Using Small Data to Interpret Big Data:**311 Reports as Individual Contributions to Informal Social Control in Urban Neighborhoods****Abstract**

Informal social control is considered a vital component of the well-being of urban communities. Though some argue that the actions that constitute this social process are often said to reflect territoriality, little else is known about how individuals contribute to it. The current study leverages a database of over 600,000 requests for government services received by the city of Boston, MA's 311 system as a way to answer such questions, focusing particularly on reports of issues in the public space arising from incivilities. In order to establish construct validity for the "big data" of the 311 system, they are combined with the "small data" of a survey of 311 users, permitting the simultaneous analysis of objective reporting behaviors with self-report attitudes. The analysis occurs in two parts. First, reporting of incivilities is distinguished behaviorally from reporting public issues arising from natural deterioration, and people are found to specialize in one or the other. Second, the survey is used to test whether the reports are a reflection of territoriality. Reports of incivilities were unique in their association with a desire to enforce local social norms. They were also associated with a second territorial motivation to benefit the community. Implications for future research are discussed.

Keywords: Disorder; 311 systems; computational social science; broken windows

Introduction

Picture a street corner in a residential urban neighborhood where a group of teenagers has congregated. Imagine further that they are partaking in some undesirable activity, becoming a nuisance or even potential danger to themselves and others. This is possibly one of the most referenced vignettes in urban sociology and criminology, used to illustrate the importance of *informal social control*, and the ability of a neighborhood's residents to redirect and discourage problematic behavior within the community. Much work has examined how this capacity varies across neighborhoods and its correlation with key demographic and social characteristics (Sampson and Groves 1989, Bursik and Grasmick 1993, Silver and Miller 2004). This has given us a good understanding of "if" a neighborhood expresses informal social control or not, but there has been very little quantitative work on "how" it actually occurs (cf. Drakulich 2014). Who is taking such action? A shopkeeper? A nearby resident? A parent of one of the teens? Do a small subset of individuals largely responsible for social control, or is it evenly distributed across the community's members? Questions of this sort remain largely unanswered.

This area of inquiry has largely been limited by the methodological challenge it poses. Whether by observation, survey, or ethnography, it would be very difficult to systematically assess propensities to contribute to informal social control across the residents of a neighborhood, not to mention scale such a methodology to make comparisons across the many neighborhoods of a single city. Here I explore whether "big data," in the form of the database generated by 311 systems, might offer a potential opportunity for this line of study. The 311 system is a recent innovation in urban policy,

now implemented in over 300 municipalities, that offers one or more convenient channels by which constituents can request non-emergency city services, typically including a telephone hotline (i.e., 3-1-1) and web-based applications (e.g., smart phone applications). The requests received by 311 systems are diverse, including snow plowing, sidewalk repairs, pick-ups for oversized garbage items, and fixing streetlight outages. Many, like complaints of graffiti or illegal dumping, refer to instances of neglect or denigration of the public space, indicating that the report is seeking to rectify an incivility, and as such might be considered an act of informal social control.

The 311 system of a large city might receive hundreds or even thousands of requests per day, generating an extensive archive that can be analyzed across space and time. A particular advantage of the 311 database when compared to the 911 call record, which also documents reports of illicit or uncivil behavior, is that a user of the system can register, creating an account that archives and tracks all of his or her requests. For analytic purposes, this acts as a sub-database that offers a detailed description of that individual's patterns of requests—for example, how many requests were made, the types of issues, and their geographic distribution (O'Brien, 2015). In turn, the database as a whole might contain tens of thousands of registrants, providing a rich opportunity to compare such metrics across a wide sample of individuals. If indeed certain types of 311 reports can be treated as instances of informal social control, it would allow the comparison of propensities for such action both within and between the neighborhoods of a city.

As with most “big data,” the purported opportunity of 311 reports is accompanied by its own set of challenges. Apart from their size, most of these novel data resources are

distinctive in that they were not intentionally collected for research purposes, but are the byproduct of some administrative operation. Consequently, they often provide a detailed view of some process that has previously been difficult to study directly. Examples include tracking the differentiation of violent offenses from other crimes over centuries of court cases (Klingenstein, Hitchcock, and DeDeo 2014), mapping the density of taxi rides to identify opportunities for ride-sharing programs (Santi et al. 2014), and modeling the communication networks of whole countries from cell phone metadata (Eagle, Macy, and Claxton 2010). The data's administrative origins cut both ways, however, because without an inherent research purpose, it is not immediately clear what they can measure or how such measurements would relate to existing theories and constructs (Boyd and Crawford 2011, O'Brien, Sampson, and Winship 2015). Taking the 311 example, reports that reference an incivility in the public space may appear to be an act of informal social control on the surface, but this cannot be confirmed by analyzing them in isolation.

This weakness does not disqualify the use of big data altogether, but it does call for a multi-method approach that marries the "big" data with the "small" data produced by traditional methodologies. Studies of this nature are relatively rare, but they have the potential to bridge the gap between administrative data and theory, imparting interpretive meaning to the former and providing a new resource for advancing the latter. The current study takes such an approach by merging the 311 database of Boston, MA, with surveys completed by its users, with the goal of establishing whether indeed reports of incivilities can provide insights on the enforcement of informal social control by urban residents. This might be described as an exercise in construct validity (c.f., Messick 1995). Before this is possible it is necessary to determine what such an evaluation would entail. Informal social

control is a neighborhood-level dynamic that emerges from the actions of residents, actions that themselves must be rooted in some particular set of motivations at the individual level. The goal here, then, would be to establish whether 311 reports of incivilities arise from a set of motivations that are believed to be associated with other contributions to informal social control, thereby justifying their use as a proxy for such tendencies.

As articulated in the following two sections, the current study works off the premise that the motivation to enforce social norms in a neighborhood arises from a broader human tendency for territoriality, that is, to claim ownership and responsibility for a space or object (Brown 1987, Taylor 1988, Perkins et al. 1993). The first section summarizes in greater detail current knowledge and existing methodologies for studying informal social control by residents. The second further defines territoriality and its theorized relationship with 311 reports. These then provide the rationale for the study design, hypotheses, and analyses that follow.

The Study of Informal Social Control

In their seminal efforts to explain why the neighborhoods of a city exhibit marked disparities in major outcomes, particularly violent crime and delinquency, the early Chicago School of urban sociology argued for the central role of informal social control, or the mechanisms by which local residents establish and enforce expectations for behavior in the local community (Park, Burgess, and McKenzie 1968/1984, Shaw and McKay 1942/1969). In the subsequent decades informal social control has become a major focus of neighborhood research, criminological and otherwise, further developing the concept

and producing repeated evidence for its importance. Kasarda & Janowitz (1974) and later Bursik & Grasmick (1993) forwarded the systemic model of crime, arguing that social control emerges from the system of formal and informal social ties within the community. Sampson et al. (1997) took this a step further, proposing that social cohesion between neighbors combined with a capacity for social control constituted the collective efficacy of a community. This metric has subsequently become instrumental in explaining not only local crime rates and levels of physical and social disorder (i.e., the accumulation of incivilities and their artifacts in the public space; Morenoff, Sampson, and Raudenbush 2001, Sampson and Raudenbush 1999, Sampson, Raudenbush, and Earls 1997), but also a variety of indicators of resident mental and physical health (Ullman, Goldman, and Pebley 2013, Cohen et al. 2006, Cagney and Browning 2004, Browning and Cagney 2002, Buka et al. 2003, Ahern and Galea 2006, Skrabski, Kopp, and Kawachi 2004). The importance of informal social control has also been influential in the realm of policy and practice, forming in part the basis for community policing programs, which join the tools of formal law enforcement with efforts to support the community's endemic ability to discourage crime (Skogan and Hartnett 1997, Greene 2000).

These insights have inspired research on the factors that promote or inhibit a community's capacity for social control. Following the premise of the systemic model of crime, this work has emphasized the importance of social networks and the structural characteristics believed to inhibit their construction, including concentrated disadvantage, residential instability, and ethnic heterogeneity (Sampson and Groves 1989, Bellair 2000, Warner and Rountree 1997, Steenbeek and Hipp 2011). Expansions on this theme have included efforts to determine: whether social networks mediate the effects of demographic

characteristics on crime, or whether these demographics in fact moderate the effect of social networks (Warner and Rountree 1997); which types of social interaction are most likely to deter crime (Bellair 1997); and how relationships with formal law enforcement impact the capacity for informal social control (Silver and Miller 2004, Lynch and Sabol 2004).

This literature importantly connects demographic and social context to a collective capacity, but the fact remains that informal social control must be perpetuated by the actions of individual community members (c.f., Coleman 1990). It is this embodiment of informal social control and the dynamics surrounding it that we have had so little opportunity to study quantitatively at the individual level. To understand why, note that the events of interest entail the co-incidence of two things: a violation of a social norm, either in the form of an ongoing incivility or the physical artifact of said incivility (e.g., graffiti); and someone who moves to address the situation. The optimal methodology would seemingly be systematic observation of public behavior (Raudenbush and Sampson 1999), but such protocols already entail an extensive investment of time just to identify incivilities, setting aside the question of observing someone taking action on them. Consequently, one might spend hours in a neighborhood and only record a few cases. Even if it were possible to use such an approach to identify between-neighborhood differences, it would likely be impossible to identify individual differences, which would require repeatedly observing the reactions of individuals to multiple incivilities.¹ In contrast,

¹ Note that Wallace and Schalliol (2015) have demonstrated the potential of systematic social observation to capture building-level differences in disorder over time, but this is a somewhat different methodological question as the buildings themselves remain in a single, known location, whereas people's movements and likelihood of encountering a continued string of incivilities is less predictable.

survey approaches suffer from issues of validity, the largest being the need to pose the questions as responses to hypothetical situations (“e.g., If a crime occurred, would you...”; Steenbeek and Schutjens 2014, Slocum et al. 2010, Warner 2007). When surveys do ask respondents to recount actual events (e.g., Wells et al. 2006) they may be vulnerable to the effects of social desirability and recall bias. Last, ethnographic work may be the most successful at uncovering these behavioral dynamics and their impact on the neighborhood by recording people’s perceptions and motivations surrounding specific events and contexts (Suttles 1968, Carr 2005, Kefalas 2003, Pattillo-McCoy 2000). For obvious reasons, however, such studies cannot be extended to a broader quantitative scale.

The proposition here is that 311 reports of public incivilities expose a particular behavior that contributes to informal social control with sufficient detail to study individual differences within and between communities, overcoming the weaknesses of other methodologies. Given their volume, such data could support detailed analysis of where, when, and how often individuals act in such a way, while also placing these variations within the neighborhood context. Some will note that 311 is distinct from most traditional examples of informal social control by community members, like intervening with troublesome teens, because the action taken is indirect, being mediated by a formal authority. This involvement of the government does not mean, however, that 311 reports are an instance of formal control. Instead, they qualify as “public control,” a form of informal social control in which members of the community “secure public goods and services that are allocated by agencies located outside the neighborhood” (Bursik and Grasmick 1993: 17) for the purpose of enforcing local social norms (also see Warner 2007). Of critical importance is that the act of enforcement originated with and was instigated by

the desires and actions of the community members themselves, and not the formal authorities. Carr (2005) has argued that this is in fact becoming the predominant form of informal social control as urban residents have increasingly leveraged the resources offered by formal institutions, especially when they are required to complete the task at hand—as is the case for many of the requests received through 311, which necessitate specialized equipment and expertise.

This reasoning supports the notion that the same motivations that lead a person to intervene directly when, say, a group of teens are being a public nuisance, also manifest themselves in the decision to call 311 to report graffiti or illegal dumping. Nonetheless, this remains an open empirical question, and the one that this study seeks to examine. In order to test whether 311 reports are in fact a reflection of a person's more general tendency (or lack thereof) to contribute to informal social control, it is first necessary to determine what these motivations might be. This is the focus of the next section.

Territoriality: An Individual-Level Motivation for Informal Social Control

Informal social control is a characteristic of the community that emerges from the actions and interactions undertaken by those who live, work, and otherwise visit a neighborhood. These actions have their own motivations at the individual level, determining how, why, and when they occur. For 311 reports of public incivilities to be informative regarding informal social control in general, they would have to have some of the same motivations as other behaviors that fulfill the same role, which then begs the question: what are those motivations? Theory and evidence would suggest that they are

based in our capacity for territoriality, or the tendency to claim ownership and responsibility for a space or object.

For much of the last quarter of the 20th century, criminologists took an interest in the contributions of human territoriality to the dynamics of urban neighborhoods (e.g., Brantingham and Brantingham 1981, Newman 1973, Perkins et al. 1993, Brown and Altman 1981). Though one might expect such work to have centered upon gangs battling for control of one block or another, the concept encompassed a broad range of ways that people might interact with “territory.” In fact, early work on human territoriality explicitly sought to reject its equivalence to the tendency of other animals to compete over space, like male elk or blackbirds during mating season, or bears marking trees in the forest (Edney 1974). The resultant body of work has observed how people claim, personalize, identify with, and share spaces in various contexts, including classrooms, offices, dorm rooms, and, of course, neighborhoods, giving rise to an expanded definition of territoriality, spanning all attitudes, cognitions, and behaviors that arise from a sense of ownership of an object or space (Altman, 1970; B. B. Brown, 1987; Edney, 1974; Taylor, 1988).

This expanded definition had two major implications for the role of territoriality in shaping the landscape of a neighborhood. First, it encompasses caretaking in addition to defense. Following this, researchers have identified a range of elements visible on houses that could be considered manifestations of territoriality, including fences, “No Trespassing” signs, and even house decorations during holidays (Brown and Werner 1985, Werner, Peterson-Lewis, and Brown 1989, Caughy, O'Campo, and Patterson 2001). Second, it permitted territoriality to extend from private items to shared ones, which in the context of

urban neighborhoods included the management of public spaces and the counteraction of disorder and crime. Work arising from this premise has found a consistent linkage between the territorial sentiments residents have for their home and neighborhood and the upkeep of their property (Harris and Brown 1996), and a similar correlation at the neighborhood level (Brown, Perkins, and Brown 2004, Pitner, Yu, and Brown 2012). The predicted impact on crime, however, has seen less support (Perkins et al. 1993).

This line of inquiry has gone quiet in recent years, likely because of the lack of evidence for territoriality's impacts on crime. This is beset by the interpretive challenge of translating self-report survey measures of territoriality to effects on crime when the model being tested is actually a bit more complex: 1) individual territoriality is manifest in relatively rare actions that 2) give rise to an emergent level of informal social control in a neighborhood, which 3) lowers disorder and deters crime. The survey methodologies most often utilized to date have measured step 1 in the aggregate and equated the result to step 2, thereby creating a tautology that loses the nuance of the model. If the 311 database is in fact a manifestation of territoriality, it can potentially fill this missing connection by enabling the measurement of territoriality across many individuals within a neighborhood, thereby supporting nuanced examinations of how these actors account for differences in informal social control between neighborhoods.

Determining how the 311 database might capture such motivations requires separating out those reports that are likely to be relevant from those that are not. The 311 system handles many request types, which might be divided into two categories: personal needs, like a general request or a special garbage pick-up for a bulk item (e.g., sofa,

television); and issues in the public domain, like potholes or graffiti. This latter group of reports has been referred to by O'Brien and colleagues (O'Brien 2015, O'Brien, Gordon, and Baldwin-Philippi 2014) as *custodianship*, given their intent to maintain the space against deterioration or denigration, and argued that custodianship is itself a manifestation of territoriality. This has been supported by initial investigations, which have found that reporting is anchored by the home. The average report references issues that lie within mere feet of the reporter's house, and 79% of custodians (i.e., those who made at least one report of a public issue) made such reports exclusively within two blocks of home (O'Brien, 2013). In addition, O'Brien et al. (2014) found in a survey of 311 users that those who reported greater territorial motives were more likely to make such reports.

Importantly, modern theory on territoriality divides it into two components: caretaking and defense (Brown 2009). The latter of these would seem to be most consistent with behaviors that knowingly contribute to informal social control, as they seek to protect the neighborhood from violations committed by others. Likewise, the public issues communicated by 311 reports might themselves be divided into two different types, based on the origin of the problem in question. Some issues, like potholes and street light outages, are the result of natural deterioration. Others, like graffiti or abandoned vehicles, are the result of incivilities perpetuated by others. In turn, attempts to rectify them would be in keeping with the concept of informal social control. The opportunity in this case is two-fold. The first, and main purpose of the current study, is to establish whether reports of public incivilities might be one manifestation of defensive territoriality, and as such be reflective of contributions to informal social control more generally. If this were to hold, it would help to differentiate between the roles that each of the two components of

territoriality plays in neighborhood maintenance. O'Brien et al. (2014) measured each of these constructs, but only found a motivation for community caretaking to be associated with custodianship on the whole; a desire to enforce social norms was not significant in their analysis. That said, by combining their methodology with the taxonomy of custodial reports proposed here, it might be possible to construct a more nuanced behavioral model of 311 reporting and of territoriality in urban neighborhoods.

Current Study: Interpreting Administrative Data

The current study tests these questions by marrying the “big” data generated by Boston, MA’s 311 system with the “small” data generated by a survey that asked 311 users to describe their motivations for using the system, including measures of territoriality. The 311 database utilized includes all requests for service over a four-plus-year period, all of which include the date of report and the location where services were to be rendered, as well as a standardized case type. These case types are further categorized to differentiate between issues of public incivilities, natural deterioration, and requests for personal needs. User accounts are utilized to generate individual-level measures of reporting, including the frequency of reports made in each of the three categories of case types. For sake of brevity moving forward, those who have made at least one report regarding the public domain (i.e., public incivilities or natural deterioration) will be referred to as custodians.

These accounts also often include contact information, either in the form of an e-mail or home address, facilitating certain types of spatial analyses, as well as the contacts required for the survey. Individuals who reported one or more cases during the year 2012

and had e-mail addresses associated with their accounts received an invitation to participate in the survey. The survey contained items about an individual's motives for using the 311 system and perceived benefits it provides, including two measures of territoriality: the desire to benefit the local community, and to enforce social norms. These two data sources were linked using e-mail address, creating a single composite database.

The study leverages this composite database to answer two overarching questions regarding the construct validity of reports of incivilities. **1) Discriminant validity, or do reports of incivilities reflect a behavioral construct that is distinct from reports attending to natural deterioration?** This is necessary to establish whether reports that exert social control are in fact distinguished from other forms of custodianship. It can be tested using the 311 data alone by examining whether levels of the two types of reports are tightly coupled across individuals, or if individuals tend to specialize in one type of call or the other. If the latter is true, there may be other meaningful ways in which the two forms of reporting differ, for example their geographical distribution. **2) Convergent validity, or do reports of incivilities reflect a greater desire to enforce social norms than reports of natural deterioration?** The survey makes it possible to determine which territorial motives, if any, differ between custodians who did utilize 311 for social control, those who did not, and reporters who only used the system for personal needs.

A second issue that needs to be addressed is that of the sample. As with many administrative data, the data themselves are volunteered and run the risk of being representative only of those who were willing to participate in the activity or program at hand, rather than of the population as a whole. Consider the figures presented in Table 1. In

the period under study, Boston's 311 system received 295,203 reports of public issues from constituents. Of these, 143,597 (49%) were made by 55,891 registered reporters, and the rest were made anonymously. Further, for geographic analyses a home address is required, which was only available for 25,229 (45%) of these individuals. Last, 3,643 reporters were invited to participate in the survey, of which 765 (21%) did. This is all to illustrate that, despite the large volume of data available, it is still a sample, and one that is determined by non-random processes. Previous work has indicated that those from more advantaged groups are more likely to have a home address on file with the system (O'Brien, 2015), and it would stand to reason that the decision to register at all is influenced by similar factors as well as an individual's trust in government and other personality traits.

The question about how to interpret non-probabilistic data of this sort has two parts. First is to ask how different they are from more traditional data. Though random sampling is the ideal, few if any studies actually realize this goal owing to factors that systematically influence the likelihood of participation. The current situation is not all that dissimilar, apart from the massively denser sample that still covers the geographic extent of Boston—even in larger cities, like Chicago, the largest surveys have only been a fraction of the size (e.g., Sampson, Raudenbush, and Earls 1997). The question, then, is whether the specific biases present in the data are likely to skew the relationships of interest. In the current case, do reports of incivilities in the public space entail a different set of motivations in under-represented economic and racial groups? This concern will need to be kept in mind when interpreting the results. On a final note, the decision to exclusively survey 311 reporters means that comparisons cannot be made to the broader population. This is not necessarily a problem, however, as the survey sample includes a mixture of

custodians who have reported either incivilities, instances of natural deterioration, or both, and non-custodians who made requests exclusively for personal needs. This allows us to compare motivations across groups while controlling for any unmeasured factors that might influence a person's tendency to engage with the system in the first place, which could be a confounding factor.

Data and Methods

311 Database

Boston's 311 system received 591,912 requests for service from constituents via hotline calls and internet self-service portal between March 1, 2010 and July 28, 2014 that included geographic reference.² March 1, 2010 was chosen as the start date because that is when a standardized data entry form was implemented. Each case record included the date of the request, the address or intersection where services were to be rendered (derived from a master geographical database based on city's tax assessor and roads data), and a case type describing the nature of the services required. The database was shared by the Mayor's Office and the director of the 311 system, and its use was approved by the Institutional Review Board.

The requests for service included 218 different case types, 74 of which reflected issues in the public space (listed in Table 1; e.g., street light outage), accounting for 295,203 cases (50%). Other case types referenced personal needs (e.g., request for recycling bin).

² Excluding reports mapped to City Hall were removed because it is often used as a default for issues that lack a geographical reference.

Each account has a unique ID code that is appended to its reports. There were 118,660 registered users (excluding accounts pertaining to city employees) represented in the database, accounting for 293,829 total reports; 55,891 (47%) of these qualified as custodians, having made at least one report referencing an issue in the public space, accounting for 144,716 total reports of public issues. Of custodians, 25,229 (45%) had a home address on file that could be mapped to a known location.

Survey

Registered users of the 311 system who had made at least one request for service during 2012 through any channel and had an e-mail address on file were recruited to take a survey regarding their usage of the system. These survey responses were then merged with the 311 database by e-mail address, such that it was possible to analyze them in conjunction with their reporting patterns. There were 765 respondents (response rate = 21%). The current analysis is limited to 692 respondents who, 1) could be linked to an account that had actually made a report in 2012, 2) made fewer than 100 reports, as three outliers had the potential to skew analysis, and 3) responded to all measures used in the analysis.

The survey included a series of items regarding why the respondent uses the CRM system and how it is helpful. These were used to develop scales for the two aspects of territoriality: *benefitting the local community* and *enforcing norms*. The first was measured with two items: “[It’s important] because it improves my community” and “[It’s helpful for] changing your neighborhood” ($r = .30, p < .001$). *Enforcing norms* was measured with two

items: “[It’s important] because others do not follow laws and social norms of the community” and “[It’s important] because it will make the neighborhood safer” ($r = .38, p < .001$). Respondents also reported their sex, race, age (in 10-year ranges), income, and highest education attained. Many declined to report their income, so highest education is used as the main indicator of socioeconomic status.

Analysis

All analyses were conducted using R v. 3.1.0 (Team 2014). Specific techniques and packages are described as they are utilized.

Results

Discriminant Validity Pt. I: Specialization

Of the 74 case types that reflected issues in the public domain, 12 had been previously classified as part of either of two measures of man-made physical disorder, private neglect and public denigration (O'Brien, Sampson, and Winship 2015). An additional nine case types were determined to also reflect incivilities (see Table 2 for custodial case types with 1,000 or more cases, and the Appendix for all custodial case types). These 21 case types comprised 20% of all custodial calls. The remainder was reports of natural deterioration.

As would be expected given the relative frequency of reports of incivilities and natural deterioration, of the 47% of users who were custodians, far more made reports about the latter (41% vs. 10%; 4% reported both). Actual numbers of reports were typically low, but the distribution had an extremely long tail (incivilities: *mean* = 0.5, *max* = 434; natural deterioration: *mean* = 2.09, *max* = 7,058). The simplest test of whether these two classes of reports reflect distinct behavioral constructs would be to examine their correlation at the individual level. The result was a small negative correlation ($r = -.11$, $p < .001$), indicating that individuals who made more of one type of call tended to make fewer calls of the other type.³

The extent of this specialization might be studied more directly by examining the distribution of reports of incivilities across individuals with the same level of custodial calling. To illustrate, let us limit the analysis to individuals who have made five custodial calls ($N = 995$). This might include anywhere from zero to five reports of incivilities (i.e., exclusive reporting of natural deterioration or incivilities, respectively). Because 20% of custodial calls are for incivilities, if the two types of reporting are substitutable then the most likely proportion of such reports for an individual would be the same (1-out-of-5), and others would vary around this. The binomial equation would predict this to account for 41% of individuals.⁴ Instead, only 18% of this group made one report of an incivility. There was a corresponding increase in those who exclusively reported natural deterioration (60% vs. a predicted 32%) or incivilities (4% vs. a predicted .03%).

³ Before the analysis, outliers with more than 100 custodial reports (91 individuals; 0.2% of custodians) were removed and both sets of counts were log-transformed to account for the Poisson distribution.

⁴ Based on the binomial function, $\binom{n}{k} * a^{n-k} * b^k = 5 * .8^4 * .2^1 = .41$.

Extending this analysis, expected counts were calculated for every possible combination of number of total custodial reports and social control reports ($N = 8,933$) and then limited to those in which the expected count was greater than .5 (i.e., could be rounded to 1 or greater; final $N = 326$). As in the previous illustration, expected and observed counts were then transformed into proportions of individuals at that level of reporting activity. Figure 1a charts together the relationships between these expected and observed proportions to the percentage of incivility reports. As described, the expected proportions were highest when incivility reports were near 20% of reports, and then descend close to zero at the highest level of social control reporting. In contrast, the observed counts peak for those who exclusively report natural deterioration, are lowest in the very ratio of “mixed calling” that would be expected to be highest, and increase with the proportion of incivilities reported. Figure 1b illustrates this relationship further, plotting the percentage difference between observed and expected counts of individuals across the range of percentage of social control calls.⁵ Note that this difference is most pronounced for those who specialize in reporting incivilities created by others.⁶

Discriminant Validity Pt. II: Geographic Distribution

Given evidence that reports of incivilities and natural deterioration reflect distinct behavioral constructs, it is worth exploring how else they differ. One area of particular interest is how these two behaviors interact with the varied geography of the city. Previous

⁵ $\% \text{ diff} = \frac{\text{obs.} - \text{exp.}}{\text{exp.}}$

⁶ The significance of this result was confirmed by a curvilinear regression, which found that the proportion of incivility reports was a positive, quadratic predictor of the percentage difference between observed and expected ($\beta = .75, p < .001$).

research has demonstrated that custodial reports are largely anchored by the home, though a minority of individuals makes such reports in regions away from their home neighborhood (O'Brien 2015). It may be that this pattern differs across the two forms of reporting. Because reports of incivilities have the potential to be more personal, they might be expected to occur closer to home. To answer this, the current analysis uses the home addresses available for a subset of registered 311 users to measure the distance of each report from the reporter's home.⁷

One approach to this question is a within-subjects design, comparing the locations of an individual's reports of incivilities to her reports of natural deterioration, which controls for individual differences in reporting activity that might confound comparisons of distance in the aggregate.⁸ There was a small but significant difference between the two types of reporting, with reports of incivilities sitting closer to the reporter's home (*mean* = 214.3 m vs. 482.4 m; $t = 2.29, p < .05$ for log-transformed values).

Another approach would be to ask what proportion of each type of report occurred in the reporter's home neighborhood. This is trickier because "home neighborhood" is a subjective term that might differ even between people living next-door to each other. To address this, a clustering algorithm was used to approximate the home neighborhood of a given individual from the geographic distribution of her reports. The technique identified a set of reports with sufficient geographic density to be considered a distinct cluster that

⁷ Calculated using the Pythagorean equation, $\sqrt{(x_r - x_h)^2 + (y_r - y_h)^2}$, where the subscripts *r* and *h* indicate the location of the report and the home, respectively).

⁸ This approach is limited to the 2,549 custodians who have made both types of reports and had home addresses on file.

either centered on or lay within 300m of the reporter's home address.⁹ This technique found that only 21% of incivilities were outside of the reporter's home neighborhood compared to 30% for natural deterioration ($\chi^2_{df=2} = 179.8, p < .001$). Similarly, 21% of individuals reported any incivilities outside of their home neighborhood versus 27% for natural deterioration.

Convergent Validity: Do Reports of Incivilities Reflect a Desire to Enforce Social Norms?

On their own, the 311 data can tell us much about the dynamics of reporting behavior, but can say nothing explicit about the motivations that underpin them. To examine such questions requires a more traditional survey methodology. The intent here is to test the extent to which the two types of self-reported territorial motivations—benefiting the community and enforcing norms—can distinguish between the tendency to report incivilities or natural deterioration in the public space.

The sample of survey respondents was largely White, well-educated, and middle-aged (see Table 1 for more detail on sample characteristics), distinguishing it from both the general population of Boston and the assumed population of 311 users. Further, survey respondents were more active reporters. Custodians were more prevalent than in the overall population of registered 311 users (64% vs. 47%) and also made more total reports

⁹ Density reachability and connectivity clustering (fpc package in R; Hennig 2014) used a minimum distance of 300 m, reflecting the diameter around the home of the narrowest definition of neighborhood ((one's block and the adjoining block, based on the average length of Boston streets (~75m); Suttles 1972). This produced clusters of reports for every custodian with at least two public reports within 300 m of each other. Any reports that did not fit these criteria were classified as one-case clusters, meaning if they were within the 300m threshold of home they could be considered a "home" cluster.

(incivilities: *mean* = 0.9 in a single year vs. *mean* = 0.5 in four-plus years; natural deterioration: *mean* = 1.84 in a single year vs. *mean* = 2.09 in four-plus years).

Within the survey sample, 36% were non-custodians during 2012, 43% made custodial reports only for issues of physical deterioration, 7% only for incivilities, and 14% made both types of custodial reports. As illustrated in Figure 2, these four groups appear to differ in their territorial motives, with the desire to benefit the community increasing as people participate in more types of reporting, and the desire to enforce norms increasing for individuals who reported incivilities.

Regression models verified this relationship (see Table 3). Because counts of reports of incivilities and natural deterioration were both Poisson distributed and featured a large proportion of individuals making zero reports, this was done using a generalized linear model with a zero-inflated Poisson link. The models included gender, age, education, and ethnicity as covariates, as well as the log-transformed count of the other type of reporting, controlling for overall activity. The models found that those who reported a greater motivation to enforce social norms were more likely to have reported one or more public incivilities (i.e., less likely to be a zero; $B = -0.27$, O.R. = 0.76, $p < .01$). The count model found that both territorial motivations predicted more reports (benefit community: $B = 0.31$, O.R. = 1.36, $p < .001$; enforce norms: $B = 0.08$, O.R. = 1.36, $p < .05$). In contrast, a motivation to benefit the community predicted a higher likelihood of having reported any issues of natural deterioration ($B = -0.31$, O.R. = 0.73, $p < .01$), and neither motivation predicted more reports. In addition, a few demographic factors predicted patterns of reporting. Most notably: women were not more likely to be non-reporters, but were likely

to make fewer reports in total (public incivilities: $B = -0.51$, $O.R. = 0.60$, $p < .001$; natural deterioration: $B = -0.35$, $O.R. = 0.61$, $p < .001$); and Black individuals were more likely to report any issues of natural deterioration ($B = -0.19$, $O.R. = 0.83$, $p < .01$) and to make more reports ($B = 0.24$, $O.R. = 1.27$, $p < .05$), but *fewer* reports of public incivilities ($B = -2.72$, $O.R. = 0.07$, $p < .01$).

Discussion

The current study sought to impart greater interpretability to the “big” data generated by Boston’s 311 system by combining it with the “small” data generated by a survey of 311 users. More specifically, the goal was to verify whether certain 311 reports which ostensibly enforce local norms for the treatment of a neighborhood’s public spaces are in fact an expression of an individual’s territoriality, as previous theory would suggest (Perkins et al. 1993, Taylor 1988, Brown and Altman 1981). The analysis found evidence for this in two parts. First, an assessment of discriminant validity uncovered clear specialization by individuals in reporting either issues arising from natural deterioration or incivilities, indicating that the two different types of reports reflect different behavioral patterns. The expected ratio between the two types of reports at the individual level, 4:1, was in fact the *least* common ratio, and instead there was a heavy overrepresentation of those who reported exclusively one or the other. The distinction between the two types of behavior was further illustrated by their geographic distribution, which is critical to understanding its impact on the urban landscape. Reports of incivilities were more likely to occur closer to home, potentially reflecting their more personal nature.

The second stage of the analysis demonstrated convergent validity between reports of incivilities and the survey scales measuring territoriality, finding that a desire to enforce social norms was higher in those that had reported incivilities. It also predicted making more reports overall. The other territorial motivation, the desire to benefit the community, also predicted greater volume of reporting incivilities. In contrast, having reported natural deterioration was only predicted by the desire to benefit the community, and volume of reports was not associated with either territorial motivation. In sum, reporting incivilities was at the confluence of the beneficent and defensive aspects of territoriality in a way that reports about natural deterioration were not.

On their own, these findings give greater nuance to existing evidence that custodianship defined more generally—any act seeking to maintain the public space, whether in response to natural deterioration or public incivilities—is an expression of territoriality (O'Brien, Gordon, and Baldwin-Philippi 2014, O'Brien 2015). We see here how the information contained within the 311 database could map onto a two-component model of territoriality that distinguishes between caretaking and defense (Brown 2009). In doing so, it provides insights into the distinct roles these two motivations play in shaping the urban landscape. Caretaking appears to underpin reports for all types of issues in the public domain, but the motivation to defend the space is expressed specifically in the desire to report issues created by the transgressions of others. This latter point leads to the broader goal of this study, and how these data might be used in the study of informal social control. This is the focus of the next section.

Before proceeding, however, it is necessary to address certain limitations of the study. As noted at the outset, the sample of users analyzed here was not necessarily representative of all users of the 311 system. This was notably true of the sample in the survey, which was of higher socioeconomic status and more White than Boston's general population, and presumably than other users of the 311 system. In some ways this was useful, as the greater than expected variation in usage enabled more robust comparison. It also raises certain concerns, particularly whether it is possible that the relationships between territorial motivations and reporting incivilities are different for more disadvantaged people and neighborhoods. This and similar questions must be examined in future study.

Generalizability must be considered on a substantive level as well. Though there is a statistical relationship between a particular behavior captured by the 311 system and territorial motivations, that does not guarantee that they are completely reflective of a propensity to contribute to informal social control in other ways. Consider the differences between such a report and the example with which this paper started: intervening upon adolescent troublemaking. The two acts may indeed rely on the same motivations, but channel those motivations through different media. The one requires an interaction with a government system, whereas the other requires a social exchange with a group of teens—teens who are “up to no good” no less—and in most cases will rely upon existing relationships to be effective. This would suggest that this behavior is constrained by context, and some individuals who would call 311 will be uncomfortable taking direct action on social incivilities, or only rarely encounter situations in which they feel empowered to do so. This, however, does not nullify the conception of these two actions as

being linked through a common, territorial motivation. Instead, it introduces a contextual variable that might moderate whether and how strongly territoriality will manifest itself across situations. Nonetheless, it highlights a simplifying assumption that should be treated carefully in future work using these data, particularly where individuals who are either disadvantaged or disenfranchised are particularly intimidated by personal confrontation with transgressors in their neighborhoods, or conversely are unwilling to summon government authorities. That all said, the relationship between these different types of action could be a fruitful area for future research.

Future Directions

In keeping with the theme of this special issue, the goal here was to describe a particular instance of how big data might advance research in the social sciences while also highlighting a more general need for “small” data that can provide a more concrete interpretation of what these novel data in fact capture. By unlocking the meaning of big data, these sorts of validation exercises open up a variety of new research directions, which I summarize in two classes: first, there are additional opportunities to integrate them with traditional methodologies, like surveys, observations, and experiments; second, there is a renewed opportunity to analyze them on their own, leveraging some of characteristics that make them so exciting in the first place, including their size, depth, and longitudinal nature. I illustrate this potential by suggesting some future directions for the use of the 311 database as a tool for the study of dynamics of informal social control across the urban landscape, organized around the three-part model presented above to describe the

theoretical relationship between territoriality and crime. 1) Individual territoriality is manifest in specific, relatively rare actions that 2) give rise to an emergent level of informal social control in a neighborhood, which 3) lowers disorder and deters crime.

Turning to the first component of the model, the combination of 311 reports and traditional methodologies offer a window onto the expression of territoriality within everyday contexts. This could give rise to a research agenda that combines the individual differences on the one hand—as measured through variation and typologies in reporting—with the different types of situations or spaces where incivilities might occur. One might take a survey approach, finding out more about the attitudes, motivations, and neighborhood contexts that are and are not associated with such behavior than was done here. For example, one initial study that immediately suggests itself from the results here is the tendency of Black individuals to report more issues of natural deterioration but fewer of public incivilities. It seems possible that this might be explained by either individual differences in perception, or by the nature of the contexts that they encounter more often (O'Brien et al. 2014, Sampson and Raudenbush 2004). The study of the expression of territoriality is also ripe for public experimentation. As in the studies conducted by Kees Keizer and colleagues (Keizer, Lindenberg, and Steg 2008, 2013) one might stage an incivility, or place a sign communicating the prohibition of certain behaviors, and use the data being collected by the 311 system to evaluate responses to the stimulus, thereby alleviating some of the difficulty of observing responses. Clever protocols might even find ways to connect experiments to individual level data, thereby directly testing how different types of custodians react to the same situation, and thus better exposing their specific

contributions to the neighborhood. In any of these cases, because the data are continuous in time and space it is possible to generate both before and after data for the final analysis.

The newfound interpretive meaning of the data also facilitates research centered on the 311 data on its own. This can be seen in the second component of the model, or the emergence of informal social control at the neighborhood level. Treating reports of incivilities as an expression of informal social control, we can utilize the full dataset, which contains over 100,000 individuals, to approximate the distribution of such actors across the neighborhoods of the city. This would enable research that goes beyond previous work, which has consistently equated the effect of territoriality on local dynamics as the mean of individual measures (e.g., Perkins et al. 1993). Rather than just counting individuals or averaging their call volume, one might develop typologies of actors and ask how important each is. It is even possible that different types of actors specialize on particular types of issues or reporting in certain contexts that others do not, creating a division of labor in the pursuit of informal social control.

Likewise, being able to characterize neighborhoods according to the prevalence of these actors would further the existing literature about the structural and social characteristics that predict variations in informal social control across communities (Sampson and Groves 1989, Bellair 2000, Warner and Rountree 1997, Steenbeek and Hipp 2011). Though much work has been done at the neighborhood level, little is known about how these associations are mediated by the behaviors of individuals. Does disadvantage deprive individuals of the resources they need to take such action, or the knowledge that such programs are available? Do weak social networks mean individuals do not have the

social motivations to do so? Do features like rentership and residential instability remove the intrinsic motivation to care for a space? Why might too many networks interfere with such activity (cf., Bellair 2000, Pattillo-McCoy 2000)? Finally, the longitudinal nature of the data might enable examinations of how informal social control emerges or collapses over time, and how this might be dynamically responsive to changes in the neighborhood context.

Conclusion

In keeping with the theme of this special issue, the goal here was to describe a particular instance of how the anticipated contribution of big data to the social sciences might be accelerated through its integration with “small” data. In doing so, a secondary intent has been to eschew the allure of analyzing these novel digital data in isolation, and misconceptions that big data portend the “end of theory” (Anderson 2008). To the contrary, theory is as necessary as ever as a tool for organizing and giving meaning to the complex, multidimensional mass of information that has recently become available, but theoretical interpretation requires techniques that can combine these new resources with traditional methodologies. Once this is accomplished, the research questions that might be asked and answered are myriad. In the current case, we see the potential to reopen an area of research that went quiet 20 years ago, and to do so in a manner that links a well-articulated model of individual behavior to the emergence of a critical neighborhood-level social process. Thus, this manuscript is but a single and early step towards incorporating a brand new resource into the long-standing body of research on the urban landscape.

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Table 1. Characteristics of registered users in the 311 database and survey sample participants.

	Mean (SD or Range) or Count (%)		Mean (SD or Range) or Count (%)
Complete Data Set (N=591,912 reports)			
Identified Reporters (N=118,660 making 293,829 reports)			
<i>Reporter Types</i>			
Non-custodian	62,769 (53%)		
Public Incivilities	7,025 (6%)		
Natural Deterioration	44,192 (37%)		
Both	4,674 (4%)		
Identified Custodians (N=55,891 making 144,716 public reports)			
<i>Reporting</i>			
Public Incivilities	0.50 (0 – 434)		
Natural Deterioration	2.09 (0 – 7,058)		
Survey Sample (N = 722 making 1,961 Public Reports in 2012)			
<i>Reporter Types (2012 only)</i>		<i>Ethnicity</i>	
Non-custodian	249 (36%)	White	545 (79%)
Public Incivilities	297 (7%)	Black	63 (9%)
Natural Deterioration	47 (43%)	Hispanic	17 (2%)
Both	99 (14%)	Asian	11 (2%)
<i>Reporting (2012 only)</i>		Other	56 (8%)
Public Incivilities	0.90 (0 – 51)	<i>Age</i>	
Natural Deterioration	1.84 (0 – 60)	18 – 24	10 (1%)
<i>Gender</i>		25 – 34	119 (17%)
Male	343 (50%)	35 – 44	163 (24%)
Female	349 (50%)	45 – 54	179 (26%)
<i>Education Level</i>		55 – 64	128 (18%)
High school or less	38 (5%)	65 – 74	81 (12%)
Some college	93 (13%)	>75	12 (2%)
Professional degree	20 (3%)	<i>Territorial Motives</i>	
Associate's degree	38 (5%)	Benefit Community ^a	4.32 (0.83)
Bachelor's degree	233 (34%)	Enforce Norms ^a	3.43 (1.24)
Master's degree	221 (32%)		
Doctoral degree	49 (7%)		

^a – On a 5-point Likert scale.

Table 2. Frequencies of 311 case types referencing issues in the public space, categorized into instances of natural deterioration and incivilities (limited to types with 1,000 or more reports).

Case Type	Count	Case Type	Count
<i>Natural Deterioration</i>		<i>Natural Deterioration (Cont.)</i>	
Building Inspection Request	4069	Snow Removal	11786
Catchbasin	1266	Street Light Knock Downs	2561
General Lighting Request	3401	Street Light Outages	28893
Highway Maintenance	6505	Traffic Signal Repair	12704
Misc. Snow Complaint	2055	Tree Emergencies	6320
Missed Trash/Recycling/Yard Waste/Bulk Item	24234	Tree Maintenance Requests	13104
Missing Sign	2963		
New Sign Crosswalk or Pavement Marking	1801	<i>Incivilities</i>	
New Sign, Crosswalk or Pavement Marking	2486	Abandoned Vehicles	8385
New Tree Requests	3001	Empty Litter Basket	2214
Park Maintenance Requests	11405	Graffiti Removal	17942
Pick up Dead Animal	7300	Illegal Dumping	4777
Request for Pothole Repair	26549	Illegal Occupancy	1241
		Improper Storage of Trash (Barrels)	11405
Request for Snow Plowing	32447	Overflowing or Un-kept Dumpster	1311
Requests for Street Cleaning	24685	Parking Enforcement	4190
Roadway Repair	1126	PWD Graffiti	2776
Sidewalk Repair	6237	Rodent Activity ¹⁰	8021
Sidewalk Repair (Make Safe)	10739		
Sign Repair	6899		

¹⁰ Though not the act of a human, it is the indirect result of poor sanitation and loads statistically with other issues of inappropriate disposal of trash (O'Brien, et al., 2015).

Table 3. Complete parameter estimates from regressions modeling both the likelihood of zeroes and the total count for reports of incivilities and natural deterioration, using demographic and behavioral predictors, while controlling for neighborhood effects.

	Reports of Incivilities				Reports of Natural Deterioration			
	Zero-Inflation		Total Count		Zero-Inflation		Total Count	
	Beta (Std. Error)	Odds Ratio	Beta (Std. Error)	Odds Ratio	Beta (Std. Error)	Odds Ratio	Beta (Std. Error)	Odds Ratio
<i>Reports of Incivilities^a</i>	—	—	—	—	-0.25*** (0.15)	0.78	0.41*** (0.03)	
<i>Reports of Nat. Deterioration^a</i>	-0.44*** (0.13)	0.64	0.39*** (0.04)	1.48	—	—	—	—
Demographic Predictors								
<i>Female^b</i>	-0.05 (0.20)	0.95	-0.51*** (0.09)	0.60	-0.26 (0.18)	0.77	-0.35*** (0.06)	0.61
<i>Black^b</i>	0.05 (1.31)	1.05	-2.72** (0.96)	0.07	-0.19** (0.07)	0.83	0.24* (0.10)	1.27
<i>Hispanic^b</i>	0.21 (0.87)	1.23	1.21 (0.83)	3.35	-0.00 (0.05)	1.00	-0.12 (0.22)	0.21
<i>Age</i>	-0.03 (0.09)	0.97	-0.00 (0.03)	1.00	0.16 (0.28)	1.17	-0.02 (0.02)	0.90
<i>Education</i>	-0.11 (0.06)	0.90	-0.18 (0.02)	0.84	0.12 (0.50)	1.13	-0.04* (0.02)	0.82
Territorial Motivations								
<i>Benefit Community</i>	-0.14 (0.15)	0.87	0.31*** (0.09)	1.36	-0.31** (0.11)	0.73	-0.03 (0.19)	1.99
<i>Enforce Norms</i>	-0.27** (0.09)	0.76	0.08* (0.04)	1.08	0.14 (0.08)	1.15	0.02 (0.03)	1.25
N/Non-Zeroes	692/152				692/413			

^a- Log-transformed.

^b- Dichotomous variable with '1' equal to the variable's name.

* - $p < .05$, ** - $p < .01$, *** - $p < .001$

Figure 1. Evidence for specialization by custodians on either issues arising from natural deterioration or incivilities by a) comparing the expected and observed proportion of custodians at each possible mixture of the two classes of issue, and b) the percentage difference between the expected and observed proportion over the same range.

Figure 2. Comparing levels of the two territorial motivations across non-custodians and custodians having reported either issues arising from natural deterioration, incivilities, or both.

APPENDIX

Table A1. Frequencies of all 311 case types referencing issues in the public space, categorized into instances of natural deterioration and incivilities.

Case Type	Count	Case Type	Count
<i>Natural Deterioration</i>		<i>Natural Deterioration (Cont.)</i>	
Bridge Maintenance	116	Requests for Traffic Signal Studies or Reviews	961
Building Inspection Request	4069	Roadway Repair	1126
Bus Stop Issues	113	Sidewalk Cover / Manhole	890
BWSC Pothole	82	Sidewalk Repair	6237
Catchbasin	1266	Sidewalk Repair (Make Safe)	10739
City/State Snow Issues	238	Sign Repair	6899
Construction Debris	537	Snow Removal	11786
Corporate or Community Group Service Day Clean Up	148	Street Light Knock Downs	2561
Downed Wire	383	Street Light Outages	28893
Fire Hydrant	622	Traffic Signal Repair	12704
General Lighting Request	3401	Tree Emergencies	6320
Highway Maintenance	6505	Tree in Park	213
Install New Lighting	208	Tree Maintenance Requests	13104
Knockdown Replacement	642	Upgrade Existing Lighting	232
Late Bus Issues	180	Utility Casting Repair	333
Litter Basket Maintenance	323		
Misc. Snow Complaint	2055	<i>Incivilities</i>	
Missed Trash/Recycling/Yard Waste/Bulk Item	24234	Abandoned Bicycle	544
Missing Sign	2963	Abandoned Building	471
New Sign Crosswalk or Pavement Marking	1801	Abandoned Vehicles	8385
New Sign, Crosswalk or Pavement Marking	2486	Abandoned Vehicles - Private Tow	11
New Tree Requests	3001	Empty Litter Basket	2214
News Boxes	503	Exceeding Terms of Permit	329
Park Improvement Requests	226	Graffiti Removal	17942
Park Maintenance Requests	11405	Illegal Auto Body Shop	242
Park Safety Concern	1	Illegal Dumping	4777
Park Safety Notifications	87	Illegal Occupancy	1241
Parking Meter Repairs	434	Illegal Posting of Signs	497
Parks General Request	704	Illegal Rooming House	837
Parks Lighting Issues	508	Illegal Use	185
Parks Lighting/Electrical Issues	278	Illegal Vending	195

Pavement Marking Maintenance	630	Improper Storage of Trash (Barrels)	11405
Pick up Dead Animal	7300	Overflowing or Un-kept Dumpster	1311
Pigeon Infestation	147	Parking Enforcement	4190
Request for Litter Basket Installation	471	Parking on Front/Back Yards (Illegal Parking)	743
Request for Pothole Repair	26549	PWD Graffiti	2776
Request for Snow Plowing	32447	Rodent Activity ¹¹	8021
Requests for Street Cleaning	24685	Trash on Vacant Lot	864

¹¹ Though not the act of a human, it is the indirect result of poor sanitation and loads statistically with other issues of inappropriate disposal of trash (O'Brien, et al., 2015).