular plot), and tests whether a given point pattern departs from randomness toward clustering or regularity. It can also be used to test for significant interaction between two point populations. The X, Y coordinates of all points on the plot must be completely mapped. In our case study, the actual voter distribution was created as a point data layer via address matching. We used the program developed by Melinda Moeur for the calculation of K-function. For computation and analytical details see Moeur (1995) and Bailey and Gatrell (1995) for details.

The distance matrix \(d_{ij}\) between all pairs of points on the plot is tabulated. The cumulative distribution function of the distance from all points on a plot to all other points, \(\hat{K}(d)\), is computed as

\[
\hat{K}(d) = A \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{\delta_{ij}(d)}{n^2}, \text{ for } i \neq j,
\]

where

\[
\delta_{ij}(d) = \begin{cases} 
1 & \text{if } d_{ij} \leq d \\
0 & \text{if } d_{ij} > d
\end{cases}
\]
for \( n \) points on a plot of area \( A \). \( \hat{K}(d) \) can be interpreted as the expected number of points within distance \( d \) of an arbitrary point. The \( \hat{K}(d) \) distribution is computed for values of \( d \) from 0 to a maximum of \( 1/2 \) the length of the shortest plot boundary. To correct for boundary effects (because the summation excludes pairs of points for which the second point may be outside the plot and therefore unobservable), the calculation replaces \( \delta_{ij}(d) \) with a weight \( w_{ij}(d) \), the inverse of the proportion of the circumference of a circle centered on point \( i \) and passing through point \( j \), lying within the plot. Thus, \( w_{ij}(d) = 1 \) for circles wholly contained in the sample plot, and \( w_{ij}(d) > 1 \) for situations requiring correction for edge effects (see Diggle 1983, p. 72 for more details):

\[
\hat{K}(d) = A \sum_{i=1}^{n} \sum_{j=1}^{n} \frac{w_{ij}(d)}{n^2}, \text{ for all pairs of points with } d_{ij} \leq d
\]

In practice, \( \hat{L}(d) \) is reported rather than \( \hat{K}(d) \). \( \hat{L}(d) \) is a square root transformation that linearizes \( \hat{K}(d) \), stabilizes its variance, and has an expected value of approximately zero under the Poisson assumption:

\[
\hat{L}(d) = \sqrt{\frac{\hat{K}(d)}{\pi}} - d.
\]

Spatial distribution patterns of voter turn-out and non-voters in our case study were analyzed by Ripley’s \( K \)-function (Ripley, 1981). A circle of radius \( d \) is centered on each point. In our case study, each point represents a registered voter. The number of neighbors (voters or non-voters) within the circle is counted. If it is known that the study area does not contain the entire spatial process under study, it is important to consider edge effects (Fotheringham, Brunsdon, & Charlton, 2001). For events close to the edge of the study area, there is a chance that other events just outside the study area will not be represented in \( K(d) \), causing an underestimate of \( K(d) \). In our case, edge effects should not be a problem because outside the precincts there are literally no eligible voters. In other words, all events under consideration are within our study area—all the precincts.

If the distribution of the points is Poisson random, the expected value of the cumulative function \( K(d) \) equals \( \pi d^2 \), i.e. the area of a circle of radius \( d \), which gives a linear plot of \( \sqrt{K(d)} \) versus \( d \). It has become common practice to plot the derived sample statistics \( \sqrt{\frac{K(d)}{d}} - d \) because this expression has zero expectation for any value of \( d \) when the pattern is Poisson random.

The sample statistic calculated from the data is tested against the null hypothesis of spatial randomness by randomly repositioning all points in the study area and then analyzing the generated points as the actual points. For statistical significance, we used the values at the limit of the 2.5% tails of 500 randomizations (mean \( \pm 1.96SD \) for a 95% confidence interval. If the deviation of the sample statistic from zero expectation is significantly positive, a clustered distribution of the sampled points can be assumed, while significant negative deviation suggests a regular
(uniform) pattern (Diggle, 1983). If the sample statistics remains within the bounds of the confidence interval at any given d, the null hypothesis of complete spatial randomness cannot be rejected.

Getis–Ord’s G-statistic

To explore neighborhood effects, voting results at the precinct-level were analyzed using Getis–Ord’s $G^*_i$. Unlike other global measures such Moran’s $I$ or Geary’s $C$, Getis–Ord’s $G^*_i$ is capable of revealing local clustering of specific phenomena (Getis & Ord, 1992; Ord & Getis, 1995). Using Ripley’s $K$-function and Getis–Ord’s $G^*_i$, we can explore the relationship between the distribution of actual voter turn-out and the neighborhood effect of voting in local politics. Because spatial/topological relationships are encoded as part of the GIS data structure, GIS greatly facilitates the implementation of these spatial statistical techniques and stimulates further development of individual-based analytical techniques (Gatrell & Rolwingson, 1994; Kwan, 2000; Fotheringham, 2000; Anselin, 2000; Goodchild, 2000).

$G^*_i$ is computed for each precinct as:

$$G^*_i(d) = \sum_j W_{ij} \sum_j x_j$$

where $W_{ij}(d)$ is an element in binary contiguity matrix corresponding to a cut-off distance of $d$; $x_j$ is a voting result observation at precinct $j$. The $G^*_i$ statistic is interpreted as a measure of the clustering of like values around a particular observation (in our study, precinct). An expected value and standard deviation can be computed for each observation, and the significance of the index can be evaluated by comparing a standard z-score to a distribution; see Getis and Ord (1992) for details. It is unlikely that Ripley’s $K$ function, $G^*_i$ has been used extensively in electoral studies (O’Loughlin, Flint, & Anselin, 1994; O’Loughlin, 2002).

The G-statistic is computed by defining a set of neighbors for each location as those observations that fall within a critical distance $(d)$ from the locations. For each different distance a separate weight matrix is constructed. For our study, $d = 1.5$ miles. Unlike other spatial autocorrelation measures, such as the Moran’s $I$ or Geary’s $C$, G is an observation-specific measures of spatial association, which is capable of indicating the extent to which a location is surrounded by a cluster of high or low values for the variable under consideration.

A positive and significant z-value for a $G^*_i$ indicates spatial clustering of high values, whereas a negative and significant z-value indicates spatial clustering of low values. The identification of locations or clusters of locations with high $G^*_i$ statistics may assist in filtering out spatial dependence or provide a clue to the existence of outliers. $G^*_i$ also allows for the decomposition of a global measure of spatial association into its contributing factors by location. It is particularly suitable for detecting potential non-stationarities in a spatial data set, e.g., when the spatial clustering is concentrated in one subregion of the data only. A global measure of spatial association, such as Moran’s $I$ or Geary’s $C$ will fail to detect such a pattern.
Results and discussions

With the help of GIS-based address matching and spatial statistical analysis, we were able to reexamine this issue at both individual (actual voters) and aggregate (voting results for each precinct) levels. The spatial distribution of the actual voter turn-out through address matching and voting results at the precinct level are shown in Fig. 1. Each dot represents the location of a registered voter who cast their vote in a local election.

Among the three referenda covered in our study, the 1995 referendum on the $10...
A million tax bond was the least controversial and thus least cared about by the voters. Voter turn-out was extremely low [Fig. 1(i)]. This referendum was initiated by the City Council because the City charter requires that major capital expenditures be so approved. It received little media coverage, had no local grass roots organization working for or against it, and passed by an overwhelming majority [Fig. 1(ii)]. Voters clearly perceive that it is appropriate to spend tax dollars on infrastructure improvement and municipal services. Those voters against the bond initiative seem to have been motivated primarily by fear of the potential negative environmental impacts of such municipal service facilities as incinerators and garbage disposal facilities. Contextual/neighborhood effects had a clear impact on voter turn-out, with those precincts slated for the infrastructural improvements having by far the biggest voter turn-out.

Results of the second-order analysis and $G$-statistic provide a more rigorous test for the spatial pattern of voters and voting results at the precinct level. Although the voter distribution at a fine scale (within less than 1 mile) falls within the 95% confidence interval and thus appears to be random, the distribution at a broader scale (outside 1 mile radius) confirms the clustering of voters whereas non-voters appear to be randomly distributed between a 1 and 2 mile radius. The $L(d)$ statistic appears positive and is consistently above the upper limit of the confidence interval for the actual voters [Fig. 2(i)]. This suggests the existence of a significantly clustered distribution of voters at a broader scale, with maximum intensity at scales 1.2–1.5 miles. For the voting results at the precinct level, the results of $G$-statistic also indicate the clustering of both high and low values in a northeast (high)–southwest (low) pattern separated by Texas Avenue [Fig. 2(ii)]. Unlike the tax bond issue of 1995, the 1997 referendum on the construction of a city convention center was controversial and received considerable coverage in the local newspaper and on the local TV. The City Council and local businesses argued that a convention center near Wolf Pen Creek Park would stimulate economic growth and create new jobs. Private business was not willing to build a convention center although it was willing to build a large hotel adjacent to it. Controversy developed over the City Council’s willingness to spend tax dollars to build a convention center, then lease it out to private enterprise. Some local voters opposed spending tax dollars on what they believed should be a business venture. A grass-roots organization sprang up to campaign against it. Because of the potential city-wide impact of the convention center, the media coverage, and the effective grass-roots opposition there was a better voter turn-out for the 1997 referendum than for that of 1995 [Fig. 1(iii)]. The media were usually positive, being generally in favor of city growth. The convention center was eventually approved by the voters, but by a very narrow margin [Fig. 1(iv)].

The voter turn-out pattern for the 1997 referendum, as shown by the results of second order analysis, appears to be regular and uniform at intermediate scales (0.7–1.8 miles), but exhibits random patterns at both fine (less than 0.8 miles) and broad (1.8 and 2.5 miles) scales [Fig. 2(iii)]. In comparison, the non-voters appear to be consistently random across scales. The $G$-statistic for the voting results at the precinct level shows no clear clustering pattern, unlike the 1995 referendum [Fig. 2(iv)].
The most controversial referendum in the history of the city so far has been the 1999 ordinance to force the city to re-open Munson Avenue. In response to a proposal by external planning consultants to greatly increase traffic on already overtaxed streets in one of the city’s oldest and most attractive neighborhoods, local residents pressured the Council to experiment with traffic-calming measures and, ultimately, to close the street to through traffic. Closure, in turn, provoked a grassroots response against it, with residents of Munson being attacked for being elitist. The media started by supporting traffic-calming in the area, switched to opposing closure, and reverted to supporting closure just before the referendum. The city did
not enforce the initiative petition rule that only the five electors who submitted the petition had to carry it. As opposition to closure grew over a period of several months more and more people were recruited to carry the petition in pyramid scheme fashion. Those who favored continued closure raised a significant sum of money and developed a strong advertising campaign in the newspapers and on television.

The ordinance to re-open Munson Avenue passed by a near 2–1 margin in almost all precincts [Fig. 1(vi)]. Because of the strong media interest the 1999 referendum had an unusually large voter-turn out. Analysis of the geographic pattern of that turn-out shows it extending in a line south of the TAMU campus. A major issue regarding closure was that Munson is perceived as providing a north–south relief route to the heavily trafficked highways that border the TAMU campus to the east and the west, respectively Texas Avenue and Wellborn Road. People in the voting precincts south of TAMU presumably saw the closing of Munson Avenue as restricting their travel behavior and reducing their route alternatives [Fig. 1(v)].

Results of second order statistics indicate that the voter distribution appears to be regular/uniform at fine scales (less than 0.8 miles), random at the intermediate scale (0.8–1.7 miles), and clustered at large scales at the peak of 2.5 miles, whereas non-voters exhibit clustering at intermediate scales and randomness at both small and large scales [Fig. 2(v)]. This clearly indicates that the campaigns by “Citizens for Neighborhood Integrity,” which favored continued closure, and “Friends of Our Community,” which favored re-opening, mobilized more voters in precincts that might be affected by this ordinance. \( G \)-statistic showed a clustering of high values in the city as a whole [Fig. 2(vi)].

The results from our case study suggest that neighborhood effects in local politics are heavily influenced by the distribution of actual voters (Table 1). As revealed from the results of \( K \)-function and \( G \)-statistics, if voter turn-out is clustered at intermediate and large scales, voting results tend to be clustered and also exhibit a sharp polarization between high and low values. If voter turn-out tends to be uniform/regular at intermediate scales but randomly distributed at both small and large scales, there appears to be less clustering in the voting results and thus lack of the neighborhood effect. If the voter turn-out pattern is mixed-uniform/regular at the small scale, random at the intermediate scale, but clustered at the large scale, the voting results also tend to be clustered and thus show a stronger neighborhood

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<td>Regular/uniform at small scale, random at intermediate scale, but clustered at large scale</td>
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effect. Unlike the first case, the spatial pattern of voting results lacks polarization between concentration of low versus high values (Table 1).

Our case study contributes to the literature in two aspects. First, it examines the neighborhood effects for local elections, a scale that has not received the attention it deserves except in Johnston’s (1974) earlier work in New Zealand. As the former Speaker of the US House of Representatives, Tip O’Neill (1994), famously commented, all politics is local. We found neighborhood effects ambivalent in local referenda; they are both contingent on the issues and highly correlated to the publicity generated. Second, by using a GIS-based address-matching technique, we were able to map both the voting results at the precinct level and the spatial distribution of voter turn-out. Admittedly, neither the application of the GIS-based G-statistic nor the topic of neighborhood effect is new. What is new in our case study is our use of address matching techniques to allow us to analyze individual voter data in each referendum and our second-order spatial analysis of the actual voter distribution. With a scale sensitive second order analytical measure, we were able to gauge the nature of the spatial clustering of actual voter turn-out and how the spatial distribution of voters influences the neighborhood effect of voting results at the precinct level.

Furthermore, previous studies on the neighborhood effect have focused too heavily on spatial dependence and not on spatial heterogeneity. Our study reveals the spatial heterogeneity and complexity of neighborhood effects. What we have demonstrated in this study is that even in a small community like College Station the neighborhood effect is far from simple for most local issues. Although spatially clustering patterns are clearly observed, our data do not show any evidence of the processes that have contributed these patterns. Strong empirical evidence exists to support speculations on the various processes contributing to the neighborhood effect, such as “conversion by conversation,” “people who talk together, vote together” etc. (Pattie & Johnston, 2000; McAllister et al., 2001). Books and Prysby (1991) have proposed a theory of contextual effects involving four separate potential processes: (1) personal observation, whereby individual voting behavior is influenced by events and situations in the milieu; (2) informal interaction, with inter-personal communications influencing voting behavior, as in Cox’s formulation and what has been reported by Pattie and Johnston (2000); (3) organizationally-based interaction, in workplaces, churches, labor unions and a range of other organizations (grass-roots etc.), many of which are local in their structure, and which provide milieus for meeting and discussing political issues with neighbors (Huckfeldt & Sprague, 1995); (4) mass media, many of which are locally focused and provide politically relevant cues about events in voters’ own neighborhoods. From our first hand experience, we believe all four factors were at work in our case and they interact in complex ways to produce the patterns observed in voter turn-out and actual voting results. Although all these four processes are plausible explanations for the patterns we observe, our case study did not reveal which process is more prominent in each referendum. It is obvious that we need more detailed data and further study to link geo-spatial patterns to various social processes.

Authors who have promoted the neighborhood hypothesis recognize that alterna-
tive explanations can be provided for the effect without calling on local social interaction as a causal mechanism involved. Our study shows that the spatial distribution of voter turn-out influences the geographical patterns of voting results significantly. This suggests that a complete understanding of the neighborhood effect in local politics must encompass both spatial dependence and spatial heterogeneity. In other words, although the neighborhood effect (spatial dependence) cannot be denied, its manifestations can be affected by a plethora of factors that contribute to the contingent nature of the effect (spatial heterogeneity). The methodology we used opens new avenues for future inquiries using individual voter data.

Concluding remarks

More than a decade has passed since the exchange between Taylor (1990) and Goodchild (1991) in this journal about the potentials and implications of GIS for geography in general and political geography in particular. During the past ten years, both GIS and political geography have witnessed exciting new developments, which reinforce the two fundamental points of the Taylor–Goodchild exchange: that GIS can and should be applied in politics and that politics is deeply rooted in GIS technology and its applications. It is beyond the scope of this paper to scrutinize this dual relationship between GIS and politics. Our case study, however, does serve a more modest purpose, that is, GIS-based spatial analysis is of immense utility in exploring the impacts of voter turn-out on neighborhood effects. By using GIS and GIS-based spatial analysis for electoral geography to handle both ecological and individual data, we have revealed some new textures in the relationship between the distribution of actual voter turn-out and the neighborhood effect in local politics. We hope our paper will enlarge the awareness of political geographers on the potentials of GIS in electoral geographical research. Evidently, the role of GIS has shifted from being simply a data storage/facts repository tool in the early 1990s to a robust analytical tool to develop geographic knowledge system (GKS) in political geography in the late 1990s. With the advancement in GIScience, it can be expected that the engagement of political geography with GIS will go beyond the methodological/technical level to reach new theoretical and intellectual heights in the new millennium.

References


