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Using a Geographic Segmentation to Understand, Predict, and Plan for Census and Survey Mail Nonresponse

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The 2010 U.S. Census used a multimode response model with the first phase being a mailout/mailback and the second being a personal visit follow-up. Knowing which segments of the population are predisposed to mail back a form is essential to develop methods to maximize census participation and to plan for and monitor areas of nonresponse. In this article, we describe a geographic segmentation of survey and census response focused on the underlying constructs behind census tracts with historically low mail response rates. We perform a cluster analysis based on twelve demographic, housing, and socioeconomic variables used to calculate a "hard-to-count" score. This yielded eight mutually exclusive geographic clusters of the population that varied across the spectrum of mailback propensities. Each segment is distinguished by unique demographic, housing, and socioeconomic characteristics and several segments are closely aligned to three different hard-to-count profiles.

To gauge how the segments performed in terms of recent mail response behavior, we examine several outcome measures with data from the 2010 Census and the American Community Survey collected in 2009 and 2010. To conclude, we discuss the usefulness of extending this geographic segmentation model beyond the census to targeted experiments and other applications in demographic surveys.

Key words: Hard-to-count populations; social marketing; cluster analysis.

1. Introduction

The overriding goal in the U.S. Decennial Census is to count every person residing in the U.S. as of April 1 of the census year. To achieve this goal, the U.S. 2010 Census employed a multi-mode response model with the first phase being a mailout/mailback and the second being a personal visit nonresponse follow-up. This effort was aided by a massive social marketing campaign designed to increase awareness and participation. The campaign consisted of paid media, public relations, a partnership program with

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national, state, and local community organizations, and a Census in Schools Program. The campaign was one of the most far-reaching social marketing campaigns ever conducted in the U.S. It included promotional materials and advertising produced in 28 languages and leveraged multiple media channels including television, radio, newsprint, and social and digital media. This effort was known as the 2010 Census Integrated Communication Program or ICP (see U.S. Census Bureau 2010).

As in the case of most social marketing campaigns, resources for the 2010 Census were limited and had to be allocated effectively to achieve the campaign goals and maximize return on investment. Because census mail returns are a much cheaper way to count households and also provide better quality data than data collected during personal visit follow-ups, maximizing mail returns was one of the primary 2010 Census campaign goals (see U.S. Census 1966 and Taeuber and Hansen 1964 for historical research on census "enumerator variability" and data quality compared to self-reports). To illustrate this point, the U.S. Census Bureau has estimated that a single percentage increase in mail returns translates to roughly 85 million dollars saved in personal follow-up costs (U.S. Census Bureau 2008).

A segmentation strategy is essential for social marketing and commonly cited as a first step when building public information campaigns (Rimal et al. 2009; Moss et al. 2009; U.S. Department of Health and Human Services 2005; Albrecht and Bryant 1996; Williams and Flora 1995; Fine 1980). It allows a campaign to know what populations need the message most, where to deliver the message, how to tailor the message, and what media channel is most effective to deliver the message. For example, if a population segment is primarily urban-dwellers who use a great deal of public transportation and speak English as a second language, the campaign might choose to develop non-English print advertisements displayed in out-of-home venues such as billboards, train stations and bus shelters.

The 2010 Census campaign was no exception – knowing which segments of the population are predisposed to mail back a form (and which are not) is essential to develop methods to maximize census participation and to plan for and monitor areas of nonresponse. One approach to build such a segmentation model is to leverage community-level socioeconomic and environmental indicators to understand the survey response process. For example, in an effort to evaluate nonresponse in a telephone survey, Johnson et al. (2006) used zip-code level indicators as a macro-level approach to predict survey participation, noncontacts, and refusals. Such an approach builds from the conceptual framework for survey cooperation described in Groves and Couper (1998) whereby the social environment and household(er) characteristics of the population are hypothesized to influence survey participation. Elements under these two constructs include economic conditions, neighborhood characteristics, household structure, and socio-demographic characteristics.

Our approach was to undertake a macro-level analysis in order to devise a comprehensive geographic-based population segmentation defined by unique demographic, housing, and socioeconomic variables. The end goal was to more fully focus on and understand why some areas are more or less predisposed to census and survey participation and, more importantly, how the 2010 campaign could leverage this knowledge to effectively target and plan 2010 Census campaign efforts.

2. Data: The 2000 Planning Data Base (PDB)

To build the segmentation, we chose census tracts rather than households as our unit of analysis. Census tracts average about 4,000 inhabitants and are relatively permanent statistical subdivisions of a county. Tracts are designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions. The first reason for selecting tracts was that, as described below, a tract-level database for the entire U.S. was available to us at the time of the study. Second, in the U.S., advertisers purchase broadcast media according to a geographic unit known as a designated market area or DMA. DMAs correspond to geographically clustered counties receiving the same broadcast signals. Consequently, since media purchases are not made at the household level, tracts as the segmentation unit facilitated understanding segment distributions at the DMA level, but were small enough to aid in planning field nonresponse follow-up.

The source of the data used in the analyses is the U.S. Census Bureau 2000 Planning Database (PDB) which is populated by the Census 2000 long form data. The PDB is a tract-level database that is publicly available and contains a range of housing, demographic, and socioeconomic variables correlated with mail response (Bruce and Robinson 2006; Robinson et al. 2007). The 2000 PDB contains all tracts with population and housing units in the Census 2000 mailout/mailback universe. After excluding nonrepresentative tracts, our dataset for analysis contained 62,708 tracts within the 50 states. This PDB also contains the Census 2000 mail return rate for each tract. The mail return rate is defined as the percentage of occupied housing units eligible to receive a mail form that returned a form. This yielded a macro-level indicator of mail behavior by tract.

In addition to housing and socioeconomic indicators, the PDB also contains the "hard-to-count" (HTC) score (Bruce et al. 2001; Robinson et al. 2007). U.S. Census Bureau demographers developed this score after the 1990 Census as a way to profile census tracts according to mail response propensity (Bruce and Robinson 2003). The HTC score for each census tract is based on twelve variables highly correlated with census mail response and scores range from 0–132 for any given tract. The twelve variables that comprise the score are:

- % vacant units
- % nonsingle family attached/detached units (density of housing units)
- % renter occupied units
- % units with >1.5 persons per room (crowding)
- % nonspousal units
- % units without phone
- % people below poverty level
- % units receiving public assistance
- % people unemployed
- % linguistically isolated households
- % moved within last year
- % adults without high school education.

Taken alone, HTC scores are effective to see *where* the difficult tracts are, that is, the tracts with low mail return rates relative to the national average in 2000. However, we were interested in the underlying constructs behind the tracts with below average mail return

rates. Consequently, we sought to uncover fundamental *differences* between HTC areas as a way to inform the campaign and better target messages, public relations activities, media, and advertising. A similar approach was applied by Lastovicka et al. (1987) to understand lifestyle segmentations in order to develop message content in an anti-drinking-and-driving campaign.

3. Cluster Analysis

3.1. Forming the Clusters

Using data from the 2000 PDB, we performed a cluster analysis. This grouped each and every tract into one of several mutually exclusive clusters creating a multidimensional classification typology reflecting different mailback propensities and categories of the twelve HTC variables. Our study used the SAS procedure FASTCLUS to perform a disjoint cluster analysis based on distances computed using the twelve hard-to-count score variables. The FASTCLUS procedure uses Euclidean distances so the cluster centers are based on least-squares estimation. The method is sometimes called the k-means model, since the cluster centers are the means of the observation assigned to each cluster.

The intent of the classification (Hartigan 2006) with the cluster analysis was to produce a segmentation that would aid the design and implementation of the 2010 Census ICP. We imposed several requirements on the cluster analysis. First, all clusters needed to be large enough to enable further study for purposes of the 2010 ICP in terms of media preferences, communication habits, response barriers, and 2010 Census motivators. Second, the clusters needed to be easily interpretable by those who were involved in implementing various aspects of the 2010 Census, such as staff in the field and in the communication program. Third, the clusters should be heterogeneous in terms of historical mail return rates and HTC scores. Since the mail return rate was not used in forming the clusters, a wide range would indicate the clusters captured a differentiation in the mail response behavior.

The decision to use all twelve variables in the cluster analysis, rather than a subset, leveraged earlier research when designing the HTC scores. Although a few pairs of the twelve variables had some correlation, no two of them measured exactly the same thing. The HTC scores better reflected the level of difficulty when the pairs of variables that had some correlation were both included. Also, our interests lay more with variables that described hard-to-count areas; thus we did not attempt to include variables describing easier-to-count areas (e.g., percent with college degrees).

We performed exploratory analysis specifying several different numbers of clusters but eventually settled on eight. In line with our goals, the choice of eight clusters produced clusters distinct enough that they could be logically named according to their differences from (and in some cases similarity to) one another. In three instances, pairs of clusters appear closely related to one another with homeownership/renter status as the distinguishing feature. This variable was deemed an important characteristic upon which to delineate segments since owner/renter status has historically proven to be a very strong predictor of Census mail participation and Census undercounts (Stackhouse and

Table 1. Mail Return Rate, Number of Tracts, and Occupied Housing Units by Cluster

#	Cluster name	Census 2000 mail return rate	Total occupied housing units		Number of tracts
			Number (in millions)	Percent	
1	All around average I (homeowner skewed)	77.3%	36.5	35	21,174
2	All around average II (renter skewed)	74.2%	16.5	16	8,957
3	Econ. disadvantaged I (homeowner skewed)	66.5%	6.6	6	5,230
4	Econ. disadvantaged II (renter skewed)	58.0%	3.0	3	2,574
5	Ethnic enclave I (homeowner skewed)	69.8%	3.4	3	2,440
6	Ethnic enclave II (renter skewed)	63.6%	2.5	2	1,754
7	Young/mobile/singles	67.1%	8.0	8	4,073
8	Advantaged homeowners	83.2%	26.8	26	16,506
	Total	75.4%	103.3	100	62,708

(Source: Census 2000 Planning Database tract-level analyses).
Note: The mail return rate is the percentage of occupied housing units eligible to receive a mail form that returned a mail form.

Brady 2003; Word 1997; Hogan 1993). The largest of the eight groups represented 35% of all occupied housing units, the smallest only 2%.

Table 1 clearly illustrates that the clusters achieved the requirement of capturing the variation in mail return rates and shows where the low, medium, and high mail response tracts were located. In addition, each cluster had enough tracts to make further studies for the 2010 ICP feasible. The choice of eight clusters produced an R-squared of 0.72, indicating that the difference between groups captured by this solution is reasonable, particularly when the solution satisfies external validation by exhibiting differences in mail return rates (Sharma 1996). Other choices of the number of clusters did not satisfy all requirements for implementation.

Based on the means of the tract values (Bates and Mulry 2008a, Appendix B), the HTC scores, and other variables available in the PDB, the clusters were interpreted as follows:

3.1.1. All Around Average I (Homeowner Skewed)

This group has the largest number of occupied housing units and had the second highest mail return rate in Census 2000 (77.3%). Tracts in this cluster are close to average on every one of the hard-to-count variables. Around 28% of the housing units are not single-family structures, only one-quarter are renters, and slightly less than half (45%) are in nonspousal households.

In this cluster, unemployment, poverty, education and mobility levels are all close to national averages. The tracts are fairly representative of the national average racial breakouts but have above-average percentage of non-Hispanic Whites (80%), slightly

below-average percentage of Blacks (9%), 2% Asian or Native Hawaiian/Pacific Islander (NHPI), and 1% American Indian/Alaska Native (AIAN). Tracts in this cluster contain about 7% Hispanics which is well below the national average. Around one-quarter of the population is under age 18 and about 15% are over 65. This group is the largest cluster, representing about 36.5 million occupied housing units (about 35% of the total). This cluster has the largest percentage of rural tracts (on average around 37% are rural).

3.1.2. All Around Average II (Renter Skewed)

Cluster 2 is also somewhat unremarkable and "average" on most of the hard-to-count variables. About the only distinguishing characteristic is an above-average number of households renting and in multi-units. This group of tracts is slightly more racially diverse than Cluster 1 (12% Black 11% Hispanic, and 69% non-Hispanic White) and is also much more urban and densely populated. Like Cluster 1, this group is relatively large (represents around 16% of all occupied housing units). Tracts in this cluster had close to average mail return rates in Census 2000 (74.2%).

3.1.3. Economically Disadvantaged I (Homeowner Skewed)

This cluster reflects households that are economically disadvantaged. One noticeable difference is that this cluster has fewer renters than Cluster 4 (less than half rent – 46%). Nonetheless, households in these tracts have a high percentage in poverty, receiving public assistance, and adults without a high school education. Above-average unemployment and nonspousal households are also characteristics of this cluster. Blacks comprise about one-half (49%) of the population in these tracts – the second largest Black population next to Cluster 4. This cluster has above-average number of children (29% are younger than 18). This group represents about 6% of the total occupied housing units. The overwhelming majority of tracts in this cluster are urban (92% urban on average). This cluster had mail return rates in Census 2000 that were well below average (66.5%).

3.1.4. Economically Disadvantaged II (Renter Skewed)

The economically disadvantaged renter cluster had the lowest mail return rate of any group (58.0%). Close to three-quarters of the households in these tracts contain non-spousal renters in multi-units (especially 10+ units). These tracts also have the highest poverty, public assistance, and unemployment of any cluster. This cluster most closely resembles Cluster 3 but has far fewer homeowners (on average 81% of households are renters). Like Cluster 3, this group contains a higher-than-average percentage of Blacks (54%) but also has an above-average percentage of Hispanics (21%). This cluster reflects the most urban of all clusters (99.9% urban on average). This cluster represents about 3% of the total occupied housing units.

3.1.5. Ethnic Enclave I (Homeowner Skewed)

This cluster is characterized by above-average crowding and poverty, public assistance, unemployment and low education. However it also contains a *below-average* percentage of nonspousal households and above-average percentage of children. It looks most like Cluster 6, with the following differences: lower occurrence of linguistic isolation, lower mobility, higher homeownership, and fewer Asians. This cluster is also less urban and less

densely populated than Cluster 6. This group is predominantly Hispanic (61%), with 24% non-Hispanic White, 8% Black, and 5% Asian or NHPI. Tracts in this cluster had below-average mail return rates (averaging 69.8%).

3.1.6. Ethnic Enclave II (Renter Skewed)

Cluster 6 had the second lowest mail return rate at 63.6%. This cluster has above-average presence of children and is characterized by multi-unit structures with at least ten units. This group is exclusively urban, the most densely populated of clusters, and characterized by crowded housing. On average, half of the persons residing within this cluster lack high-school degrees. These tracts are predominantly composed of Hispanics (59%) and Asians (11%), with only 19% non-Hispanic White, 9% Black, and 1% AIAN.

This cluster contains tracts with high levels of linguistic isolation (on average, around 31%). In some tracts, this ranges as high as 79% of households where Spanish is spoken at home and no household member 14 or older speaks English very well. Likewise, other tracts have as high as 74% of households where an Asian/Pacific Islander language is spoken at home and no household member over 14 speaks English very well. This group is overwhelmingly renters (75%). It also has high rates of poverty, unemployment, and public assistance. This is the smallest of the eight clusters, representing only 2% of the total occupied housing units.

3.1.7. Single Unattached Mobiles

This cluster had a similar mail return rate as the economically disadvantaged homeowner skewed cluster but upon closer inspection looks very different. The overwhelming majority of households are nonspousal renters located in multi-units (especially structures with at least ten units). Persons residing in these tracts have higher than average education along with very high mobility. The tracts are densely populated and almost exclusively urban. These tracts have a below-average percentage of children (17%). This cluster has a relatively high percent of group quarters (4%), possibly reflecting college campuses. These tracts may include a disproportionate share of younger singles in school or just out of school and into the workforce for the first time. This cluster is racially diverse, with a slight majority non-Hispanic White (59%), followed by Blacks (17%) and an above-average percentage Asian (7%). This group represents about 8% of the total occupied housing units.

3.1.8. Advantaged Homeowners

The tracts in Cluster 8 had the highest mail return rate (83.2%) in Census 2000. As such, these tracts have a very low percentage of renters, few multi-units structures, very low levels of poverty and unemployment, low mobility, and few nonspousal households. This cluster is indicative of stable homeowners who reside in spousal-households in single-unit houses, about one-quarter of which are located in nonurban areas. This group of tracts is the least racially diverse of all clusters, with 85% non-Hispanic White and only 4% Black, 5% Hispanic, 4% Asian or NHPI and less than 1% AIAN. It is also the least densely populated cluster as measured by population per square mile. This group is the second largest behind Cluster 1, reflecting 26% of the total occupied housing units.

To illustrate how certain segments tend to be concentrated throughout the U.S., we created a map of the eight clusters (not shown – see Bates and Mulry 2008b for color map). We found the advantaged homeowners were particularly noticeable in the Midwest and along the North Atlantic seaboard while clusters of the economically disadvantaged were apparent in the South along the Arkansas/Mississippi border. As might be expected, some of the ethnic enclave clusters could be seen in California, Arizona, New Mexico and Texas. From this illustration, it became apparent how the segmentation could be used to inform media buys across different DMAs. For example, the DMA that included the city of Boston, Massachusetts, skewed high on single unattached mobile tracts compared to the DMA that included Philadelphia, Pennsylvania, which in turn skewed more toward the economically disadvantaged than the Sacramento/Modesto/Stockton, California, DMA that skewed high on ethnic enclave segments.

In summary, the cluster analysis revealed eight segments, five of which had below-average mail return rates from the previous census and above-average HTC scores. Among these five, three distinct profiles emerged – (1) underserved clusters containing economically disadvantaged households, (2) clusters containing more densely populated ethnic minorities, and (3) a cluster that skewed toward unattached younger mobile singles. From these descriptions, one can begin to hypothesize the different reasons for lower response – for example, ethnic enclave segments contain newly arrived immigrants and thus likely have language barriers, unfamiliarity with the U.S. Census, and perhaps fear of government, especially among the undocumented. On the other hand, the segment containing the young, highly mobile population may also be unfamiliar with the census (having been too young to participate before), but may also be harder to contact because they are seldom at home. They may also be more likely to discard a mail form as they rarely use the postal mail as a means of communication, favoring mobile technologies such as cellular phones. This segmentation scheme served as the foundation for understanding the nuances between populations having traditionally low mailback rates and how the communication campaign could leverage these nuances to devise different strategies and interventions to engage them.

4. 2010 Census Mail Response by Cluster

The segments described above represented the framework for planning various aspects of the 2010 ICP, including the targeting and placement of paid media, the selection of media platforms, and the tailoring of messages (U.S. Census Bureau 2008). In this section, we track recent mailback data from the 2010 Census and the 2009 and 2010 American Community Survey (ACS) to assess the segmentation strategy. This allows us to validate the segmentation as a legitimate planning tool. For example, was the mail behavior of the clusters as expected? Were patterns of behavior similar or different in the context of a decennial census versus a national mail survey? Did the patterns hold across different geographic regions? The second reason for examining mailback outcome measures against the segments is to learn about aspects of the 2010 Census and how they worked among HTC populations. Was there evidence of the communications campaign having an impact in HTC populations?

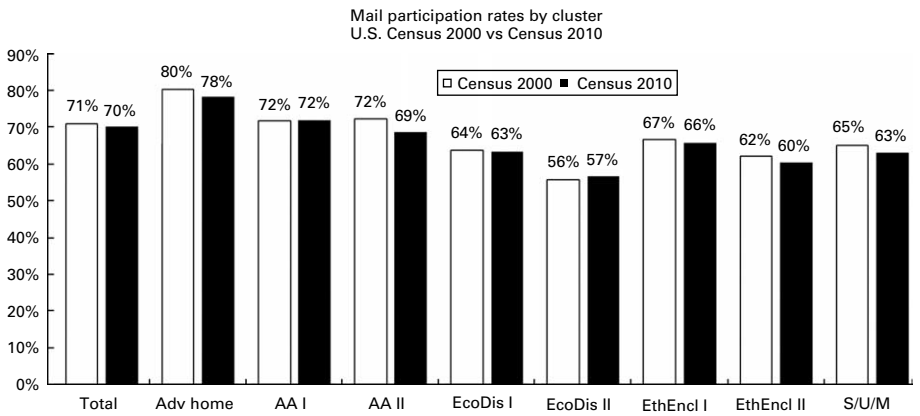

Fig. 1. Mail Participation Rates by Cluster U.S. Census 2000 vs Census 2010. (Source: U.S. Census Bureau Center for Economic Studies 2010 Census participation data files. Data as of April 19 in 2010 and April 18 in 2000, the date of first cut for personal visit follow-up in each census)

In Figure 1, we compare census mail participation by cluster for the 2000 versus 2010 Census. This determines how well the segmentation model held up ten years later. For this analysis we use the census mail participation rate. The numerator for the participation rate is the number of forms mailed back, while the denominator is the number of forms in the mailout universe *minus* forms returned to the post office as "undeliverable as addressed" (or UAAs). Participation rates were calculated for the whole population and used as a real-time tool during the 2010 Census to make operational decisions. For purposes of this analysis, we used April 19 as the cutoff date for mail returns. This was the first cutoff date for creating the personal visit nonresponse universe. The comparable cutoff date in 2000 was April 18. Participation rates reported here do not reflect official and final 2010 Census mail return rates.

The *pattern* of mail participation observed across the segments in the 2010 Census is extremely close to that observed ten years earlier. As expected, the advantaged homeowner cluster had the highest participation rate and the five HTC clusters had the lowest. This is an encouraging sign that the relative pattern of response for the geographic segmentation remained consistent across the two censuses. Despite population shifts in the clusters and possible changes in the propensity to respond across new and old residents, the geographic segmentation scheme still worked at a macro level ten years later to predict high, medium, and low mailback areas. Not only did the pattern remain stable but the Census 2010 rates were also very close to the Census 2000 rates. In all cases but one, mail participation across clusters was the same or only a few percentage points lower in 2010. The one exception was for the economically disadvantaged (renter skewed) segment which was one percentage point higher in 2010. By itself, this is a remarkable finding given the steady and growing decline in response to surveys over the last two decades (Atrostic et al. 2001; de Heer 1999).

To investigate if the pattern of response was consistent for clusters in different geographic areas, we examined mail participation rates by cluster for each of the twelve Census Regional Offices (ROs) shown in Table 2. Historically, mailback rates fluctuate by RO during the decennial census and in ongoing demographic surveys. Census 2010 was no

Table 2. Census mail participation rates in 2000 and 2010 by region by cluster

	Atlanta		Boston		Charlotte		Chicago	
Cluster	2000	2010	2000	2010	2000	2010	2000	2010
Adv Hmown	78.5	75.8	80.7	79.3	78.4	79.2	83.0	81.9
AA I	67.7	70.5	73.6	73.8	66.7	74.6	79.8	77.3
AA II	68.5	66.1	73.4	69.4	70.7	69.3	75.7	72.2
EcoDis I	61.4	62.9	68.2	63.3	63.5	67.4	65.7	65.2
EcoDis II	53.2	54.8	57.4	55.8	56.3	59.1	51.9	53.5
EthEncl I	66.2	69.1	63.1	64.3	56.6	65.0	64.3	66.5
EthEncl II	64.6	67.0	54.2	54.3	64.0	63.2	50.9	53.4
S/U/M	61.9	58.8	65.5	63.9	65.1	63.3	65.9	65.3
	Dallas		Denver		Detroit		Kansas City	
Cluster	2000	2010	2000	2010	2000	2010	2000	2010
Adv Hmown	77.1	74.3	77.5	76.2	84.7	81.6	80.6	79.9
AA I	65.5	66.4	70.5	67.9	76.5	74.1	72.7	70.6
AA II	69.4	65.0	70.4	67.5	77.5	72.4	75.2	71.4
EcoDis I	62.2	60.0	62.9	62.2	65.5	63.2	65.1	63.1
EcoDis II	51.8	48.0	54.3	58.4	57.9	57.2	57.6	60.2
EthEncl I	63.4	63.9	61.9	62.4	60.2	56.0	60.9	59.7
EthEncl II	55.3	57.4	56.2	58.9	51.1	52.1	62.3	63.3
S/U/M	61.3	56.3	65.2	62.9	69.3	64.5	67.3	66.8
	Los Angeles		New York		Philadelphia		Seattle	
Cluster	2000	2010	2000	2010	2000	2010	2000	2010
Adv Hmown	80.5	74.8	80.3	74.8	81.1	80.0	79.9	77.3
AA I	75.3	69.8	72.2	66.6	76.2	75.5	74.2	72.6
AA II	73.7	67.9	65.9	61.9	74.4	71.4	73.1	70.4
EcoDis I	68.9	65.3	52.4	51.4	61.6	61.8	66.6	66.1
EcoDis II	62.2	59.2	55.4	56.8	57.0	59.0	56.6	58.9
EthEncl I	72.5	68.2	53.6	51.7	60.6	64.6	69.0	67.7
EthEncl II	68.2	63.8	59.6	57.1	57.6	59.7	64.1	64.1
S/U/M	68.9	63.8	62.2	62.1	66.2	65.5	67.6	66.3

(Source: U.S. Census Bureau Center for Economic Studies 2010 Census participation data files dated April 19, 2010).

exception, with the highly urban and coastal ROs of Los Angeles and New York having lower mailback rates than, for example, the Midwest RO of Chicago. However, within each RO, the relative pattern for mail response across clusters was very similar in 2000 and 2010. The basic pattern between HTC clusters and easier to count clusters seen at the national level was replicated within the ROs with only a few exceptions. Advantaged homeowners had the highest participation rate in every RO in 2000 and 2010. The cluster with the lowest participation rate in every RO was either economically disadvantaged (renter skewed) or ethnic enclave (renter skewed). It is interesting to note that a few HTC clusters surpassed their mail participation rates of Census 2000. For example, in the Atlanta region, both the ethnic enclave segments had higher rates in 2010 than 2000, as did

the economically disadvantaged and ethnic enclave (homeowner skewed) clusters in the Charlotte region. Alternatively, a few HTC segments also underperformed compared to Census 2000, notably the single unattached mobile cluster in the Dallas region and both ethnic enclave clusters in the Los Angeles region. The presence of such nuanced differences within region points to using the segmentation scheme at a subnational level for further planning, refining, and predicting mail nonresponse.

5. The American Community Survey: Another Evaluation Tool

Fortunately, we have mail response results from a national demographic survey without the luxury of a massive communications campaign to use as a tool in further evaluating the geographic clusters and, in an indirect way, assessing the 2010 Census communications campaign. This survey is the U.S. Census Bureau's American Community Survey (ACS) (U.S. Census Bureau 2009). The ACS is conducted every month by the U.S. Census Bureau as a replacement for the decennial census "long form" used in previous censuses. A few days before the first day of each month, the ACS mails questionnaires to a sample of 250,000 housing unit addresses. The ACS employs a mail strategy that includes mailing a prenotice, the questionnaire, a reminder card, and a second questionnaire to addresses that did not return the initial questionnaire. This is a mail implementation strategy very similar to the one used in the 2010 Census. However, the ACS is a more burdensome data collection that requires about 45 minutes to complete (the 2010 Census took only ten minutes).

Table 3. March Panel ACS mail check-in rates in 2009 and 2010 by cluster

Cluster	Check-in rate 2009	Check-in rate 2010	Change in check-in rate	Percentage change
Adv H owner	61.1	64.7	3.6	5.9
	(0.4)	(0.2)	(0.8)	(0.8)
AA I	50.2	54.5	4.3	8.6
	(0.4)	(0.2)	(0.8)	(1.0)
AA II	47.1	53.4	6.3	13.3
	(0.5)	(0.4)	(1.0)	(1.4)
Eco Dis I	33.1	39.1	5.9	18.0
	(0.8)	(0.5)	(1.3)	(3.1)
Eco Dis II	26.7	34.3	7.5	28.2
	(1.1)	(0.6)	(1.6)	(6.1)
Eth Encl I	31.0	36.4	5.4	17.4
	(1.2)	(0.6)	(1.6)	(5.2)
Eth Encl II	24.4	31.6	7.2	29.3
	(1.2)	(0.6)	(1.6)	(6.6)
S/U/M	42.5	50.0	6.5	15.3
	(0.8)	(0.4)	(1.2)	(2.4)
Total	48.1	53.2	4.9	10.3
	(0.2)	(0.1)	(0.5)	(0.5)

Source: 2010 ACS Mail Check-in Final Control File.
Check-in rates and standard errors for 2009 and 2010 were calculated 90 days after forms were mailed. March mail responses were received in March, April, and May.

Table 4. April Panel ACS mail check-in rates in 2009 and 2010 by cluster

Cluster	Check-in rate 2009	Check-in rate 2010	Change in check-in rate	Percentage change
Adv H owner	59.8	57.4	−2.4	−4.1
	(0.2)	(0.2)	(0.7)	(0.5)
AA I	49.7	47.9	−1.7	−3.4
	(0.2)	(0.2)	(0.7)	(0.6)
AA II	47.0	47.2	0.2	0.5
	(0.3)	(0.3)	(0.8)	(0.9)
Eco Dis I	32.9	31.3	−1.6	−4.8
	(0.4)	(0.5)	(1.0)	(1.9)
Eco Dis II	25.6	24.5	−1.0	−4.0
	(0.5)	(0.6)	(1.1)	(2.8)
Eth Encl I	29.0	29.3	0.2	0.8
	(0.5)	(0.5)	(1.2)	(2.6)
Eth Encl II	24.9	25.9	1.0	4.0
	(0.6)	(0.6)	(1.3)	(3.6)
S/U/M	41.2	42.8	1.6	3.8
	(0.4)	(0.4)	(0.9)	(1.3)
Total	47.3	46.3	−1.0	−2.1
	(0.1)	(0.1)	(0.5)	(0.3)

Source: 2010 ACS Mail Check-in Report Final Control File.
Check-in rates and standard errors for 2009 and 2010 were calculated 90 days after forms were mailed. April mail responses were received in April, May, and June.

To understand the mail behavior of the clusters absent the decennial census environment, we purposely selected mail check-in rates from the March 2009 and April 2009 ACS – one year removed from the height of the 2010 Census communication activities. The mail check-in rate is defined as the ratio of addresses responding by mail to the total addresses in the mail out. In Column 1 of Tables 3 and 4 we present check-in rates for March and April 2009, respectively.

5.1. ACS Mail Response by Cluster

The first column in Table 3 shows that the pattern of mailback behavior across clusters from the March 2009 ACS is very differentiated, with large gaps between some clusters. Clusters we expected to have a higher mail check-in rate indeed did so, and those expected to have below-average mail check-in performed accordingly also. For example, the economically disadvantaged (renter skewed) and ethnic enclave (renter skewed) clusters had similarly low mail check-in rates (27 and 24 percent, respectively) compared to the much higher performing cluster of advantaged homeowners (check-in rate of 61 percent). The same pattern of differentiation across the segments also appears in the April 2009 ACS check-in rates in the first column of Table 4.

Looking at the cluster mailback metrics from this perspective presents a different assessment of the segmentation scheme. The 2009 ACS reflects a survey without the benefit of a paid communications campaign, front page news stories, and widespread grassroots promotions. In short, it reflects mailback behavior from a much more "typical" demographic mail survey. Consequently, it provides validation that the segmentation

scheme could be applied for purposes of planning for mail nonresponse in a national survey as well.

5.2. Assessment of the 2010 Census Communications Campaign

We also used the geographic segmentation to obtain clues about the effect the 2010 Census communications campaign, particularly among HTC populations. Our outcome measure for this is a comparison of the ACS mail check-in rates for the March 2009 versus March 2010 sample panels, shown in Table 3. For both years, responses for the March panel were received in March, April, and May. March 2010 was the zenith of the 2010 ICP as paid advertising, earned media, and public relations events were occurring over many different media outlets and Census Day was April 1. By comparing to one year prior, we can compare mail response behavior with and without the census "environment" as an intervening variable. As such, it serves as a proxy for understanding the 2010 Census communications campaign's effect. We admit this is not a perfect assessment since the outcome measure is the ACS mailback and not the census form. However, recent cognitive studies on ACS materials indicate there is confusion between the decennial census and ACS forms – many respondents are not aware they are two different data collections (Schwede and Sorokin 2010). Additionally, in Census 2000 a "halo" or positive spillover effect was observed in mail check-in rates for the ACS around the time of the census. Consequently, we believe this comparison arguably still serves as a measure for the 2010 campaign's effect.

The change in the mail check-in rate between March 2009 and 2010 was 4.9 percentage points overall and ranged from 3.6 percent to 7.5 percentage points across the clusters. The five HTC clusters had the largest *percentage increase,* ranging from 15.3 to 29.3. The percentage increase in the three easier to count clusters ranged from 5.9 to 13.3. These findings are rather dramatic considering the ACS form is much more burdensome than the census and that the biggest increases were seen among the most difficult to enumerate populations.

The hypothesis that the census communications campaign had a positive effect is further supported by the mail check-in rates for the April panel (Table 4). (Data collection for this panel took place in April, May, and June.) Here we see a marked decline in check-in rates relative to the previous month's panel. During this time, the 2010 Census communications campaign was winding down and the number of advertisements and events publicizing the census greatly tapered off. Overall, the April panel mail check-in rate in 2010 was 1.0 percentage point lower than the mail check-rate in 2009. However, it is interesting to note that the pattern of a larger *percentage increase* in check-in rate seen in March 2010 still appears in April for both the ethnic enclave II and the single unattached mobile clusters, albeit at a lower level ranging from 3.8 percent to 4.0 percent. We hypothesize this may, in part, be a result of extra media buys late in the campaign (between March 29 and April 24). Some of these supplemental ads targeted young adults (age 18–24) via college newspapers, public service announcements on music television (MTV), and digital ads. Additionally, national television and spot radio and television ads were targeted to English-dominant Hispanics. The decision to purchase additional ads was a product of the Rapid Response Program – an initiative aimed at targeting media to geographic areas with below-expected mail participation rates (DraftFCB 2011).

6. Other Applications

The robustness of the geographic segmentation in identifying the variation in mail participation rates in both the 2000 and 2010 Censuses, in both the 2009 and 2010 ACS, and across subnational regions implies there are other opportunities and applications in survey research beyond the 2010 ICP. One example is for defining strata for purposes of targeting HTC and other populations in ongoing demographic surveys. This is particularly effective when new information is brought to bear. For example, to further define the clusters, one might overlay the geographic segments with consumer marketing data, thereby introducing new variables such as psychographics and media consumption habits. Knowing a cluster's Internet access and usage would provide valuable insight into survey mode preferences when designing a multimode survey. Media preferences may also indicate in advance that special strategies are needed in some clusters more than in others. These strategies might include mailing bilingual questionnaires, mailing second questionnaires, and sending interviewers to follow up in person.

Such a merge was undertaken in preparation for the 2010 Census when the geographic clusters were merged with Mediamark Research Institute and Simmons data – two national consumer research surveys commonly used for marketing applications (Bates et al. 2008). Two experiments recently conducted by the U.S. Census Bureau leveraged information from the merge. One is the 2011 ACS Internet Test (Zelenak et al. 2010) which explores the use of the Internet as an alternative response mode. The experiment introduces different Internet response option treatments, with some emphasizing the mode and others not. Based on information about Internet access, use and preferences across the eight geographic segments, the experiment stratified the Internet response option among a sample of households in both the advantaged homeowner and single unattached mobile clusters.

Another example is the 2010 Census Quality Test (Hill et al. 2010). This study was a reinterview of 2010 Census respondents to investigate the potential for nonresponse bias and measurement error when providing an Internet response option. Like the ACS test, this experiment used the cluster scheme and knowledge about Internet use to determine an oversample of cases slated to receive a reinterview invitation via the Internet. These two experiments serve as examples of how the segmentation may be useful in improving the methodology for current demographic surveys.

7. Summary and Discussion

Using a tract-level cluster analysis, we uncovered eight mutually exclusive segments of the U.S. population. The data input for the analysis relied on twelve variables previously used by census demographers to calculate a decennial census hard to count (HTC) score. For each segment, we closely examined the housing characteristics along with socioeconomic and demographic characteristics. This information coupled with each segment's historical mailback rate and HTC score not only allowed us to pinpoint *where* tracts with low mail return rates tend to be located, but also helped differentiate *why* a tract may be more or less inclined to respond. For example, the biggest barriers to census participation in the ethnic enclave clusters may be low familiarity with the decennial census, language barriers, fear of government, and irregular/densely populated housing

units. Conversely, households located in the single unattached mobile cluster may be harder to count because of high noncontact rates and higher mobility (and like the ethnic enclaves, this cluster may also be unfamiliar with the census, because of never having participated before due to a younger age skew). This type of information is critical for survey managers who need to devise tailored methods for encouraging census and survey participation. For example, if managers know that a certain tract or DMA skews toward the single unattached mobile, they can expend more resources promoting the census through media channels such as college newspapers, movie theaters, digital media, and radio.

It is notable that the clusters mirror in many ways the "stair step" typology of household characteristics correlated with mail return documented by Word (1997). Word noted that in the 1990 U.S. Census, White, non-Hispanic owners in spousal households had the highest mailback rate while Hispanic renters in nonspousal households had the lowest mailback rate. In keeping with this typology, our highest mail return cluster (advantaged homeowners) had the highest percentage White population, lowest percentage renters, and lowest percent nonspousal households. In contrast, the cluster with the lowest mail return rate (economically disadvantaged renter skewed) had the lowest percentage Whites, highest percentage renters, and highest percentage nonspousal households.

It is also notable that two of our clusters (the economically disadvantaged) resemble the "concentrated disadvantage" community-level predictor noted by Johnson et al. (2006). This zip-code level predictor was negatively associated with telephone survey response just as our economically disadvantaged clusters were negatively associated with census mail response. Some of our other cluster characteristics, however, are in direct opposition to findings from the same study. For example, Johnson et al. (2006) found that "concentrated affluence" was also negatively associated with telephone survey response. But our study suggests that concentrated affluence is most pronounced in the Advantaged Homeowner cluster and this cluster consistently had the highest mail response rates in both the censuses and ACS. Perhaps some of this can be attributed to mode differences and the larger difference between a federal government data collection and a university-sponsored health survey. We are not certain but the discrepancy begs further inquiry.

Since the classification and construction of the clusters was based upon tract-level descriptors correlated with Census 2000 mail response, we were anxious to see how the segmentation would work to predict mail response levels in the 2010 Census, in a more recent demographic survey (the ACS), and as a way to measure the effect of the 2010 ICP. This was critical to validating the segmentation as a legitimate planning tool and source for targeting census communications and mail implementation strategies. For the 2010 Census, we found the national mail participation rate patterns by cluster to be identical to ten years prior. A similar (albeit much more pronounced) mail participation pattern was seen across clusters in the 2009 and 2010 ACS. Finally, we uncovered indirect evidence that the 2010 Census ICP was successful in motivating mail response, particularly among the HTC clusters.

We conclude by pointing out several important limitations. First, the data describing the tracts as well as the HTC scores and mail return rates were from the 2000 Census and thus seven years outdated when we constructed the segmentation. As a result, we suggest a repeat of the cluster analysis using tract data from the five-year ACS. This would refresh

the clusters with more current data and also introduce additional socioeconomic indicators to help define the clusters. It may be that new clusters will emerge while others fade away. We also encourage the exploration of appending auxiliary data to the clusters such as consumer research data.

A second limitation is our use of tracts as opposed to housing units as our units of analysis. Because we were interested in an audience segmentation that could specifically help inform a paid media campaign, tracts were the preferred units since broadcast media is purchased according to DMAs, not individual households. This approach is a macro-level analysis that presumably loses some of the more nuanced understanding of who does and does not respond by mail. These limitations aside, we believe the segmentation can be used for purposes other than a social marketing campaign, for example to help design survey methodological experiments such as targeting HTC populations by defining test strata in mailout/mailback or multi-mode surveys.

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