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Mass Protests Meet Big Data

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Abstract

Researchers studying electoral behavior have the option of utilizing ecological analysis of vote counts as an alternative to survey research based on self-reported data. However until now, systematic quantitative research on contentious political behavior has relied entirely on survey methodologies. Big data that is continuously gathered on the location of cellphones opens the way to a behavioral analysis of street protests. This study is the first to use such data to measure the number of participants in protest events, aggregated by localities of residence for which socioeconomic, electoral and other contextual data are available.

The motivation for our study is the wave of mega-protests that swept the Middle East and Southern Europe in 2011. We analyze participation in a series of mass demonstrations in Israel, in which nearly one quarter of the non-elderly adult population claimed to have participated. In addition to overcoming other limitations of survey research, our data make it possible to probe who participated in protest events held at different times and venues. This is critical for addressing the theoretical puzzle posed by the appearance of encompassing protests in societies riven by deep cleavages and ideological polarization. Our findings indicate that even though groups alienated from the class, cultural and political identities of the protest core tended to refrain from active participation, the protesting population nevertheless exhibited a significant degree of social and political diversity. We show that this heterogeneity was facilitated by *segmented solidarity*, i.e. temporal and spatial segmentation of the mobilization of different cleavage groups.

Mass Protests Meet Big Data

It is rare to observe protest campaigns that mobilize millions of citizens in the course of a series of interconnected demonstrations. Yet in the aftermath of the financial crisis of 2008 the world witnessed a number of extraordinary mobilizations of this type, including urban revolutions in authoritarian or post-Communist regimes; anti-austerity and anti-inequality protests in the developed world; and outbursts of middle class discontent in emerging economies (Kousis 2014; Flesher Fominaya 2014; Castells 2012; Mason 2012). Scholars have noted both continuities and differences between this protest cycle and its predecessors, but insufficient attention has been paid to the exceptional scale and heterogeneity of participation in the demonstrations that accompanied these campaigns, and their even more diverse and extensive hinterland of sympathizers (Perugorría, Shalev and Tejerina 2016).

At the same time, thanks to technological developments new types of data on individual and collective behavior are becoming available. The gathering and processing of information on the day-to-day lives of ordinary citizens on an unprecedented scale makes it possible to gain new insights into social and political behavior by overcoming limitations of traditional methods of investigation. This paper shows how a type of behavioral data not yet utilized by *social* movement researchers, a byproduct of the routine use of mobile phones, can be exploited to better understand the nature of "encompassing protests". We start by introducing this concept as a framework for understanding patterns of participation in exceptionally large-scale street protests. Next we note the limitations of familiar data sources, followed by a detailed description of a unique type of behavioral dataset on protest participation that makes it possible to overcome these limitations (while also posing new methodological and analytical challenges). The remainder of the paper is devoted to illustrating the uses of this new type of data in the context of an unprecedentedly broad protest that took place in Israel in the summer of 2011.

THEORETICAL AND METHODOLOGICAL MOTIVATION

Encompassing protests

An analysis based on the leading protest event databases has recently demonstrated that "the largest events—relatively few in number—contribute the majority of total participants" (Biggs 2016:3). Nevertheless, while protest cycles have come under extensive scrutiny (e.g. Tarrow 2011), mega-sized protests have received very little attention as a distinct mode of collective political action. In the United States, the quintessential social movement society (Meyer and Tarrow 1998), they are rare occurrences. Between 1960 and 1995, in the average year only 1.5 demonstrations mobilized at least 100,000 participants.[1] Yet in Israel in the summer of 2011, two events in Tel Aviv were attended by at least

[1] Authors' analysis of "The Dynamics of Collective Action in the U.S., 1960-1995" dataset downloaded from http://web.stanford.edu/group/collectiveaction/cgi-bin/drupal on 24 November 2013. We analyzed events coded as a demonstration, march, vigil or "group act of civil disobedience", including those in which coders estimated participation based only on "clues" in the newspaper report.

150,000 protesters. Retrospective sample surveys indicate that as in Spain and Greece, where "movements of the indignant" preceded the Israeli protest, one in every four or five adult Israelis claimed to have participated in one or more street demonstrations in the course of a 5-6 week period of mass mobilization. Moreover these protests enjoyed remarkable popular legitimacy, with a majority of the public expressing strong support.[2]

We conceptualize the Spanish, Greek and Israeli movements as instances of *encompassing* protest, defined as protest campaigns[3] that are passively supported by a broad public consensus, and mobilize large numbers of active participants from diverse backgrounds. At the ideal-typical extreme, an encompassing protest would win the enthusiastic support of a large majority of citizens and be opposed by virtually none, and its supporters and participants would be representative of the socioeconomic, cultural and political diversity of the society at large. Despite the prominence of instances resembling this unusual form of contentious political action in "the year of the protester" (as Time Magazine dubbed 2011), the encompassing protest has yet to be recognized as a distinct empirical and analytical category.[4] In practice, one of the most central features of encompassingness is a paradox – that while appearing to be broadly consensual and capable of mobilizing exceptional numbers and types of participants, their inclusivity is also systematically constrained by social and political divisions. But discovering the balance between inclusivity and exclusivity is challenging. In each of the mega-protests that occurred in 2011, including the Tunisian and Egyptian revolutions, while journalists and other commentators were struck by the exceptional diversity of protest participants, survey data later revealed that some sectors were much more engaged than others, with class, identity groups and political partisanship all playing a filtering role (Beissinger, Jamal and Mazur 2015; Yoruk and Yuksel 2014; Perugorría, Shalev and Tejerina 2016). As we discuss below, however, estimates based on survey research have important limitations.

The constraining role of social and political divisions can be understood by drawing on the canonical literature on social movement studies and political sociology. Social movement scholars are well aware that protest engagement is characterized by a wide gap between passive support and active participation (Klandermans 1984; 1997). Several "technical" explanations have been offered for this mobilization deficit, such as limited personal availability of supporters, or their geographical remoteness from available protest venues (see respectively McAdam 1986; Pierce and Converse 1989). However

[2] Based on national sample surveys carried out by Simple Logica (Spain, April 2013), MRB Hellas S.A. (Greece, June 2011) and the Taub Center for Social Policy Research (Israel, September 2011).

[3] A "campaign" is a sustained and organized episode of collective contention spanning multiple public events (Tilly 2010:53).

[4] The related phenomenon of "large protest events" has been systematically investigated in the Greek context over the years 2010-12 by Kousis (2014) and Diani and Kousis (2014). From a theoretical perspective, the connective action model proposed by Bennett and Segerberg (2013) offers an innovative approach to understanding recent mass mobilizations, and their empirical illustrations include the encompassing 15M protests in Spain. However their theory is unable to explain the balance between homogeneity and diversity in participation which we find so central to some recent large-scale and consensual protest campaigns. In future work we will offer a broader theoretization of encompassing protests and its relationship to the vast literatures on social movements and contentious politics.

other forces are also at work. Participation in a street demonstration is a performative act implying identification with the sponsoring organization(s) and with the social strata, lifestyle and values represented by protest leaders and core participants. As a result, even protests that adopt inclusive demands and identities (for example by claiming to represent "the people" or "the 99%") may be unable to mobilize sympathizers torn by cross-pressures that hinder their transition from passive to active engagement (Oegema and Klandermans 1994).

The political sociology of party systems and voting behavior teaches us that the social-psychological mechanism of cross-pressure may have deep sociological and political roots. As Bartolini and Mair (1990) have influentially argued, it is only when social fault lines are joined by collective identity and political organization that we can speak of "cleavages". Cleavages in this strong sense are capable of generating intense loyalties to parties and associations that actively promote sectoral interests and identities. Further, cleavages have an especially profound influence on political action when they form around socially-closed communities that disseminate or censor information, evaluations and invitations to participate in political action. Both mechanisms – cleavages as a basis for political loyalty, and as a mechanism of social control – could play a decisive role in either promoting or inhibiting protest participation.

In brief, then, protests with encompassing features are distinguished by the vast public support they enjoy, and the scale – and therefore diversity – of their participants. But engagement in these protests – especially active engagement – is nevertheless constrained by social cleavages, all the more so in deeply-divided societies like Israel. The probable result is *an uneven pattern in which most protesters originate from distinct population sectors, but they are joined by participants from other sectors*. What makes such hybridity possible? Students of revolutionary movements have suggested the possibility of a "negative coalition", uniting estranged groups under the umbrella of their shared animosity towards a tyrannical ruler (Dix 1984; Beissinger 2013). Walgrave and Verhulst point to a different mechanism, one with special relevance to the present study. They observe that instead of "a heterogeneous group of people join[ing] forces for a common cause by participating in the same action", protester diversity may be achieved "externally" – meaning that "different people take to the streets but *not to the same streets at the same time*" (Walgrave and Verhulst 2009:1357, emphasis added).

Following this reasoning, empirical evidence of encompassingness based only on high rates of protest participation by diverse groups over the entire course of a campaign could be misleading. Evidence of this type overlooks the separation in time and space between protest activities, lumping together what may actually be loosely-coupled mobilizations by relatively homogenous groups of protesters. Differently put, instead of literally joining hands in solidarity, the members of different cleavage groups may demonstrate in *segmented solidarity*. Given the political, organizational and emotional barriers to interpersonal intimacy and intergroup cooperation across cleavage boundaries, segmented collective action could underlie the rare appearance of encompassing protests, especially in contexts where polarization around cleavages is both high and politically salient. However, as explained in the next section, the data currently available to researchers are unable to provide empirical indications of the presence or absence of segmentation.

Limitations of conventional methods of measuring mass protest

Quantitative data on protest participation is traditionally gathered in one of three ways: (1)Media reports based on estimates by police, journalists or organizers; (2)Retrospective self-reports collected by means of national sample surveys; or (3)On-site surveys based on sampling demonstrators in the course of a protest event. Each method has strengths and weaknesses, depending on the type of protest and the aim of the research. We are specifically interested here in their potential for studying mass mobilization in mega-sized protest campaigns, with the goal of probing the nature and limits of their encompassingness.

Ample research on protest events relies on media reports (Koopmans and Rucht 2002; Earl et al. 2004). While this method has many uses, it is clearly unsuitable for tackling questions of participant composition. In contrast, survey-based research can be highly informative regarding the balance between inclusiveness and cleavage-based distinctiveness in specific mega-protests. As already noted, recent studies of this kind have successfully challenged media images and popular myths regarding massive protest campaigns that occurred in diverse contexts (see also Beissinger 2013; Rüdig and Karyotis 2014). At the same time, from our perspective they also have two important limitations. First, due to the sampling and measurement issues touched on in the next paragraph, national sample surveys are at risk of generating biased measures of participation by different social groups, inflated for some and under-estimated for others. Second, surveys carried out to date have not collected detailed information for large numbers of respondents on *when and where* they took to the streets over the course of a campaign. As a result they are of no help in evaluating our hypothesis that encompassingness may be achievable by means of segmented solidarity.

Surveys that are truly nationally representative are difficult to obtain, especially vis-à-vis minority groups with atypical identities and lifestyles – the very groups which are key to establishing the inclusiveness of a seemingly encompassing protest. A variety of solutions have been proposed for the problem of "hard-to-reach populations" (Marpsat and Razafindratsima 2010). In the field of protest research, targeted sampling among specific groups of interest has been employed in studies of anti-abortion activists in the U.K. by Clarke (1987), and Muslim immigrants in Switzerland by Giugni, Michel and Gianni (2014). It is conceivable that in the future web surveys may succeed in recruiting diverse respondents from access panels, but these come with their own problems (Stoop and Wittenberg 2006). In addition to problems of coverage, as is well known from voting research, the retrospective self-reports on which surveys rely are an unreliable guide to political behavior as they are subject to social desirability bias and hindsight bias (Karp and Brockington 2005; Huber and Power 1985). At the time of being asked, respondents may not recall whether they participated or may adapt their answers to match the way they or others perceive the protest at the time of the survey. For example when a protest is deemed as unsuccessful after the event, people feel less identification compared to their attitudes during the events, and may misrepresent their actual participation.

On-site surveys of demonstrators represent an alternative approach, based on gathering information from participants in ongoing protest events. Typically only a small set of questions are posed in face-to-face interviews, and most information is supplied using a supplementary mail-in questionnaire

completed by the respondent after the event. While care is taken to sample systematically, the total number of interviews that can be carried out during a demonstration is limited, and mail-back questionnaires suffer from incomplete response and potential non-response bias (Walgrave and Verhulst 2011). In recent years efforts have been made to develop standardized protocols that, when properly followed, generate reliable samples from on-site surveys (Van Stekelenburg et al., 2012; Walgrave & Verhulst, 2011). However, such rigorous methods pose high requirements in terms of resources, coordination and forward planning. As a result, while a major multi-national program of on-site surveys was in the field at the time of the recent mega-protests (www.protestsurvey.eu), only a single event was caught in its net (Anduiza, Cristancho and Sabucedo 2013).

An additional limitation of surveys of demonstrators is that no information is collected on non-protesters, be they opposed, indifferent or in favor of the protest. This poses a serious problem in assessing what differentiates active participants from the rest of the public. By using external data sources it is possible to make only rough and limited comparisons between the protesters and other groups (e.g. Norris, Walgrave and Van Aelst 2005; Walgrave, Rucht and Van Aelst 2010). In encompassing protests in particular, the question of who participates and who does not is fundamental.

BEHAVIORAL BIG DATA ON PROTEST PARTICIPATION

A byproduct of recent developments in digital communications technology is the birth of new information banks that record numerous activities performed through or with electronic devices. The fact that most people today carry mobile phones wherever they go makes it possible to track population movements through time and space. The geographical positioning of mobile devices can be most accurately determined by gathering locational data when their GPS capability is activated, but it can also be established more crudely by their position in relation to the cell towers. These towers receive signals continuously emitted by mobile phones whenever they are turned on, regardless of whether calls are being made or text messages are being exchanged (Smoreda, Olteanu-Raimond and Couronné 2013). Researchers from various fields are increasingly taking advantage of the approximate locational data automatically and almost continuously gathered from mobile phones (Francesco, Laura and Vincent 2014).

While most research based on the locational tracks left by mobile phones focuses on transportation and other issues connected with individual spatial mobility (Becker et al. 2013), studies have begun to appear on topics of interest to social scientists, including ethnic segregation (Silm and Ahas 2014) and social interaction (Gao et al. 2013). Our research on the 2011 social justice protest in Israel uses this type of data to systematically study the social composition of street protesters at varying times and places over the course of a two-month protest campaign, partially or fully overcoming the limitations of the sample-dependent and non-behavioral methodologies reviewed above. However, this type of data also poses unusual challenges which require new methods of data processing and analysis. This section introduces the database utilized in our research, and the steps we followed in order to make it useable for research purposes.

Our data provider entered an agreement with Israel's largest cellular network carrier to continuously obtain real-time information on the geographical location of network users.[5] The provider processes the data, stores it (typically for three years) and sells extractions to interested clients. Unlike cellphone-based research on individual spatial mobility, which relies on carriers' records of phone and text communications (CDR), the raw data obtained by our provider is simply a record of sightings of mobile phones identified by their hardware ID, with no linkage to phone numbers or any other indications of the identity of phone owners.

The data processing carried out by the third-party provider consists of two steps. First, the presumed residential location of phone owners is identified, based on linking recurrent sightings of each device late at night. Due to both privacy concerns and the imprecision of the locational data obtained from cell towers, devices cannot be connected to precise locations and are linked to census tracts.[6] In a second step, for specific times and locations[7] designated by the client, the data provider estimates the aggregate number of persons present and their distribution across inferred places of residence. Estimation relies on a proprietary statistical model that takes into account the sampling ratio, i.e. the number of mobile phone users served by the network provider in each locality relative to the size of its population. The only previous research study based on data supplied by our provider used it to investigate commuting patterns throughout Israel. The results proved to be "remarkably consistent" with census data (Razin and Charney 2015:1142).

In the database acquired for this research, the values in the dataset are estimated hourly averages in increments of 50 persons. These estimates are arrayed in a matrix consisting of "sending locations" in the rows, and the locations of individual protest events in the columns (Table 1). Row totals indicate the total number of participations each sending locality contributed to the protest campaign, while column totals represent the total number of persons sighted at each event. The ratio of cell values to the appropriate total yields either the distribution of protest attendees by place of residence (columns), or the dispersion of locality residents across different protest events (rows). Respectively, these ratios enable the data to be analyzed from either an event-oriented perspective, or from the perspective of sending localities.

[5] The data provider is Trendit, an Israeli technology company (www.trendit.net/#/home/technology). The mobile network carrier generating the data is Cellcom, which in 2011 accounted for 35.7% of all Israeli subscribers (Cohen 2013). According to *Mobile World Live,* an independent international source, this network has complete geographical coverage throughout Israel (http://maps.mobileworldlive.com/network_info.php?nid=645&org_id=7824&cid=43). It is considered to have especially high rates of penetration among the Arab and ultra-orthodox populations, which are both difficult to investigate using surveys (Harel Kfir 2011; Kristal 2011).

[6] According to Smoreda et al. (2013:746), passive cellphone localization data is accurate "within a hundred meters in densely populated cities, and within several kilometers in rural areas".

[7] Target areas must be at least 200X200 meters in size.

Table 1: **The dataset matrix**

						All events	
		Event 1	Event 2	...	Event n	**Locality's total participations**	**Locality's % of all participations**
Sending locality	Locality 1						
	Locality 2						
	...						
	Locality n						
All localities	**Total event participations**						*Column sums to 100%*
	Event % of all participations					*Row sums to 100%*	

As noted, the provider aggregates the data by census tracts, known in Israel as Statistical Areas, which are either city neighborhoods or small to medium-sized rural or urban localities. To minimize reliability issues we limit our analysis to Statistical Areas with a working-age population of at least 300, obtaining estimates of protest participation for 2,180 areas.[8] Both the mean and the median working-age population of the included areas is approximately 1,800. The use of Statistical Areas (hereafter "localities") as the unit of analysis opens the way to linking participation in protest with a wide variety of indicators routinely collected by Israel's Central Bureau of Statistics. These include living standards, population composition by national and ethnic origin, and the distribution of votes in national elections.

Based on media reports on the time and location of 45 demonstrations and rallies held around the country which reportedly included at least 1000 participants, usable data were extracted for 38 events that took place between July 23 and September 10, 2011.[9] By "event" we mean a demonstration held in a specific location, irrespective of whether it was part of a coordinated action carried out simultaneously in other locations. In practice, participation in the 2011 protest campaign was concentrated mainly in a series of 5 coordinated protests held on Saturday nights, in all but one case with their epicenter in Tel Aviv. For each of these nationwide protests our data include events that took place in as many as 18 different locations.

[8] The full complement of Statistical Areas in our dataset comprises 95.9% of Israel's working-age population, including settlers in the Occupied Territories and excluding East Jerusalem. (East Jerusalem was excluded because its residents are not Israeli citizens and in addition the Central Bureau of Statistics treats it as a single Statistical Area.) Note that the effective n=2,180 was reached after 53 were dropped on account of missing data on covariates.

[9] The original data extraction included 7 events that we later disqualified. Two of these events were not integral parts of the protest. One event was excluded because it generated implausible data that our provider was unable to correct. The remaining 4 events yielded estimates of fewer than 1000 participants. Three other events that yielded fewer than 1000 participants were retained because they occurred at locations which also hosted additional events, enabling their campaign-wide results to easily pass our threshold.

Demonstrations are usually held in city centers where people may be present for a variety of other reasons, including social interaction, shopping, recreational activities and residency. In order to turn the area-level estimates supplied by the data provider into a measure of protest participation, it was necessary to develop a procedure for estimating the number of *inactive bystanders* – persons present at the time and place of a demonstration who were not active participants. The number of bystanders included in our dataset is potentially substantial because the target area for estimating how many people were present at each event had to be defined broadly. First, the largest demonstrations involved dynamic masses of people traversing a variety of spaces in the course of about four hours. Second, measurement was not planned in advance or monitored in real time. We relied on media reports to identify the routes and sites of protest events after the event. Third, because of the way cellphone signals are localized, the target areas had to be defined broadly enough to take into account the location of the nearest cell towers. This geographical over-shooting was aggravated in some mammoth events, when local overload caused signals to be rerouted to other antennas.

Our data extraction included not only the estimated number of persons present at the time and location of each protest event, but also a benchmark figure assessing the number who were there exactly a week earlier.[10] We treated this benchmark as representing the upper bound of the true number of bystanders present at the protest. During a protest event the regular traffic of visitors to the area is likely to be reduced, since most people with no interest in participating in a protest probably try to avoid the commotion. Thus, before subtracting the benchmark counts from the event counts they must first be deflated. For each protest event the deflation rate was individually customized for every Statistical Area represented in the crowd. Details of the procedure we followed are provided in Appendix 1. Our estimate of the number of bystanders was subtracted from the highest hourly reading taken in the course of each event to yield the *net maximum number of participants* – our measure of the highest number of presumed demonstrators from each Statistical Area in the country actually present in the course of a given event.

The net maximum is the measure on which nearly all of our analysis relies. It is utilized from both of the perspectives on our dataset mentioned earlier in connection with Table 1 – a locality-centered view and an event-centered view. From the first perspective we are interested in examining how engagement in the protest campaign as a whole varied between different types of sending localities. Two global measures of locality-level participation were constructed. The first is *peak participation*, the highest net number of demonstrators from a given locality observed across all of the events included in our study. Since this number is likely to be correlated with the size of the sending locality, the peak is expressed relative to the working-age population. A second measure, *total number of participations*, is the sum of the maximum observations across all events, again relative to the size of the sending locality.

On the face of it total participations better measures the magnitude of a locality's engagement throughout the campaign, but its interpretation is ambiguous. Since the number of spatially accessible protest events depends on their location, it makes sense to focus instead on each locality's "best effort"

[10] In a small number of cases this benchmark referred to the same time and day more than 1 week prior to the event.

(i.e. its peak participation). In addition, the total number of participations is difficult to interpret because a high figure could be generated by a range of scenarios, from one-time attendance by many members of the community to repeated participation by a smaller group of activists. Consequently we generally prefer to focus on each locality's peak participation.

Our other approach to the data is from an event-oriented perspective. This involves analyzing and comparing the distribution of participants by locality of residence in relation to specific *events*, *locations* that hosted one or more events, or event *dates*. By identifying spatial and temporal patterns of involvement – where and when different types of localities mobilized – event-centered analyses reveal the social structures and relations embedded in a protest campaign. In particular, they shed much-needed light on the extent to which mobilization was integrated or segmented, and hence the more subtle social and political boundaries of an encompassing protest.

Methodological summary and caveats

Table 2 condenses the key differences between the three main methodologies on which the preceding discussion has focused. Surveys collect information directly from individual respondents, which makes it possible to connect their participation in protest to their backgrounds, outlooks, and a host of theoretically-grounded causal mechanisms such as a sense of grievance, sympathy for the protest, personal contact with activists and supporters, and availability for participation (e.g. Rüdig and Karyotis 2014). However, samples are limited in size and coverage. In contrast, our big data is based on massive quantities of stored locational information generated by automated monitoring and recording of the signals emitted by the mobile phones used by millions of network customers. This behavioral data, collected in real time and digitally warehoused, is aggregated from the individual level to the level of census tracts. It offers very high time and space resolution, making it possible to explore within-campaign dynamics.

Table 2: **Differences between cellular big data and other methods of studying massive protest campaigns**

	SAMPLE SURVEYS	ON-SITE SURVEYS	CELLULAR BIG DATA
Unit of analysis	Individuals	Individuals	Localities
Time of data collection	After the event	In real time	In real time
Sample size	Small purposively-designed sample	Small "found" sample	Large "found" sample
Sample coverage	Depends on sampling frame & respondent cooperation	Non-participants are not covered; Representativeness of participants is hard to achieve	Depends on cellphone penetration & network coverage
Source of protest data	Self-reports	Behavior	Behavior
Time and space resolution of protest data	Low	Low	High
Source of data on covariates	Self-reports	Self-reports	Census, administrative & event data

Clearly, as in all methodological choices tradeoffs are involved. Perhaps the most obvious is the fact that while the type of behavioral data we use is free of the distortions inherent in sampling procedures and self-reports, it may be subject to several types of error including inaccuracies in positioning information, imperfect population inferences from data on one network's phone owners, and uncertainty regarding the number of "innocent bystanders". Yet these limitations are more likely to affect the estimated numbers of participants than their composition and segmentation, which are the main interest of this research.

Analytical approach

At the heart of this study lies a search for empirical relationships between the social composition of localities and participation of their residents in a protest campaign. We seek to identify the socio-political bases of active engagement and link them to Israel's cleavage structure. Specifically, we aim to exploit the locality-level basis of our data in order to explore whether participants from localities representing social groups on different sides of cleavage boundaries protested together or followed the principle of segmented solidarity. But in attempting to infer group differences from aggregate data, are we not at risk of committing the ecological fallacy? Indeed we are, but not as flagrantly as might be feared. Robinson's (1950) famous warning was directed against using ecological correlations between variables measured using aggregated area-level data, in order to infer relationships between the same variables at the individual level. However, our interest is in differences between groups, not individuals. Furthermore, we have suggested that the causal mechanisms generating these differences include community-level dynamics that are "properties of areas as such", and therefore appropriate to ecological correlations (Menzel 1950:674).

Even in a digitally networked world, the places in which people live constitute the local context in which opinions are shaped, norms are enforced, information is shared and participation is either proposed or discouraged by associations, activists and interpersonal networks. Nevertheless, without multilevel analysis of data on individuals nested within areas, it is not possible to differentiate between two effects of interest - "the balance of social groups composing each locale" and "how each social group reacts to the context in which it operates" (Voss 2004:70; see also Glynn and Wakefield 2010). All is well so long as group differences and contextual effects are harmonious. A classic example of a collision between the two arises if a rising share of a racial minority in local communities increases the sense of threat experienced by the majority. The ironic consequence, documented for US elections, is a *positive* correlation across states between percent black and support for candidates considered to be hostile towards blacks. This outcome results from the contextual effect of the racial mix, not the political preferences of individual black voters (Giles and Buckner 1993; Firebaugh 2009).

An additional concern raised by analysis of aggregate data is the susceptibility of ecological relationships to scale effects, a problem exacerbated by the arbitrary and "modifiable" size of the areal units for which aggregate data are typically available (Yule and Kendall 1950). It has long been known that larger geographical units tend to amplify bivariate correlations (Gehlke and Biehl 1934). This can result in gaps and even inversions of relationships between variables measured at the individual and aggregate levels. Nevertheless, the most dramatic contradictions arise when areal units are extremely aggregated, such

as when comparing the states of the United States (e.g. Robinson 1950; Gelman et al. 2007). As noted earlier, our unit of analysis – the Statistical Area – comprises an average of only 1,800 working-age adults. This appears to be consistent with expert advice to ecological analysts, that they "compromise between having a unit large enough to get reliable rates and not blurring meaningful local variation" (Arsenault et al. 2013:12).

In the empirical sections of the paper we follow two different approaches to analyzing our aggregate data prudently. The initial empirical results document differences in protest participation between localities that differ sharply in their composition vis-à-vis the principal cleavages that divide Israelis. However, except in completely homogenous communities this type of bivariate analysis could yield misleading results. Our second and primary analytical strategy is based on an alternative to the conventional approach to analyzing the effects of multiple explanatory variables. Since we assume that the different characteristics of neighborhoods both overlap and interact in their effects, our aim is not to generalize about "the" effect of a given cleavage, but rather *to place each cleavage group in the local context (or contexts) in which its members are typically found*. We use Latent Class Analysis (LCA), a model-based form of cluster analysis, to classify localities into a limited number of meaningful types, each with a distinct multidimensional profile. As we explicate below, the resulting inductively-generated typology parsimoniously divides thousands of census tracts into six readily-identifiable types.

The advantages of this approach are threefold. First, it provides a way of directly dealing with elective affinities (and therefore multicollinearity) between cleavages. Second, comparing a limited number of cleavage clusters is a more feasible way of analyzing multiple interaction effects than standard linear models. The third advantage is that the resulting analysis is relatively robust in the face of ecological inference concerns. Not only is it based on data for quite small geographical areas, but clustering identifies the most typical and distinct forms taken by the multiple attributes of these areas.

THE CASE STUDY

Before illustrating the uses of different kinds of analysis and indicators using our database on the summer 2011 protest in Israel, we set the scene in two respects. We first outline the main features of the Israeli protest, and then provide an overview of the cleavage structure and its expected relationship to engagement in the protest.

The Israeli protest

On July 14th 2011 a small group of students and activists established an encampment in the center of Tel Aviv in an outcry against the scarcity and price of rental housing in the city (Schechter, 2012; Grinberg, 2013). Within days numerous tents were set up alongside in Tel Aviv, and similar tent sites spread across the country. These occupations in city centers were soon joined by a series of nationwide mass demonstrations of unprecedented scale and other forms of political protest, occurring on an almost daily basis for nearly two months. The expansion of the protest was not only in size but also in the scope of the grievances and aspirations which it voiced. The initial focus on the housing market was replaced by a much broader focus on a variety of social and economic issues that were conveniently

bundled together under an overarching demand for "social justice" that became the primary moniker of the protest. The wide scope of the grievances raised, the impact of rises in living costs – especially housing – on almost every sector of the population, and the strict avoidance by leaders and activists of any kind of political partisanship made the protest appealing to most segments of Israeli society.

The social protest that erupted in Israel was part of the worldwide wave that peaked in 2011. It shared features typical of Indignados and Occupy movements in other affluent democracies, coupling alienation and mistrust toward institutional politics with deep concerns about socioeconomic inequality and dwindling economic opportunities for many in the privatized neo-liberal economy (Flesher Fominaya 2014; Della Porta 2015; Ancelovici, Dufour and Nez 2016). As elsewhere, the Israeli movement was led by frustrated young adults, who demanded that the government radically change the rules of the economic and political game. But while many of these movements had a lot in common, both in their demands and modes of operation (Glasius & Pleyers, 2013), they were mainly nationally-based and challenged local social, economic and political arrangements.

From both a comparative and historical point of view, the protest in Israel exhibited some distinctive characteristics. First, in contrast to Israel's protests in the past it enjoyed very wide support and almost no opposition. This included a warm embrace by the mass media, including the business press. Even some of those who were targeted by the protesters (i.e. members of the government and the economic elite) released statements of endorsement and identification. Such a consensus is rare in the Israeli context, in which long-established cleavages between rival political camps and identity groups are hardly ever challenged. Israeli politics is primarily occupied with matters of national security and collective identity, which form a political divide between the 'hawkish' right and 'dovish' left political camps (Shamir and Arian 1999). In fact, traditionally these are the only issues that manage to mobilize the masses into significant political protest. In this respect the 2011 protest was a doubly unique phenomenon in Israeli politics: an unprecedented mass mobilization raising social and economic issues that normally receive less public attention; and a political movement that seemingly managed to construct bridges between sectors that seldom cooperate.

In comparison to the other relatively encompassing protest movements that preceded it in Southern Europe, the Israeli case is also striking in that it was not an anti-austerity protest. The Israeli economy did not suffer from poor performance during the years that immediately preceded the protest. It successfully coped with the 2008 global financial crisis, and on the eve of the protest economic growth was high. Israelis did not face an externally or internally-imposed austerity plan, nor did they suffer from high unemployment rates. It is true that inequality and poverty rates in Israel are among the highest of the OECD countries, but this is nothing new. In short, from both a material and a political perspective, the outbreak of large-scale economic protest was utterly unexpected.

Another feature of the Israeli movement, shared to a varying extent by other Occupy-type protests, is that it was not led by those suffering the most severe economic disadvantage. On the contrary, the backbone of the protest comprised young activists from the middle and upper-middle classes, the younger generation of families that generally benefited from the liberalization of the Israeli economy since the 1980s (Rosenhek and Shalev, 2014). In contrast, members of lower classes and marginal

groups appeared to be less enthusiastic. Indeed, despite the leaders' and activists' persistent efforts to be as inclusive as possible and to refrain from articulating their distinctly Jewish, secular, and anti-settlement orientation (Schechter 2012), the movement was often signified as a protest of the middle class. Mistrust and alienation were exhibited, if at all, by the members of distinct identity groups economically, socially and/or politically estranged from the protest core.

The cleavage structure and its echoes

For readers unfamiliar with the structure of identity conflicts and political cleavages in Israel, a brief introduction is needed. First and foremost is the division by national groups between the Jewish majority and the Arab minority. The latter, constituting about one fifth of the population, suffers from consistent marginalization as a result of years of conflict prior to and following the founding of Israel in 1948 and its self-definition as a Jewish State. The Arab minority has its own internal cleavages but these are of limited relevance to the 2011 protest, since Palestinian citizens largely refrained altogether from participating (although many of them supported its focus on social and economic issues) (Khattab 2011; Sheindlin 2011). The political identity and activity of Arab Israelis is largely oriented to and organized around their own local communities. Moreover they did not believe that the protest movement – "an all-Jewish spectacle of solidarity" (Monterescu and Shaindlinger 2013:17) – was genuinely interested in or even aware of their interests and needs.

The national divide is supplemented by an ethnic cleavage among Jews, most of whom are only first or second generation Israeli-born. There are pervasive and persistent distinctions between groups of common origin, especially European and "Oriental" Jews (in Hebrew *Mizrachim*, referring to those who originated in Middle Eastern and North African countries). From an early stage, European-origin Jews enjoyed superior access to both private and public resources in comparison with Orientals. After 1989 a massive immigration wave from the countries of the former Soviet Union added a distinctive group of "Russian" Jews to the mixture. Religiosity forms another cleavage: among Jews between secular, traditional, religious and ultra-orthodox; and among Arabs between Muslims, Christians and Druze. Ethnic and religious cleavages are manifested in social and cultural distinctions between identity groups. In addition, this assemblage of identities is closely linked to both deep economic inequalities and harsh ideological disputes, mainly between more progressive and liberal values and more conservative and nationalistic worldviews (Shafir and Peled 2002).

Table 3 summarizes, schematically, the four principal cleavages among the Jewish majority in Israel. However, it does not address the substantial overlaps between the different cleavages. Historically, the hegemonic group in Israel consisted mainly of European Jews, who were predominantly secular, identified with the political left and relatively affluent. This sector, especially its younger generation, has been losing its hegemonic status in recent decades. Many of the inciters, organizers and activists in the 2011 protest – the protest core – belonged to the younger generation of this traditionally high-status group (Rosenhek and Shalev, 2014).

From our theoretical perspective it is expected that groups typically in conflict with the protest core, including Arabs, Ultra-Orthodox Jews and the radical right, would be unlikely to actively participate. A

more complex case is the mirror image of the protest core, the historically disadvantaged sector of Oriental Jews, characterized by a combination of low socioeconomic status, strong identification with Jewish religious tradition and high support for the rightwing political camp. Members of this group are believed to have largely refrained from taking an active part in the protest (Misgav 2013). However, this is not necessarily true of all Oriental Jews. In recent decades significant numbers of Jews of Oriental descent have experienced upward mobility, adopted more secular Jewish identities, and/or shifted towards the political center. This segment may have been more open to the protest's crystallization of a new political identity and agenda focused on the middle class.

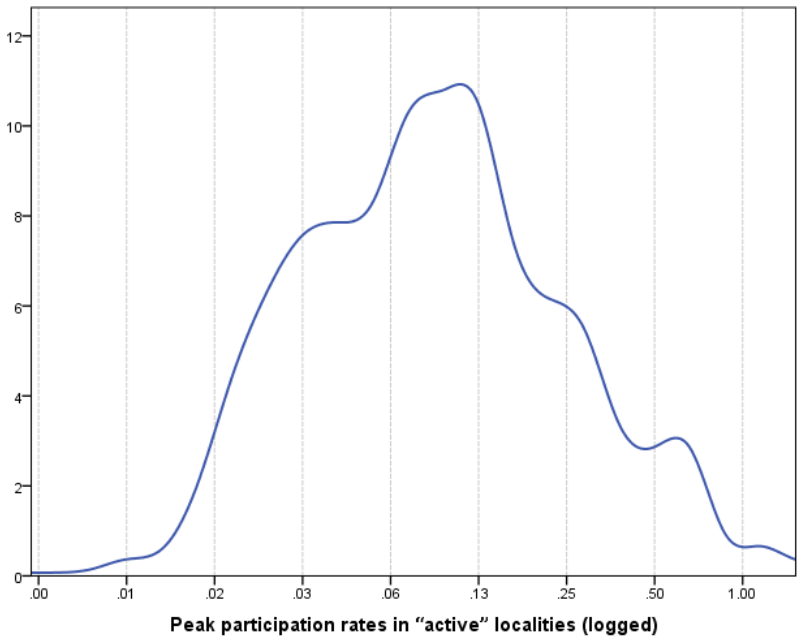
Table 3: **Cleavages among Israeli Jews**

Cleavage	**Main cleavage groups**
Ethnicity/Origin	Europeans, "Orientals" and Russians
Religiosity	Secular, Traditional, Religious and Ultra-Orthodox
Class	Poor, working class, middle class and upper class
Politics	"Dovish" left, "moderate" center and "hawkish" right

FINDINGS

A first indication of the breadth of the mobilization that occurred during the protest is found in the high proportion of the geographical units that actively participated in the demonstrations.[11] Of the 2,237 communities with more than 300 adult residents included in our analysis, over 60% (1,362) were represented among the demonstrators at a non-trivial level. However, as can be seen in Chart 1, the peak participation of active communities varied considerably around the median of 8.5% of the local adult (working-age) population. The log transformation reveals a roughly normal distribution.

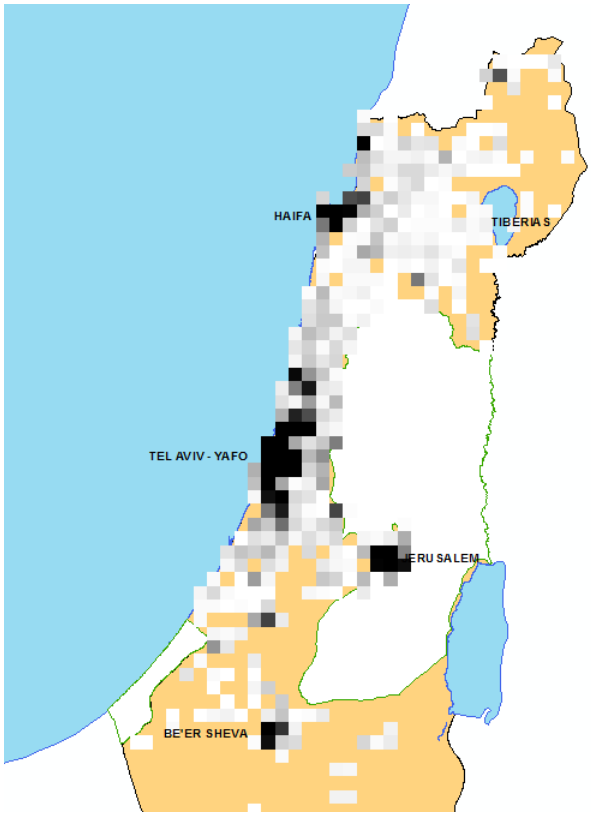
Chart 1: **Smoothed histogram of community participation rates**



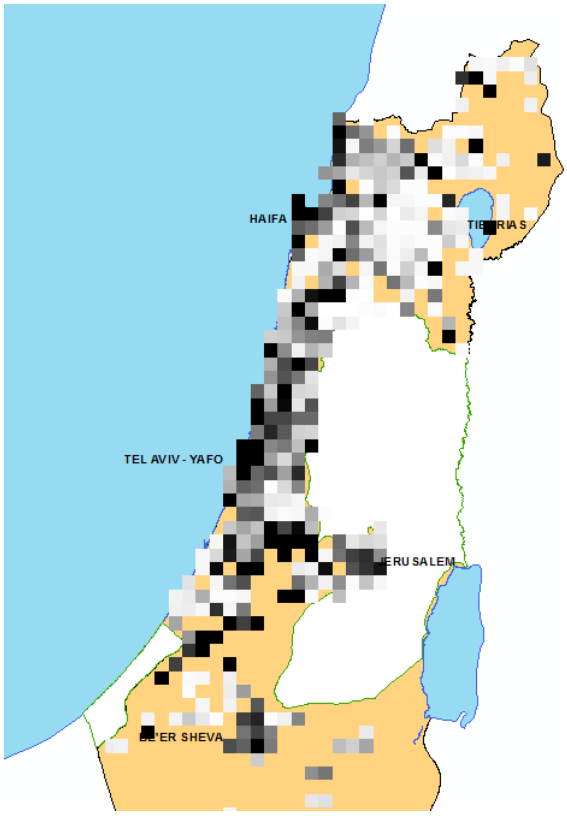
Maps 1 and 2 show, respectively, the spatial dispersion of participation in terms of the number of demonstrators observed over the course of the campaign; and the share of the local population which participated at the peak. While the majority of all participations came from Israel's few densely populated urban areas (Map 1), in relative terms (Map 2) it can be seen that high rates of participation were not exclusive to a few distinct areas. Most importantly, the rate of participation was far from uniform. This variation is the focus of our inquiry.

[11] "Active participation" of a geographical unit is defined as the presence of at least 25 of its residents in one event that remained positive following the corrections we carried out to remove bystanders.

Map 1: Dispersion of participations by their place of origin (absolute numbers)



Map 2: Dispersion of participations by their place of origin (relative to population size)



Despite the inclusive rhetoric used in the Israeli protest, as noted earlier it was widely perceived as primarily representing and being led by the middle and upper-middle classes, while less privileged and lower-status groups remained on its margins. Furthermore, some leaders and supporters of the right-wing coalition in office at the time of the protest claimed it was inspired and led by leftists determined to unseat the government and defend their historic privileges. To some extent these claims are corroborated by our data. The simple bivariate correlations between community characteristics and protest participation presented in Table 4 clearly indicate that participation was more extensive in communities with higher rates of Jews of European origin and left-wing voters, and with more favorable socioeconomic conditions.

Table 4: **Pearson correlations between community characteristics and protest participation**

Participation	Socioeconomic status	Jews of European origin (%)	Share of support for political camps (2009 elections)	
			Left	Right
Peak	.32	.30	.33	-.19
Total	.30	.30	.29	-.19

Relational analysis of cleavages

Given these strong associations across localities between protest participation and key cleavage lines, the next obvious step would be to proceed to a multivariate analysis that estimates the relative importance (or "net effect") of each cleavage. The limitation of this approach is that it ignores the inherently relational (interactive) character of cleavage systems (Taylor and Rae 1969; Gubler and Selway 2012). When cleavages overlap they have mutually reinforcing effects that promote social closure, which in turn either facilitates or inhibits communal participation in protest. In contrast, when cleavages cross-cut one another interests and identities are fragmented and collective action is hampered. Either way, two different effects on area-level mobilization are possible: compositional effects (who lives where) and contextual effects (how individuals are affected by local settings).

The conventional approach, which treats cleavages as a series of independent variables and uses multiple regression to isolate their separate and joint impact, is of limited value in real-world situations in which the cleavage structure in relational. Technically this means that complex interaction effects are anticipated.[12] Latent Class Analysis (LCA) helps deal with this and other challenges posed by our research question. It is a model-based method for identifying distinct clusters of observed attributes (Vermunt and Magidson 2002; Muthen 2001). In its most common application, LCA yields a categorical variable representing a discrete number of latent "types" (in this case, types of localities). Unlike traditional clustering methods, LCA does not require investigators to arbitrarily predetermine the optimal number of clusters. In addition, LCA allows for ambiguity in the assignment of cases to clusters, which is carried out on the basis of membership probabilities.

LCA is adopted here as a flexible tool for exploratory analysis of associations between protest participation and typical cleavage configurations. Variation in sheer levels of participation is not the only outcome of interest. We also explore whether the timing and location of events facilitated or discouraged the participation of citizens living in communities with different cleavage structures. In addition to characterizing areas in terms of broad cleavage patterns rather than by a set of separate indicators, LCA also lowers the risk of falling prey to fallacious ecological inference. Because the clusters identified by LCA represent distinct multi-dimensional configurations, conclusions drawn from aggregate

[12] Interaction effects exhaust valuable degrees of freedom, introduce problems of collinearity, and are complex to establish (Kam and Franzese 2007).

data are less likely to conceal heterogeneous behavior. However, this danger remains present for clusters that are pluralistic in character (communities with several different classes, ethnic groups, etc.). We address this issue below by performing several empirical tests.

The model used here to classify localities into latent classes includes eight empirical indicators that tap the four main cleavages of Jewish-Israeli society: ethnicity, religiosity, class and politics.[13] Due to the sharp social and political divisions between the Jewish and Arab populations, analysis of heterogeneity within the Arab sector would require a separate analysis. Here the 286 homogenous Arab localities in our dataset were assigned to a separate category outside of the LCA.

As in other log-likelihood models, optimal LCA models are chosen by consulting model fit statistics (BIC, AIC) that try to balance parsimony and accuracy. However it is also important to bear in mind that classification error increases with the number of clusters. The best fit was found with a five-cluster solution that produced a normalized entropy measure of 0.9, indicating that the model is well-founded.[14]

Table 5 summarizes the main features of the five latent clusters (more detailed results are available in Appendix 2). The largest cluster (28% of all localities) combines precisely the features that have been attributed to the leadership and core supporters of the protest. The residents of these localities tend to be affluent, secular and of European origin, and have unusually high rates of voting for leftwing parties.[15] As will be shown below, these *Core* localities indeed exhibited by far the highest levels of protest participation. The main features of localities in the second cluster, labeled *Mixed Middle* (24% of the total), are their concentration in the middle range of the socioeconomic scale and the weight of "Oriental" Jews (who originated in North Africa and the Middle East) in their ethnic composition. However, the political and religious orientation of this cluster is quite mixed. The demographic dominance of Oriental Jews is even stronger in the third cluster, which represents a very different milieu, characterized by low scores on our socioeconomic index and relatively high levels of religiosity and support for the political right. This cluster, labeled *Oriental Poor*, includes 19% of localities. The fourth cluster is made up of localities in the middle socioeconomic range with exceptionally strong support for *Rightwing* parties. It comprises both religious and secular communities, and includes most of Jewish settlements in the Occupied Territories. The fifth cluster consists mainly of enclaves of *Ultra-Orthodox* Jews living in self-segregated communities at a low socioeconomic level. Lastly, as noted above Arab communities are treated as a separate type.

[13] The indicators used in the analysis are described in Appendix Table A2.1

[14] The LCA model was estimated using Latent Gold (www.statisticalinnovations.com). Due to some high bivariate residuals we relaxed the assumption of local independence by including five Direct Effects. This yielded the final solution that has substantially lower bivariate residuals compared to the single-cluster solution and better fit than the initial 5-cluster solution.

[15] Appendix Table A2.2 illustrates the empirical basis for this generalization. Localities in the Core cluster have a probability of .93 of scoring in the top tertile of left party vote and.98 of scoring below the median on our Ultra-Orthodoxy factor. Their probabilities of being in the top tertiles of SES and European demographic dominance are .86 and .83 respectively.

Table 5: **Types of local communities in Israel (Latent Class Analysis)**

Type	Description	Proportion of localities
CORE	Predominantly affluent, secular, European Jews who lean towards the left of the political spectrum.	28%
MIXED MIDDLE	Mainly at the middle of the socioeconomic scale and of Oriental origin. Mixed in terms of political partisanship and religiosity.	24%
ORIENTAL POOR	Predominantly poor Oriental communities with high support for rightwing parties and relatively high religiosity.	19%
RIGHTWING	Strong support for rightwing parties and mainly in the middle of the socioeconomic scale. Mixed religious and secular. Over-representation of settlers and Russian immigrants.	11%
ULTRA-ORTHODOX	Concentrations of poor, Ultra-Orthodox Jews.	6%
ARAB	Homogenous Arab localities.	13%

Having identified the six different types of local communities, the next step is to examine differences in the ways they participated in the protest. With the question of encompassingness in mind, the chief task is to evaluate whether the protest was driven solely by the economic and sociopolitical losses suffered by the middle and upper-middle classes, or whether it managed to reach out to more socially distant sectors that were less likely to cooperate with the protest core. Chart 3 shows two parameters for each cluster, the proportion of communities that were active in the protest and their share in the top quintile of participation. The Core and Mixed Middle communities both exhibited high levels of activation, approaching three-quarters of the working-age population. At the other pole, only around one-quarter of Arab localities were even minimally engaged in the protest. The three other sectors are located roughly in between. The picture is significantly different for high participation. With 43% of their localities in the top quintile, Core communities far outdistanced the Mixed Middle, where this proportion was only 17%. The three most alienated clusters had very few highly mobilized localities (between 3%-7%).

Chart 3: **Percent "active" communities and percent in the top quintile of participation by type of community**

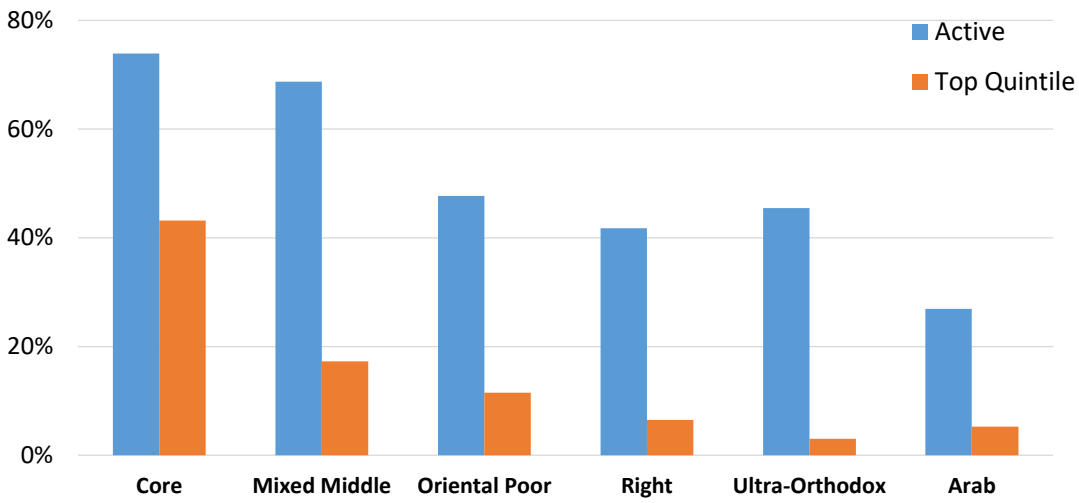


Chart 4: **Distribution of total participations by type of community**

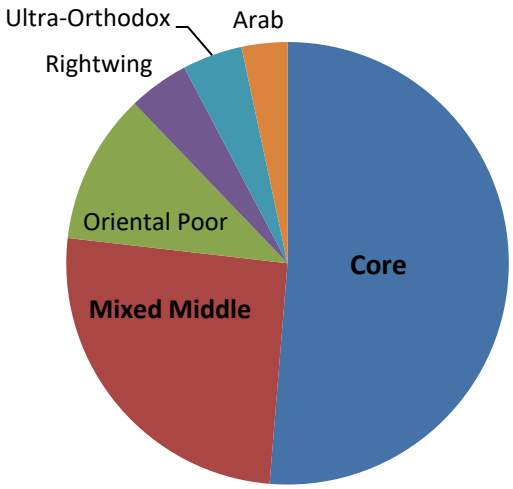


Chart 4 completes this picture by showing the contribution of each sector to the overall number of participations observed throughout the campaign. Just over half of all participations came from Core communities, more than double their share in the population. The Mixed Middle communities contributed 26%, consistent with their population share. The share in the protest of each of the other four sectors was far below their relative size, with the Oriental Poor communities contributing 11% and the other three jointly responsible for the remaining 12%.

These two charts suggest that the protest was indeed dominated by the sector that was most identified with it, namely the communities of the historically hegemonic group that lean to the more affluent, secular and leftist sides of the cleavages that characterize Israeli society. Nevertheless, nearly half of all participations were contributed by other sectors, especially the Mixed Middle and to a lesser extent the Oriental Poor communities. Moreover, despite the counter-pressures that their members had to face, some mobilization was observed even among the sectors most alienated from the protest core. Hence, while the usual cleavages clearly played a significant role in shaping participation in the protest, the unusual coalition that was formed across these divides cannot be dismissed and deserves our attention. However, before looking further into the specifics of this coalition a key issue must be addressed, which is the risk of ecological fallacy.

Testing for the ecological fallacy

The ecological fallacy refers to potentially grave inaccuracies when generalization concerning individuals are inferred from aggregate data. In our research the chief danger lies is that participations observed outside of the Core communities may actually have resulted from the activity of "Core individuals" living in these communities. When the geographical units analyzed are homogeneous, this threat is avoided. One way to achieve such high internal homogeneity is by using very small areas, as illustrated in a recent study of protest participation by Kawalerowicz and Biggs (2015).[16] Our analytical approach, based on identifying distinct types of communities, provides at least a partial solution as most of the types are quite homogeneous. This is especially the case for the Arab and Ultra-Orthodox communities, and to a lesser extent the Right and Oriental Poor sectors. Therefore the main concern is with Mixed Middle communities, which exhibited intermediate levels of participation.

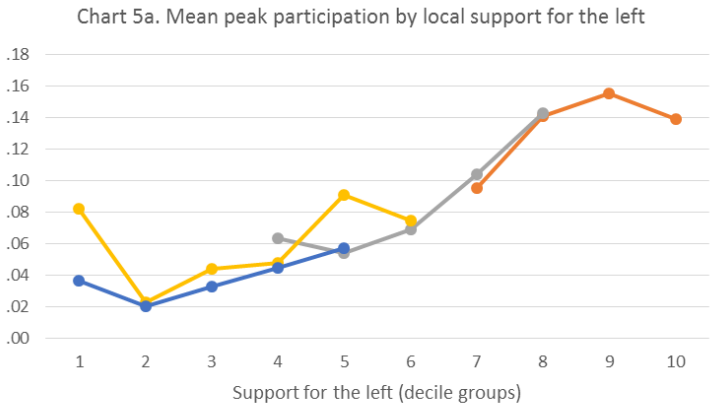
We carried out several tests to evaluate the extent to which our analysis may be prone to the risk of ecological fallacy. The null hypothesis that we seek to rebut is that affluent, leftist and Western-origin Jews dominated the protesting population *even in communities where they are the minority*. If this is the case, the relationship between their presence in a locality and its aggregate level of participation would be stronger in alienated types of communities than in the Core. Charts 5a-c present the mean of our main participation measure (peak participation adjusted for population size) for each cluster,[17] divided by deciles of three covariates: the local socioeconomic index and the shares of leftists and European Jews in the area. Averages were calculated only if there were at least 15 cases in the decile category.

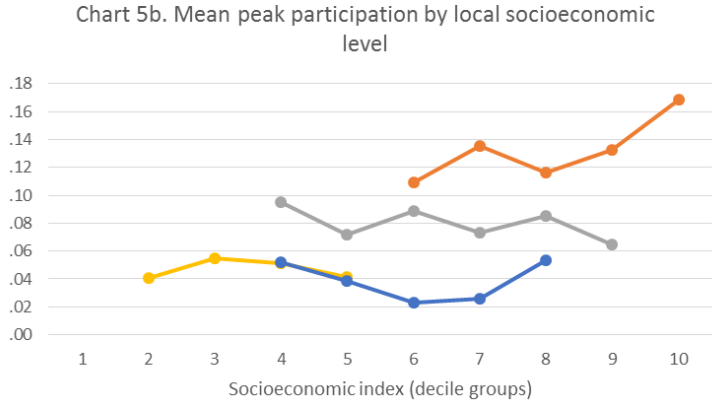
[16] The study by Kawalerowicz and Biggs is based on neighborhood-level data defined at a very high level of spatial resolution. The authors provide evidence that important ecological correlations across geographical units may be understated or even completely obscured if they are calculated using "coarser" (less homogeneous) units. On the other hand, in the absence of behavioral data, their measurement of participation in the London riots of 2011 relied on police reports. Our study represents a different tradeoff – on the one hand, the use of behavioral data on the dependent variable, and on the other, larger and less homogenous geographical units of analysis.

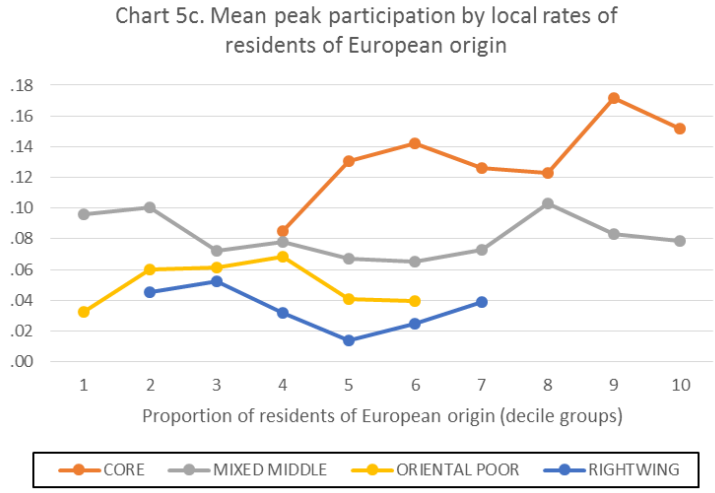
[17] The Arab and Ultra-Orthodox clusters are not shown in these charts, because being homogeneous they are less exposed to erroneous ecological inference. In any event the limited variation of the key variables in these sectors does not allow examining relationships with participation.

Naturally, the different clusters concentrate in specific ranges of the covariates' dispersion, but there are also values that overlap across several types of communities.

Charts 5a-c: **Relationships between community composition and protest participation across clusters**







In these charts rising trend lines imply that mobilization is indeed dependent on the presence of "Core individuals", while flat lines indicate that within-cluster variation in the three drivers has no effect on participation. In the second and third tests the lines are essentially flat *except* in the Core cluster – the opposite pattern to that predicted by the null hypothesis. The effects of class and ethnicity on mobilization in different types of communities (clusters) thus appear to be contextual rather than compositional. The first test presents a different pattern. Leftism is clearly correlated with participation, but this is the case within all clusters – a result which is again inconsistent with the null hypothesis. In addition, at levels of leftism shared by different clusters the slope of the trend-line is generally very similar, suggesting that its effect could be entirely compositional.

These tests however are still based on ecological correlations. In order to directly tackle the behavior of individuals we utilize a survey conducted by the Israel Democracy Institute (IDI) eight months after the protest ended (Hermann et al. 2012). This survey gathered data on self-reported participation in the protest as well as background variables including ethnic origin, political affiliation and education. The downside is that respondents' place of residence is available only at the locality level, rather than in Statistical Areas. Because of the heterogeneity of many large localities, the community type of their respondents is ambiguous. However, we were able to identify 292 adult Jewish respondents living in localities that could reasonably be assigned to one of the three largest clusters, making it possible to examine the participation of respondents with similar characteristics in different local contexts.

The limited size of the sample and the very small number of respondents in most of the 74 localities included in the analysis rule out employing a formal multi-level analysis. Instead, Analysis of Variance was used to estimate the net effect on participation of the individual-level predictors, the type of community and the interaction between the two. We made comparisons between Oriental and European Jews, supporters of different political camps, and respondents with academic versus non-academic education. Significant net differences in participation were found when comparing political camps and levels of education, although not between origin groups. Yet participation differences *between* the clusters were much more profound than the gaps between individuals *within* clusters. In addition, and highly salient to the question of ecological fallacy, no significant interaction effects were found between clusters and covariates. In other words, there is no indication that "Core individuals" made a special effort to participate when they were situated in non-Core settings.[18]

While these findings should be treated with caution, they support our assumption that context has great importance for protest mobilization. The likelihood of individuals with similar characteristics participating depended on the type of community they live in. Nevertheless, the main effect of context might be explained by self-selection into localities, rather than by the impact of population composition on social control and opportunities for interpersonal interaction. While unable to adjudicate between these mechanisms, the findings do allow us to be more confident in the validity of analyzing area-level data. Taken together, the two tests performed here do not support the argument that the participation observed in communities outside of the Core can be explained by the actions of individuals who are

[18] Detailed results are available from the authors.

atypical of their place of residence. With this concern abated, we are ready to return to the substance of our findings.

Temporal and spatial variation in protest

The exceptional advantage of the data utilized in this study is that it makes it possible to examine the impact of variation in protest participation across both time and space at a high level of resolution. By studying where, when and with whom different sectors of the population participated in the course of the campaign, we are able to shed light on what enabled a rare moment of partial coordination and cooperation between conflicting segments of a deeply divided society. The key question is the extent to which the overall diversity of the protesters was achieved by internal segmentation. We now present illustrations of how the pattern of participation by different sectors varied with the timing and location of the large weekly demonstrations.

Chart 6: **Temporal variation in the number of participants in large protest events (bars) and their composition by type of community (area chart)**

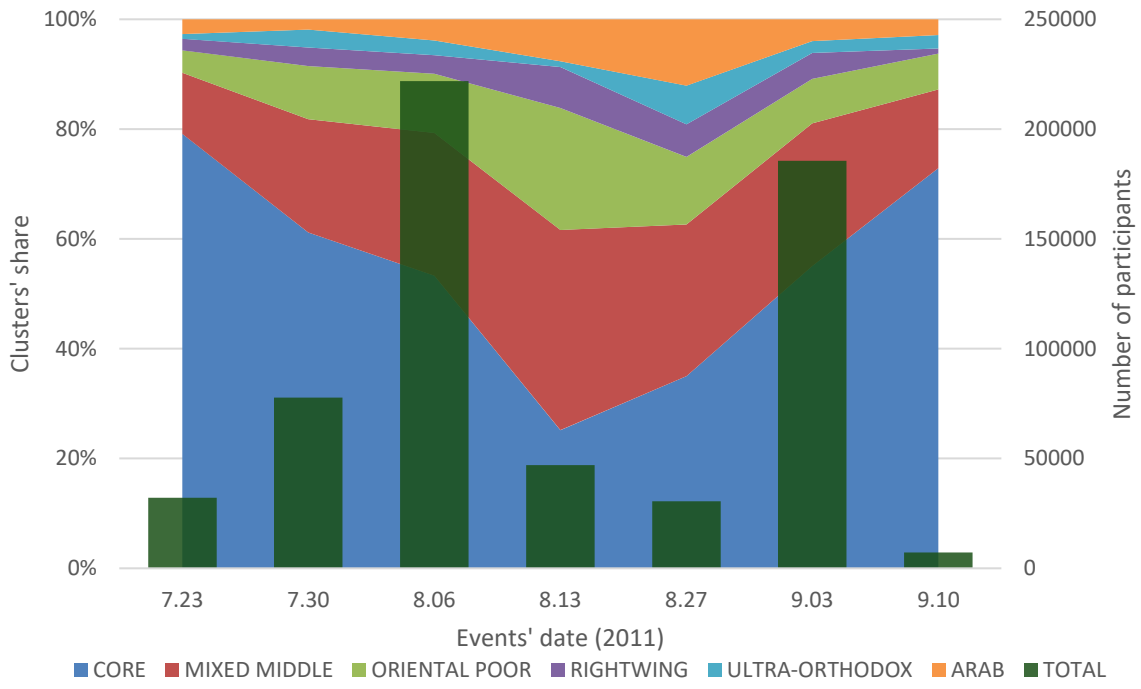


Chart 6 provides information on two different aspects of the temporal dimension: chronological changes in the overall number of participants (represented by the bars, which refer to the right axis), and the share of different types of communities (represented by the stacked area chart, referring to the left axis). The bars document the initial rapid growth of the protest until the first peak on August 6th, followed by several weeks of smaller-scale events, and then the Grand Finale on September 3rd. This dynamic is intriguing, but more interesting is the change in the contribution of the different types of communities to the demonstrations. As has already been emphasized, while the protest was initiated by

the younger generation of Israel's privileged strata, its leaders made explicit and persistent attempts to refrain from partisanship or exclusion. They sent inclusive messages to peripheral groups, particularly the disadvantaged Oriental population, presenting the protest as a fight for the interests of both the middle and lower classes. The most explicit expression of this strategy was the formal designation of one of the weekly demonstrations, on August 13th, as the "protest of the periphery". The regular mega-events in Tel Aviv and Jerusalem were suspended and multiple local events were organized elsewhere in the country.

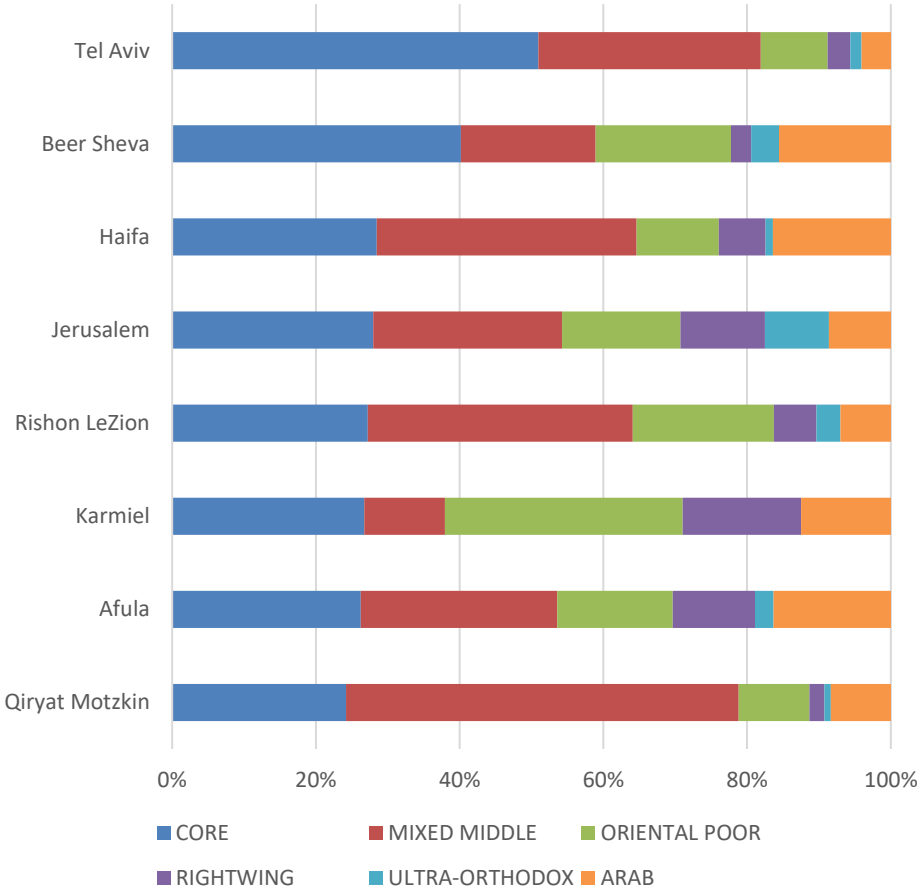
The changing composition of the area chart reveals that over the first three weeks of the campaign the share of the Core group among the demonstrators declined, whereas the role of protesters from most other sectors (particularly the Mixed Middle and Oriental Poor) increased, reaching a peak in the August 13th demonstrations. The Core constituted nearly 80% of the participants in the first mass protest, compared with a low of only 25% once explicit efforts were made to engage additional sectors. However, this diversity was achieved in a relatively relaxed moment of the campaign, when the most enthusiastic members of the Core took part while the moderate majority stayed at home. In any event, the trend towards growing diversification reversed as the protests entered their second month. The contribution of the Core climbed up again and the level of engagement of the other sectors declined, as their suspicion towards the protest and its messengers increased.[19]

We turn now to a key spatial dimension of participation, the question of who protested where. Chart 7 presents the sectoral composition of protesters in eight representative host localities, summed across multiple events where applicable. For each host locality it shows the shares of the six types of sending localities in the total number of non-resident participations.[20] The most conspicuous finding is that while in all but one of the localities the Core and Mixed Middle sectors together accounted for a majority of non-resident protesters, the role of both clusters varied substantially. The contribution of the Core ranged from more than half of the protesters in Tel Aviv to less than a quarter in Qiryat Motzkin, where the Mixed Middle accounted for the majority.

[19] This trend is observable by comparing two Peace Index polls, the first carried out two weeks into the protest and the second a month after that. Whereas the rate of strong support for the protest among those identifying with the left was very high on both occasions, among supporters of the center and right there was a decline of between 15-19 points. Similarly, strong support among observant Jews and FSU immigrants declined precipitously between the two polls, while among secular Jews (Russians excluded) there was only a small decline. (Authors' analysis of datasets available at http://www.peaceindex.org/indexYearsEng.aspx?num=18).

[20] The analysis is limited to non-residents because, as explained earlier, it is not possible to reliably determine whether the presence of residents in the area of a demonstration reflects an intention to participate.

Chart 7: **The composition of non-resident protesters in selected cities**



The variety of the profiles in Chart 7 for localities other than the three protest epicenters further underscores the spatial dimension of protester diversity. Consistent with the hypothesis of segmented solidarity, alienated sectors with very low rates of both total and peak mobilization played a more substantial part in events held in some locations than others. In Jerusalem the smaller sectors combined accounted for 45% of participations, nearly three times their share in Tel Aviv. In Karmiel, a small city in northern Israel, the Oriental Poor and Rightwing clusters contributed relatively high shares (33% and 16% respectively). Finally, due to the absence of accessible protest sites within their own communities, Arabs constituted as much as 16% of the protest body in three all-Jewish localities.

These differences indicate that people from different segments of society, even if supportive of the protest, had different preferences concerning where (and not only when) to actively participate. This may reflect with whom they felt more comfortable expressing their grievances, or the opportunities and information at their disposal. For whatever reason, the outcome was that the protest took on a different socio-political coloring in different locations – evidence for the role of protester segmentation in facilitating cross-cleavage participation.

DISCUSSION

This paper makes two contributions to social movement research, one methodological and the other substantive. On the methodological side, the paper both explains and illustrates how locational big data derived "passively" from the everyday use of cellular devices can be utilized to study the social composition, temporal dynamics and spatial dispersion of mobilization in large-scale protest campaigns. We elaborated on the limitations of traditional methods of measuring protest participation and presented the advantages of behavioral data collected in real time over reliance on surveys based on retrospective self-reports. By avoiding distortions due to sampling shortfalls and biased responses, and by providing exceptional temporal and spatial resolution, the type of big data documented and analyzed in this paper enhances researchers' ability to tackle both old and new questions regarding the dynamics of mass mobilization. At the same time, the new methodology is not without its limitations and uncertainties. It is hoped that the procedures devised for this study will provide a starting point for further refinement by future researchers.

Theoretically, we have emphasized that while "encompassing" protests mobilize an unusually diverse participating public, active engagement is also constrained by pre-existing social cleavages. Predictably, some sectors of society are over-represented while others are under-represented. Following Walgrave and Verhulst (2009), we proposed that the overall diversity of participants (external heterogeneity) may conceal variation in the time and place of participation by different groups (internal homogeneity). The empirical task of probing the interplay between protester diversity and sameness is where the unique features of locational big data come into play, making it possible to examine the composition of participants in different times and locations over the course of a campaign.

The 2011 protest in Israel illustrates the Janus-faced character of encompassing protests. On the one hand, participation was clearly structured by the deep-rooted social cleavages dividing Israeli society. More than half of all participants came from affluent, secular and left or centrist communities dominated by European Jews, the typical profile of the activists and organizers of the protest. Three sectors socially and politically distant from this profile – Ultra-Orthodox Jews, Arabs and strong supporters of the political right – exhibited low levels of mobilization. Nevertheless, two intermediate sectors – mixed middle-class communities, and poor towns or neighborhoods with a majority of Oriental Jews – together contributed almost two fifths of the total number of participations. Even the three most clearly alienated sectors played a part, accounting for roughly one in every eight participations.

Our analysis of differences in demonstrator composition between protest events held at different times and in varying locations revealed systematic patterns of specialization. The core sector was more dominant in the epicenters of the protest (especially its home base in Tel Aviv), and during the first and last phases of the campaign. In contrast, in the intermediate phase mobilization was far more diverse, and distinct sectors played a much larger role in specific events than in the campaign as a whole. By facilitating segmented engagement by diverse social sectors, the 2011 protest constituted a rare moment in Israel's firmly tribal cultural and political life (Kimmerling 2001). More broadly, we assert that the diversity of encompassing protests is made possible not only by de-politicization (detachment from conventional politics), articulation of widely-shared grievances and the adoption of amorphous but

inclusive collective identities. Inclusiveness also rests on the spatial and temporal dispersion of events, which provide opportunities for sympathizers from different social sectors to find the right time and place to get involved.

A deeper understanding of the factors accounting for protester segmentation merits further investigation. We suspect that two researchable variables played a role: the accessibility of events and the match between the sociodemographic composition of sending and hosting localities. Regarding the temporal dynamics of the Israeli campaign, the growing role of initially disengaged sectors during the first phase of the protest appears to reflect efforts by the organizers to reach out to as many social groups as possible. The result was a simultaneous increase in the weight of peripheral groups, and a (temporary) decline in participation by core supporters. Here again, the evidence suggests that behind the scenes of overall diversity lay an implicit division of labor between sectors—a phenomenon that could not be detected without data permitting decomposition of the campaign by time and space.

Note, however, that in contrast to the *tactical diversity* characterizing social movement organizations that utilize different types of political action to reach a common goal, protests resting on temporal and spatial segmentation of participants from different sectors are more likely to reflect *goal diversity*, which has been shown to facilitate mobilization while diminishing its impact on policymakers (Olzak and Ryo 2007). Critics of the Israeli protest (e.g. Alimi 2012) echo this argument, claiming that the inclusive framing of the protest contributed to its short-term success in mobilizing hundreds of thousands of citizens, but also explains its failure to convert mass mobilization into immediate and visible policy change. Nevertheless, as scholars of contentious politics are well aware, the impact of protest on politics and policy is neither immediate nor unmediated. One potentially critical intervening variable is electoral politics. In this connection it is significant that the Israeli social protest "turned out to be a central hero" in the elections held less than 18 months later (Shamir 2015:7; see also Talshir 2015). Advancing our understanding of relations between conventional and nonconventional political action by studying the impact of local mobilization on area-level voting is one of the most promising future applications of the dataset presented in this paper.

Areal and behavioral data of the type utilized in this study can also make an important contribution to evaluating the role of local communities in influencing whether individuals take the leap from "consensus" to "action" (Klandermans 1984). Countless studies have investigated the effects of personal psychological and socio-demographic traits on protest and other forms of political participation, but often without acknowledging the role of the local social and political context (Huckfeldt 1979). One contextual factor with obvious relevance for protest participation is the level of local mobilization. Combining our data on participation and other area-level characteristics with survey data on individual-level participation renders this issue empirically tractable. In future work we intend to pool data from several different nationally-representative surveys. This will enable more reliable examination of both the main effect of local mobilization and how this effect was conditioned by other characteristics of communities, including their social and political composition.

While these and other applications illustrate the novelty and versatility of the type of data introduced in this paper, the scientific contribution of single-country studies is inevitably constrained by questions of

generalizability which cannot be answered without adding a comparative dimension to the research. Encompassing protests are historically rare events, and to the best of our knowledge Israel is the only country implicated in the 2011 wave for which passive locational data are available. Still, it is safe to predict that by the time the next such a wave breaks, big data of this type will not only be more accessible but also more accurate and detailed. If future protest researchers have access to higher-resolution big data, as seems likely, it will be possible for them to study the composition and dynamics of less expansive protests. Researchers need to lay the ground now for richer and more reliable comparisons in the future, by making efforts to adopt standardized protocols and procedures for processing and analyzing the vast quantities of big locational data that are rapidly becoming a central source for studying human behavior. Such standardization will prove vital in facilitating future comparative research.

Appendix 1: The post-processing of positional data on protest participation

The data provider delivered a dataset with estimates of the aggregate number of persons present at 45 demonstrations and their distribution across inferred places of residence. The dataset also includes benchmark observations that are based on the number present at the location and hours of each protest event a week before it occurred. The main task in preparing the data for analysis was to determine how to use the benchmarks for adjusting the gross estimates of protest participation at the time and place of each event.

Since not all people caught in the area of a protest event are active participants, the gross number of observed persons must be adjusted to account for bystanders. The benchmarks provide an indication of the number of people normally present at the area of measurement. Nevertheless not all should be considered as bystanders, since most people with other reasons to be in the area would presumably avoid being there at the time of a protest event unless they have an interest in demonstrating. Thus, the benchmark estimates need to be deflated before subtracting them from the gross estimates of protest participation.

Several considerations were taken into account in this process:

1. The likelihood of active participation from the sending locality.
   Persons from locations whose residents are often observed at demonstrations over the course of a campaign are more likely to be demonstrators. Thus, when a locality has a high rate of overall protest participation, its benchmark is deflated to a greater extent and consequently a larger share of the initial estimate of protest participants is defined as active demonstrators. The likelihood of active participation was estimated using factor analysis of three indicators of strong engagement in the campaign: (1) the ratio between the highest protest observation throughout the campaign and the size of the working-age population, (2) the ratio between the average protest observation and the size of the working-age population, and (3) the ratio between the average protest observation and the average benchmark observation.
2. The distance of the sending locality from the demonstration.
   Given the effort involved, persons who come from afar are more likely to be demonstrators than mere passersby, whereas persons that live in the vicinity of a protest are more likely to be in the area for reasons unrelated to the protest. Thus, when distance from the protest location is high, the benchmark was deflated to a greater extent. The natural log of the distance[21] was used for this purpose, presuming that small differences close to the event's location have a larger effect than the same differences further away from the demonstration.
3. The likelihood that the area of the demonstration hosts other kinds of activities.
   To the extent that activities other than protesting are unlikely to take place, the benchmark is more

[21] To avoid negative values after the logarithmic transformation, a value of 1 was added to all distances before the transformation. The transformed variable ranges between 0 and 6.04.

deflated. Measurement was based on (1) the size of the measurement area[22] (larger size is expected to raise the chances of other kinds of activities), (2) the presence of facilities for commercial and leisure activities in the measurement area (offering more opportunities for non-protest activities), and (3) the accessibility of the area as indicated by bus stops and parking areas (non-protest activities are more likely in more accessible areas). Data on these properties of the receiving locations were gathered and then rated independently by two evaluators on a 5 point scale (with a correlation of 0.7 between the two raters). The average of the two scores was used for calculating the deflation of the benchmarks.

In applying these three considerations it is important to distinguish between two categories of persons observed at the protest events – residents of the area in which the protest took place and all others ("visitors"). In practice the benchmark for residents was only deflated by the first criterion, based on their overall rate of protest participation over the course of the campaign. Because the distance of residents from the protest event is equal to zero, the second criterion would have no effect on their benchmark and was not applied. The third criterion was also not applied to residents, on the grounds that because they live in the area of the demonstration they always have other reasons for being there.

A general problem in implementing the three criteria for benchmark deflation is that there is no way of determining their relative importance. Consequently, multiple versions of the deflation factor were calculated (see Eq. 1 below). Three possible weights were assigned to each indicator, resulting in 27 different combinations for non-residents but only 3 for residents, since only the first indicator was used for calculating their deflation factors. The highest score for the deflation factors in our data matrix is 1, and the lowest ranges between 0.025 using the highest weights to 0.675 using the lowest. After multiplying the benchmark reading by the deflation factor, it was subtracted from the gross protest reading (see Eq. 2 below). This yielded 27 versions of the number of participations from each Statistical Area at each event. After bottom coding (replacing negative values with zeros), the median of the 27 versions of the adjusted number of participants was used for further analysis.

Note that participation among residents was most probably underestimated by this procedure. It essentially identifies an unusually high presence of residents in the area at the time of a protest event, which is taken as a sign of their participation. Since they live in the measurement area it requires only a minimal effort on their part to participate. However, due to their regular presence residents inevitably have high benchmark observations, and there is no way of knowing from the data whether they stayed at home or were in the streets protesting. As a result, our calculation of residents' involvement in the protest almost certainly underestimates their actual participation.

[22] A large measurement area can result from (1) a long protest march and/or (2) an extended measurement area dictated by technical requirements of the system.

Eq. 1. Deflation factors.

Visitors: $DF = 1 - (W_1 * Active_i) - (W_2 * \ln(Distance + 1)_{ij}) - (W_3 * OtherActs_j)$

Residents: $DF = 1 - (W_1 * Active_i)$

DF is the deflation factor; *Active* is a measure of likelihood of active participation from Statistical Area *i*; *Distance* is the distance from Statistical Area *i* to event *j*; *OtherActs* is a measure of likelihood of other kinds of activities to take place in the area of event *j*; W_1 is equal to either 0.01, 0.02 or 0.03; W_2 is equal to either 0.01667, 0.033 or 0.05; W_3 is equal to either 0.025, 0.05 or 0.075

Eq. 2. Net protest participation.

$NetMax_{ij} = GrossMax_{ij} - (Benchmark_{ij} * DF_{ij})$

NetMax is the highest adjusted number of participants from Statistical Area *i* observed at event *j*; *GrossMax* is the highest gross number of persons from Statistical Area *i* observed during event *j*; *Benchmark* is the average number of persons from Statistical Area *i* observed in the area of event *j* a week before the demonstration; *DF* is the deflation factor used to reduce the size of the benchmark.

Appendix 2: Latent Class Analysis of Jewish Localities*

Table A2.1: **Indicators included in the LCA**

Category	Indicator	Operationalization	Format in LCA
Socioeconomic Status	Local socioeconomic index	Scores based on the single substantial factor obtained from Factor Analysis of four variables: percent of residents with academic education; percent of residents in the labor force; average household density; and percent of households with an internet connection	Ordinal variable with three equal categories
Ethnicity	Modal group of shared origin	The modal group was identified based on the distribution of residents between six origin categories: Israel; Europe/America; Asia; Africa; Asia and Africa combined; post-1989 immigrants from the Former Soviet Union	Nominal variable with six categories
Politics	Left	Percent of residents voting for the two leftwing parties (Labor and *Meretz*) in the 2009 general elections	Ordinal variable with three equal categories
	Center	Percent of residents voting for the center party (*Kadima*) in the 2009 general elections	Ordinal variable with three equal categories
	Right	Percent of residents voting for the four rightwing parties (*Likud, Israel Beitenu, Ichud Leumi* and *Mafdal*) in the 2009 general elections	Ordinal variable with three equal categories
Religiosity	Religiosity index	These indicators are based on the first two factors obtained from Factor Analysis of the following eight variables: percent of residents voting for two religious and two Ultra-Orthodox parties (*Mafdal, Ichud Leumi, Shas* and *Yahadut HaTora*) in the 2009 general elections; median age at marriage; average number of children; percent of residents with academic education; percent of residents in the labor force; and percent of households with an internet connection.	Ordinal variable with three equal categories
	Ultra-Orthodoxy index		Ordinal variable with the following five categories based on percentile ranking: bottom 30%, 30%-50%, 50%-70%, 70%-90%, and top 10%.
Settlements	Settlements in the Occupied Territories		Dichotomous variable

* Except for the voting data, all variables are based on the 2008 Census.

Table A2.2: **LCA conditional probabilities by cluster**

	CORE	MIXED-MIDDLE	ORIENTAL-POOR	RIGHTWING	ULTRA-ORTHODOX	Overall Distribution
Modal Origin Group						
Israel	.04	.00	.01	.03	.42	5%
Europe-USA	.83	.27	.06	.25	.40	42%
Asia	.02	.22	.19	.05	.05	11%
Africa	.00	.23	.51	.15	.08	19%
Asia+Africa	.11	.26	.13	.19	.04	16%
FSU	.00	.02	.10	.33	.00	6%
Socioeconomic Index						
Low	.00	.15	.96	.12	1.00	33%
Mid	.14	.71	.04	.70	.00	33%
High	.86	.14	.00	.18	.00	33%
Left Bloc Support						
Low	.00	.02	.73	.82	.96	33%
Mid	.07	.86	.27	.18	.04	33%
High	.93	.12	.00	.00	.00	33%
Center Bloc Support						
Low	.00	.05	.75	.70	1.00	33%
Mid	.15	.72	.25	.29	.00	33%
High	.85	.24	.00	.00	.00	33%
Right Bloc Support						
Low	.80	.04	.00	.00	.85	33%
Mid	.20	.74	.29	.00	.15	33%
High	.00	.22	.71	1.00	.00	33%
Religiosity Index						
Low	.40	.38	.24	.28	.21	33%
Mid	.36	.35	.33	.21	.36	33%
High	.24	.26	.43	.51	.43	33%
Ultra-Orthodoxy Index						
Bottom 30%	.79	.09	.00	.19	.00	30%
30-50	.19	.34	.00	.39	.00	20%
50-70	.02	.48	.10	.36	.00	20%
70-90	.00	.10	.77	.06	.01	20%
Top 10%	.00	.00	.12	.00	.99	10%
Settlements						
0	.99	.99	.97	.77	.90	95%
1	.01	.01	.03	.23	.10	5%
Cluster Size	**32%**	**27%**	**21%**	**12%**	**7%**	

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