Response Rates Using Mass Mailing Tools in the National Children's Study

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Abstract

Diminishing survey response rates are threatening the reliability and generalizability of survey results. Maintaining high participation is particularly important for longitudinal studies such as the National Children's Study (NCS), where attrition tends to increase over time. For the NCS, address quality impacts communication with participants, completion of mail surveys and in-person specimen collections, and linkage to existent data used to reduce response burden. For these reasons, an accurate participant mailing addresses is crucial. In this paper we test the use of Delivery Point Validation (DPV) codes and Residential Delivery Indicators (RDI) in an NCS mailing.

The United States Postal Service introduced DPV codes and RDI to identify potentially incorrect addresses prior to mailings. DPV codes help validate delivery address information by flagging incomplete or erroneous addresses, while RDIs indicate whether an address is residential, commercial, or rural. These tools are used to comply with USPS guidelines for mass mailers, but may also be useful for surveys. An analysis of the impact of using DPV codes and RDI for increasing address quality in a longitudinal study will be provided. Our preliminary results indicate that DPV and RDI do identify unreliable addresses, particularly among hard to reach populations, and that their use could substantially decrease undeliverable rates, and thereby potentially increase participant response rates, in longitudinal studies.

Key Words: Response Rate; Longitudinal Survey; Data Quality; Burden Reduction; Address Quality; Attrition

1. Background

A representative sample helps ensure the validity of conclusions extrapolated to the general population. The National Children’s Study (NCS) was a planned nationally representative longitudinal cohort study of environmental (chemical, biological, physical, and psychosocial) influences on child health and development, which would survey children and/or their parents from before birth to age 21 (The National Children’s Study, 2011). A pilot study, the NCS Vanguard, began in 2009, and enrolled over 5,000 families in 40 locations throughout the United States and followed them until 2014. Primary data were collected through in person interviews (often within the respondent’s home), bio-

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specimen collections, and mail surveys[2]. To minimize a participant's burden, the NCS planned to supplement primary data collection efforts by providing a catalogue of data sources which could be linked to the NCS data potentially by various data linkage mechanisms including address. As an effort to curb attrition, newsletters and holiday cards were also mailed to participants to keep them engaged in the study. Thus, one of the keys to participation in the study was the respondent's address. Yet, address quality has not been researched as a mechanism to improve response rates. In this paper we examine address quality using publicly available mass mailing tools and assess their usefulness in survey research.

Data from the United States Postal Service (USPS) suggest that 4-5 percent of all mail volume is non-deliverable. This rate has declined in recent years – in FY1998 there were 9.3 billion individual pieces of non-deliverable mail, or about 4.7 percent of the total mail volume. By FY2010 there were 6.9 billion pieces of non-deliverable mail, about 4.1 percent of all mail (Leininger & Hunt, 2011). Rates also vary depending on mail type. For instance, in 2004, about 3 percent of first-class mail was non-deliverable, compared to about 6 percent of all standard mail (Laurits R. Christensen Associates, Inc., 2007).

Non-deliverable mail is handled in one of three ways: it may be 1) forwarded to a new address, 2) returned to sender, or 3) treated as waste and discarded. In FY2010, of nearly 9 billion pieces of undeliverable mail, about 18 percent was forwarded, 23 percent was returned to the sender, and the remaining 59 percent was treated as waste (Leininger & Hunt, 2011). Because it is impossible to detect mail that is discarded, this analysis focuses solely on mail that was either returned to the sender (in this case, NCS investigators at NORC), or that was forwarded to a new address with a notification sent to the sender.

Unit nonresponse rates are systematically rising (Singer, 2006); consequently survey practitioners and statisticians are actively searching for ways to reduce their effects on survey estimates. Statisticians generally recommend response rates stay at or above 60% even if there is no clear link between nonresponse biases and response rates (Livingston, 2012). Longitudinal surveys, like the National Children's Survey, are especially affected by unit nonresponse. A distinctive feature of longitudinal surveys is that unit nonresponse tends to increase with time as respondents refuse participation, relocate, become difficult to find, and experience general respondent fatigue (Watson, 2009).

Addresses are used for data collection, extant data linkage, and outreach strategies to retain participants. Thus, response rates are effectively a function of address quality. In this paper we examine the East Regional Operations Center (ROC) addresses within the NCS. In particular, we examine the usefulness of Delivery Point Validation (DPV) and Residential Delivery Indicators (RDI). In doing so, we introduce survey researchers to tools that may predict inhabitant type and undeliverable mail rates. Through the analysis we seek to answer the following four questions:

[2] NCS data collection ceased in December 2014.

1) Can mass mailing tools identify unreliable NCS respondent addresses?
2) What are common errors found within the NCS mailing addresses based on these tools?
3) How demographically different are the NCS participants who pass address inspections from those who fail?
4) Can mass mailing tools reduce non-deliverable mailing rates and/or increase response rates? Additional uses for mass mailing tools are considered, including sample frame testing.

2. Mass Mailing Background

Mass Mailing tools abound in the US, dating back to the 1845 Postal Reform Act, which reduced mail prices for personal mail (Kielbowicz, 1995). Today, tools include address standardization software suites, envelope printers, mail sorting machines, and mail meters, to name a few. Nonetheless, a correct address is still paramount for completing the act of mailing a recipient. At a minimum, a US address includes the name of the recipient and/or organization, their street address, apartment or suite information, city, state, and a five digit zip code. Starting in 1983, the USPS introduced the ZIP+4 to help postal carriers identify a geographic segment within a five digit zip code. Next, USPS created a Coding Accuracy Support System (CASS)™ in the late 1980's (USPS, 2007-2008) with stage 1 released in 2002 (USPS, 2003). CASS enabled the USPS to evaluate the accuracy of address standardization tools available on the market. CASS-certified software corrects and standardizes addresses to meet USPS specified criteria. It also can append missing address information, such as ZIP codes, cities, and states to ensure the address is complete. This was the first of a set of highly-effective mailing improvements, detailed as follows.

In 2004 USPS enhanced CASS by introducing Residential Delivery Indicators (RDI) (USPS, 2004). Despite the name, an RDI indicates whether the address is a business address. While the USPS does not price delivery based on the type of address, other providers do charge more for mailing to residential addresses. Thus, USPS patented the RDI list to assist third-party mail shops to make informed pricing decisions. Two products are available within RDI, including a table which matches an address to the ZIP+4, and another more detailed product which matches based on a delivery point (for example, a house mailbox or post office box).

In 2007 USPS enhanced CASS again by introducing Delivery Point Validation (DPV), or "DirectDPV," appending two additional digits to the ZIP+4 (ZIP+6) (USPS, 2007). Validation of a delivery point enables USPS to verify an address and allows mass mailers to take advantage of a reduced presorted mail price. NORC at the University of Chicago employs CASS-certified Pitney Bowes SmartMailer software for address standardization. Along with standardizing an address, the software also appends either an error code, information code, presort error code, or no code. Information and error codes provide address limitation specifications while no code indicates that the delivery point was verified.

DPV codes are especially important for third-party mail shops to receive the lowest cost bulk-mail prices. To claim commercial mail prices, an organization must certify that they have verified either the 5-digit ZIP code, complete address, or carrier route information to quality for presorted, automated or carrier route pricing respectively (USPS, 2015). The price per piece of mail has an inverse relationship with the required quality of the address: as the price goes down, the required verification specifications become more stringent (USPS, 2015b).

To adhere to these requirements, CASS-certified software employs validation of delivery points and RDI against the USPS' own list of valid addresses. Since a static list of addresses is employed, there are some intrinsic limitations of CASS software, RDI, and DPV codes. In particular, the addresses are updated monthly which fails to capture some newly constructed building and including recently demolished structures (USPS, 2007-2008). In addition, mail standardization software is known to have limitations in rural areas (McElroy, 2003) where rural routes and non-standard, colloquial names abound. Lastly, the USPS works to protect Americans from illegal phishing of mailing addresses by inserting false positive 'seed' addresses into their address list (USPS, 2003). If someone attempts to validate a fake seed address, the system automatically shuts down and the CASS software vendor must report the violation while USPS investigates for potential address phishing activities.

With these limitations in mind, we tested DPVDirect and RDI's usefulness in a survey research environment. Typically, survey samples are constructed from a mailing address survey frame. The NCS, however, recruited respondents from a multitude of sources. In particular, participants were recruited from healthcare providers, door-to-door enrollment, and direct marketing including responding to TV and radio advertising (National Children's Study, 2011). Thus, address information was directly collected through the survey instruments. Participants were also periodically asked to provide updates to their address as a way to ensure their inclusion throughout the 20 year data collection period. As a result of this recruiting mechanism, address quality was a function of both the respondent's explanation of their address and the interviewer's ability to correctly capture the information.

3. Methodology

Our analysis focused on addresses collected from participants in the East Regional Operations Center (ROC). Participant-wide mailings occurred several times per year and address validation occurred prior to a large-scale mailing. An automated mailing address analysis was performed followed by a manual review of each flagged address. The automated analysis identified previously non-deliverable mail, new addresses collected from recent interviews or indications of a move, an indication of a new primary caregiver, new final refusals, lists of missing respondents who were in locating, and other special circumstances. In the event that one of the above flags was triggered, an analyst either updated the address with newly collected information or requested additional information from the field management SmartMailer N.15.01 by Pitney Bowes software.

During our analysis, we completed the aforementioned steps using the East ROC Fall 2014 newsletter mailing list. In addition, the standardized addresses were redelivered to the statistics team prior to the 2014 holiday card mailing. We specifically requested that the mail team also deliver the appended DPV codes. Another team appended Delivery Point RDI using Valassis V8.14 software. Addresses were then reviewed with the intention of preparing for the 2014 holiday card mailing[3]. We defined unreliable addresses as those with either 1) a non-blank DPV code or 2) an RDI equal to "business." Mailing addresses that were marked as unreliable were then compared to other addresses collected throughout the data collection process for a more complete version of an address.

If any instance of other addresses were more complete or offered another mailing address, the alternate address was tested for deliver point validation. Validated addresses were used to replace the unreliable address. Alternatively, if the mailing address was flagged as a business through the RDI tool, data collection records were investigated to determine if there was a note explaining the participant's living situation.

4. Results

Of the 1,084 study addresses in the East ROC mailing, 132 (12%) were considered unreliable using DPV and RDI. Forty-three unreliable addresses (33%) were then updated using pre-existing data through the aforementioned methods. Out of the unreliable addresses, only three addresses were business addresses and two of the three business addresses also had a DPV code. Business addresses were individually reviewed and validated. A number of specific confounding circumstances were identified in this review - for example, in one instance the respondent lived in group quarters.

To test whether DPV codes and RDI could identify unreliable NCS respondent addresses, we compared the count of addresses by category to those that were undelivered in the same category (Exhibit 1). Mail may be returned to the sender as undeliverable if the mail has: 1) no postage; 2) an incomplete, illegible, or incorrect address; 3) addressee not at address (unknown, moved, or deceased); 4) the mail was unclaimed; 5) the mail was refused by the addressee at time of delivery; 6) the mail was refused by the addressee after delivery when permitted; or 7) the minimum criteria for mailability was not met (USPS 2015c). Thus, poor address quality is one of many reasons that mail is undeliverable. Even so, using the non-deliverable rate as a proxy is a fair assessment since the majority of non-deliverable mail is due to incomplete addresses and recent moves (Office of Inspector General USPS, 2014). A t-test was used to compare the undelivered mail rate for unreliable addresses versus addresses without an RDI or DPV (reliable addresses). Eleven percent of all unreliable addresses were returned to NORC

[3] Note: NCS data collection was cancelled prior to the holiday card mailing thus cancelling our future mailing.

whereas only 3% of all reliable addresses were returned, and the difference (8%) is statistically significant. The undeliverable rates were highest in the business addresses (33%), followed by DPV error or "E" codes (16%) and lastly DPV information or "I" codes (9%). One might have anticipated a difference in the undeliverable rate between E and I codes since I codes provide information back to the mailer, whereas E codes indicate a fundamental flaw with the address.

Exhibit 1. Historic Review of Undeliverable Rate from Fall 2014 Newsletter

Code Type	**# Addresses**	**# Undelivered**	**% Undelivered**
Unreliable Addresses	132	15	11%*
DPV – E codes	31	5	16%*
DPV – I Codes	100	9	9%*
RDI – Business	3	1	33%*
Reliable Addresses: No RDI or DPV code	952	30	3%

Note: DPV Codes and RDI are not mutually exclusive. *Denotes statistically significant from the undeliverable rate for no DPV or RDI. $p < 0.01$; one-sided t-test.

Next, we reviewed errors found within the NCS mailing addresses based on DPV codes and RDI (Exhibit 2). In particular we wanted to determine the most common errors found, as well as the rate at which we could update the address based on already-collected data. The most common errors were DPV information or I codes. The majority of the I codes flagged missing or invalid apartment or suite numbers. Of the error or E codes, the majority of addresses had an invalid street name. The rate at which addresses were updated based on review of information collected from a participant was consistent across most DPV and RDI codes with the exception of addresses which were missing company name (31-44% vs. 8% respectively). If data collection efforts had continued, we would have asked field managers to investigate the flagged addresses in more detail; however, this was not an option since data collection ceased in December 2014.

Exhibit 2. Distribution of Unreliable Addresses Found in East ROC

	Description	Total Count	Count Updated	% Updated
DPV	E: **Street Name** Not Found in Zip Code Area	16	5	31%
	E: **House Number** or Range Invalid	6	2	33%
	E: Data Indicates Address **Undeliverable**	9	4	44%
	I: **Apt or Suite Number Missing**	9	4	44%
	I: **Apt or Suite # Invalid**	79	26	33%
	I: **Missing Company Name**	12	1	8%
RDI	**Business***	3	1	33%

*Note: DPV codes and RDI are not mutually exclusive

Unreliable rates were also reviewed by location. The East ROC was created from individual collection centers originally administered by unique contracting organizations. Sites were chosen to ensure a nationally representative and balanced design as they each hold unique characteristics within their surrounding areas. For this analysis, it is assumed that unreliable rates by site likely mimic the type of codes found in that geography. For example, New York Queens County includes more apartments and suites than any other site within the East ROC -thus we observed a larger number of DPV error codes in that location.

Next, we reviewed demographic characteristics for unreliable and reliable addresses to determine if respondents with unreliable addresses differed from those with more reliable addresses. What we discovered is that parents from unreliable addresses tended to be of lower income, Hispanic, Non-White, and/or speak a language other than English at home. All reported results were statistically significant using a one sided t-test. The demographic characteristics of unreliable addresses are the same people who are often missing from survey responses in general (Goyder, 1987). Thus, identifying and correcting unreliable addresses could help decrease potential demographic biases within a survey collection effort by possibly improving response rates among this population, though more research is needed in this area.

Exhibit 3. Percent of Unreliable Addresses by Site

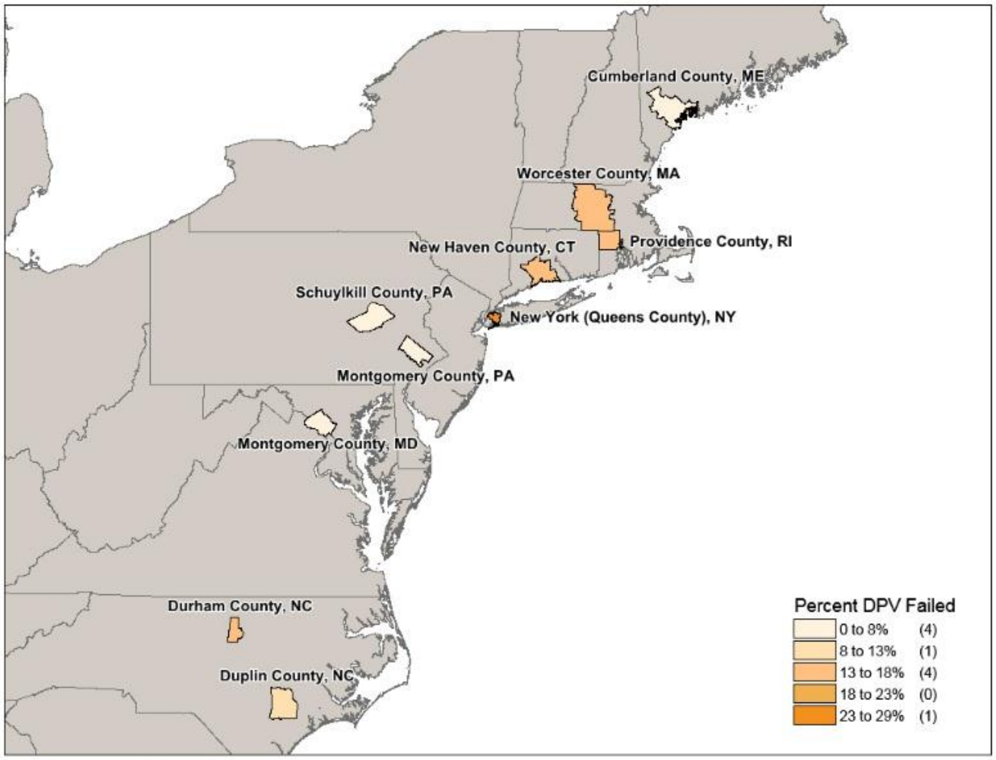

Exhibit 4. Socioeconomic Characteristics of Respondents with Unreliable Addresses

Primary Caregiver Characteristics	**Unreliable Addresses**	**All Other Addresses**
# Addresses	*134*	*982*
Income: < $25k	43%	22%
Income >= $100k	8%	33%
Hispanic	23%	9%
Non-white	35%	20%
Language: Non-English	15%	6%

Note: Unreliable addresses are those that did not have a blank DPV code or were a business address. Primary caregiver characteristic statistics exclude unknown or missing information. Proportions shown represent statistically significant differences between unreliable addresses & others. $p < 0.01$; one-sided t-test

Lastly, we reviewed whether DPV codes and RDI could reduce non-deliverable mailing rates or increase response rates. Unfortunately, we were limited in our ability to formally test this hypothesis once data collection ceased. However, Exhibit 1 shows that the undeliverable rate would have likely decreased from 16% to 3% for the 43 updated addresses. This in theory could have increased the response rate for future mail surveys for these 43 addresses. Again, more research is needed in this area.

5. Discussion

In summary, preliminary results indicate that DPV and RDI do identify unreliable addresses, particularly among hard to reach populations. The NCS was unique since addresses were collected from the respondents themselves. It is unknown if the address errors were caused by the respondent, field interviewer, or both. Yet, one might envision a scenario where a respondent provides an abbreviated version of their address with the assumption that the interviewer already knows their valid address, especially for in person interviews at the respondent's house.

Thus similar analyses are needed using an address based sample frames to see if results are transferable to address based samples. Preliminary results using NCS addresses suggest that undeliverable rates could decrease from 16% to 3%, but again additional research is needed to verify these results.

Since the results of this analysis show promise, additional research is anticipated with unrelated surveys. In particular, repeating the analysis with other surveys during the data collection phase is recommended to confirm a reduction in the undeliverable rate and to test whether the method could increase the response rate in longitudinal surveys. Also, a thorough analysis of DPV and RDI against address based sample frames could lead to future discoveries or recommendations about the proper timing of appending DPV and/or RDI to an address list for data collection efforts. For example, statisticians often turn to unknown data sources when seeking a sample frame. In theory, DPV and RDI could test the validity of an address list prior to selecting a sample. However, more work is needed in this area.

Even though our research focused on a longitudinal study, we anticipate the results to be applicable for use in cross-sectional surveys as well. As noted, DPV and RDI could prove valuable in developing a sample frame regardless of the frequency of data collection, potentially leading to lower rates of non-deliverable surveys and therefore higher participant response rates. Validating addresses prior to a cross-sectional survey mailing may also decrease costs by lowering charges for mass mailings, and by reducing the number of non-interview follow up contacts with potential respondents.

Lastly, our research benefitted from previous address collection attempts. In cases where a respondent's address was unreliable, we simply looked to previous data collection attempts for a more reliable address, yet other studies may not be as fortunate. Even so, unreliable addresses could be improved upon using other survey tools. Respondent locating and tracking mechanisms could be employed such as the White Pages, the internet, or sending field staff to investigate from the last known address (Crider, Willits, & Bealer, 1971 and Couper, 2005). Thus, DPV and RDI are intended for mass mailers, but appear to also be useful for survey researchers.

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