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**Measurement Error in  
American Community Survey Paradata and  
2014 Redesign of the Contact History Instrument**

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## 1. INTRODUCTION

In recent years, many studies have addressed the potential of using paradata to reduce total survey error (Kreuter & Casas-Cordero, 2010; Nelson et al., 2014). There is less research, however, on the quality of paradata itself and how it may be prone to measurement error. This includes missing, incomplete, or inaccurate paradata, which may bias estimates of total survey error (Kreuter & Casas-Cordero, 2010). In this research, we analyze paradata from the U.S. Census Bureau's American Community Survey (ACS) to see if modifications to the U.S. Census Bureau's Contact History Instrument (CHI) reduce measurement error, and thus improve paradata quality.

The CHI is a data collection instrument used since 2004 by Census Bureau Field Representatives (FRs) to collect data on Computer-Assisted Personal Interviewing (CAPI) contact attempts in demographic surveys. FRs are trained to record information on every contact attempt; however, CHI data have historically contained many "empty" records, which have prefilled information about sample units but empty fields pertaining to the contact attempt. It was unclear whether these empty records were due to interviewers bypassing the CHI after making a contact attempt or performing some action other than a contact attempt that the CHI did not capture.

In January 2014, the Census Bureau launched a redesign of the CHI with substantial changes to many of the questions. This included requiring interviewers to specify explicitly if they were not attempting contact and what actions they were performing instead, such as reviewing case information or locating activities. At the interviewers' request, an additional change differentiates between incoming and outgoing telephone contact attempts. The answer categories recording respondent concerns and contact strategies attempted by the interviewer also underwent changes to both reduce the number of options as well as provide clarification.

This research explores the possible impact of the 2014 redesign on the quality of the paradata produced by the CHI. First, we compare completeness of CHI data from the 2013 and 2014 ACS to determine whether empty records were reduced under the redesign, and to learn what actions FRs performed other than contact attempts in 2014. We also compare distributions for mode between the 2013 and 2014 ACS to learn more about telephone contact attempts. Next, we compare distributions for answer categories from the respondent concerns and contact strategies screens between the 2013 and 2014 ACS. Finally, we include factor analyses on the old and new respondent concerns categories to see whether constructs captured in prior research are still being measured.

## 2. BACKGROUND

### 2.1. Paradata Overview & History of Contact History Instrument

The rise of computer-assisted modes of survey administration has greatly expanded possibilities for survey research by providing new types of data. Couper (1998) first coined the term “paradata” during a presentation at the Joint Statistical Meetings in Dallas, Texas, which was used to describe the general idea of processing data produced automatically by computer-assisted data collection systems. Since then, the concept of paradata has been broadened by researchers to cover many types of data about the process of survey production, including call records, interviewer observations, and audio recordings, among others (Kreuter & Casas-Cordero 2010).

One pivotal instrument used by the Census Bureau in the collection of paradata is the CHI. The CHI is an instrument used since 2004 by Census Bureau FRs to collect data on CAPI contact attempts in demographic surveys. More specifically, CHI is a standalone Blaise application housed in the Census Bureau’s Case Management system and appears as a questionnaire for FRs to complete for each contact attempt. CHI is launched automatically when the FR exits the survey questionnaire on their laptop instrument, but it may also be launched manually (Dyer 2004). Table 1 displays CHI implementation dates for Census Bureau surveys done partially or entirely via CAPI. CHI was first launched for the National Health Interview Survey (NHIS) in 2004, and was adapted for the ACS in 2011.

**Table 1. CHI Launch Dates by Survey**

<b>Launch Date</b>	<b>Survey</b>
<b>January 2004</b>	National Health Interview Survey (NHIS)
<b>April 2005</b>	Consumer Expenditure Quarterly Survey (CEQ)
<b>March 2006</b>	Consumer Expenditure Diary Survey (CED)
<b>July 2009</b>	Current Population Survey (CPS)
<b>October 2010</b>	National Crime Victimization Survey (NCVS)
<b>May 2011</b>	Survey of Income and Program Participation (SIPP)
<b>May 2011</b>	National Survey of Fishing, Hunting and Wildlife-Associated Recreation (FHWAR)
<b>June 2011</b>	American Housing Survey (AHS)
<b>August 2011</b>	American Community Survey (ACS)
<b>January 2012</b>	National Ambulatory Medical Care Survey (NAMCS)
<b>January 2012</b>	National Hospital Ambulatory Medical Care Survey (NHAMCS)

Source: Nelson et al. (2014)

By completing the CHI questionnaire, FRs record many types of paradata for each contact attempt including:

- whether they are making a contact attempt or just looking at a case;
- date and time of contact attempt;
- contact mode (personal visit or telephone<sup>1</sup>);
- with whom contact was made, if anyone (sample unit member, non-sample unit member, or noncontact, as well as detailed information about noncontacts);
- outcome of contact attempt (completed interview, partial interview, or unable to conduct interview, as well as reasons for inability to complete an interview);
- respondent and nonrespondent concerns, behaviors, or reluctance types; and
- contact strategies employed.

See Appendix A for the flow of the CHI screens based on responses entered by the FR.

Many researchers have explored the utility of paradata, including that captured by the CHI since its inception, to optimize survey design and/or reduce total survey error (Kreuter & Casas-Cordero 2010; Nelson et al. 2014). Unlike survey response data, paradata may provide detailed information about respondents and nonrespondents alike. It may also provide information about the level of effort devoted to sample cases, such as the number of contact attempts. Groves and Heeringa (2006) advocated for optimizing survey design during data collection by continually monitoring process data and survey data, a practice they define as “responsive design.” This design seeks to improve survey cost efficiency and to achieve more precise, less biased estimates. The authors also showed the utility of paradata from the National Survey of Family Growth (NSFG) in predicting the likelihood of interviewers obtaining a screening interview or main interview on the next contact attempt. Additional examples showed the utility of cost or cost-related data and (proxy) indicators of sampling, nonresponse, and measurement error properties of key survey estimates (Groves & Heeringa 2006).

In the literature on total survey error, paradata has been used predominantly to assess or model nonresponse error and measurement error, as well as the interaction between the two (Kreuter & Casas-Cordero 2010). This is true for the CHI as well; many researchers have applied the CHI in studies of nonresponse (Maitland et al. 2008; Maitland et al. 2009; Dahlhamer & Simile 2009; Dixon 2010; Gonzalez & Kreuter 2010), finding that CHI factors are valuable in measuring response propensity but less so in measuring nonresponse bias. Other researchers have applied the CHI in studies of measurement error (Tucker et al. 2010; Tucker et al. 2011). Nelson et al. (2014) provide an extensive review of the literature on CHI paradata applications, while Kreuter

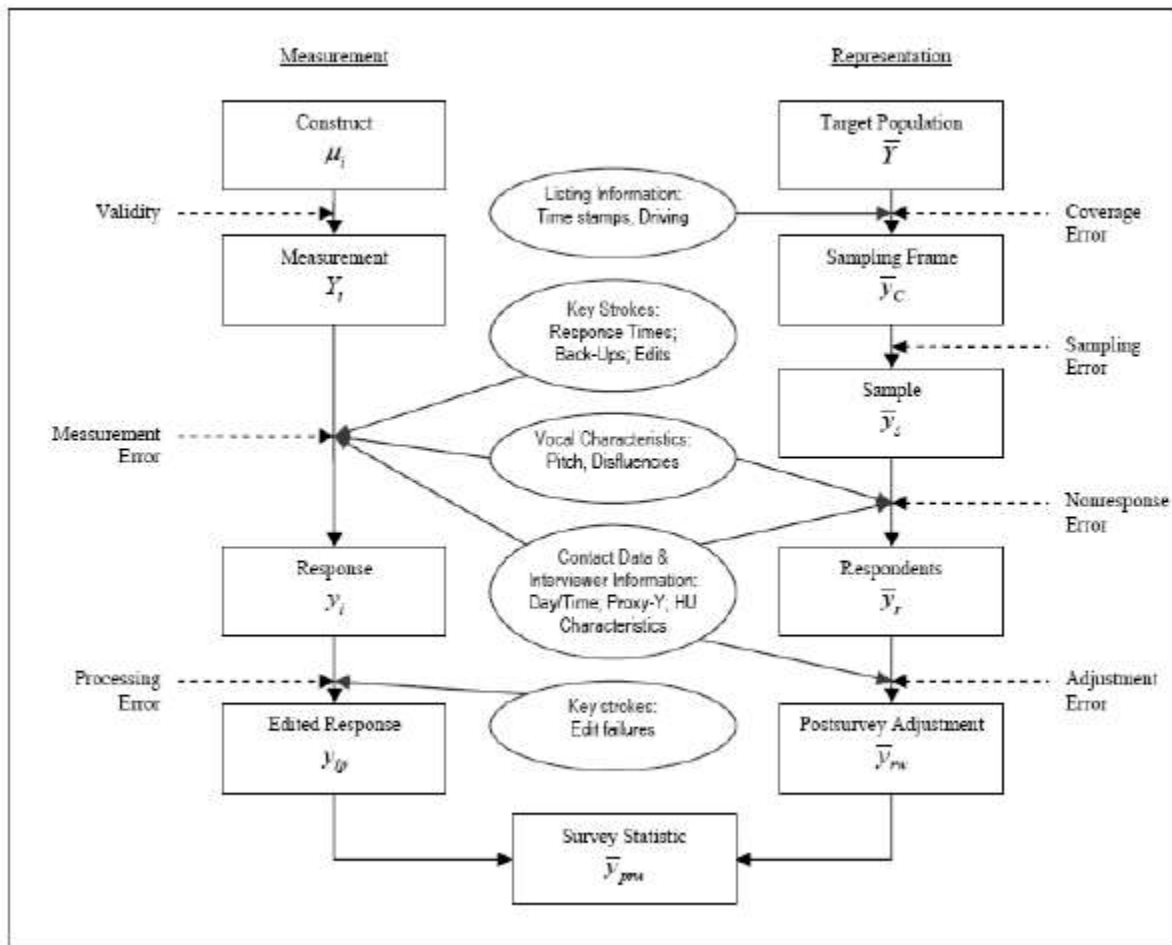
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<sup>1</sup> According to Bates and Piani (2005), “The initial visit is made in person and the majority of subsequent contacts are personal visit as well. However, contact may be attempted by telephone if the respondent requests it, if it is the only way an interview can be completed, or other factors make telephone the most efficient mode.”

and Casas-Cordero (2010) provide an extensive review of the literature on broader paradata applications.

Kreuter and Casas-Cordero (2010) further emphasized the importance of paradata by integrating it into a pre-existing framework of total survey error by Groves et al (2004) to show not just the error components, but also applicable paradata for their assessment. This is shown in Figure 1 below.

**Figure 1. Total Survey Error Components and Paradata for their Assessment**



Source: Kreuter & Casas-Cordero (2010)

## 2.2 Measurement Error & Quality Concerns in Survey Paradata

While many studies have addressed paradata applications to reduce total survey error, very few have addressed the quality of the paradata themselves and how they may be prone to measurement error. Based on papers presented at the 2010 Annual Conference of the American Association for Public Opinion Research (Casas-Cordero 2010; Sinibaldi 2010; West 2010), Kreuter and Casas-Cordero (2010) state that interviewers, “can erroneously record certain

housing unit characteristics, can misjudge features about the respondents, or can fail to record a contact attempt altogether.” They also point to studies indicating a lack of quality in paradata due to high levels of missing data in interviewer observations (Kreuter et al. 2007; D’Arrigo et al. 2009), saying these may occur if interviewers have limited time or do not feel a need to record every contact attempt. The authors caution that the utility of paradata for process improvement and error modeling is reduced by types of measurement error such as recording errors and missing data patterns, which may also bias estimates if these errors appear systematically (Kreuter & Casas-Cordero, 2010).

Wang and Biemer (2010) sought to determine whether the number of callbacks recorded is accurate, and which factors lead interviewers to over- or underreport callbacks, in the 2009 National Survey on Drug Use and Health. They state that interviewers have more incentive to underreport contact attempts than to overreport; some motives for underreporting include pressures to keep cases “alive” to avoid them being closed out due to many unproductive attempts, as well as pressures to avoid being perceived as not using time effectively. In addition, a non-motivational source of underreporting is the occurrence of “drive-bys” by which interviewers drive or pass by an address looking for signs that anyone is present; interviewers may choose not to record these as contact attempts if they believe that no one is present, although these would inform contactability and could prove useful for modeling. Other sources of underreporting are explored as well. The authors show that if the number of callbacks recorded is not accurate, then the estimates of response propensity will be biased and a callback model nonresponse adjustment will not perform well. They conclude that to obtain more accurate paradata it is necessary to either work with the existing system and add burden to the interviewers, or to redesign the system and avoid this additional burden.

Bates et al. (2010) first assessed CHI paradata quality by examining CHI records from three surveys in 2009 – the National Health Interview Survey (NHIS), the Consumer Expenditure Survey (CE), and the Current Population Survey (CPS). Evidence of underreporting contact histories was found. Though most CHI entries were recorded immediately after a contact attempt, delays in entry were more likely for attempts resulting in noncontact than those resulting in contact. In addition, all three surveys had some households with no CHI entries; this occurred for under two percent of households in NHIS and CE, and for over four percent of households in CPS, probably since CPS interviewers were newer to the CHI instrument.

More recently, Nelson et al. (2014) again assessed CHI paradata quality by examining CHI records from six surveys between February and June 2012 – the three surveys examined by Bates et al. (2010) as well as the ACS, the National Crime Victimization Survey (NCVS), and the Survey of Income and Program Participation (SIPP). In addition to some of the analyses performed in the earlier paper, the later paper drew attention to the high frequency of CHI “ghost records.” These records contain only prefilled sample unit information but lack any information about a contact attempt and may or may not be associated with an actual contact attempt. Across all six surveys, about twenty percent of all CHI records were ghost records; for the ACS, this



figure was twenty-six percent. Among ghost records, about ninety percent were generated due to FRs selecting the “just looking” option on the first CHI screen (ninety-two percent for the ACS), which immediately exits the FR from the CHI. For the remaining ghost records, eight percent were caused by FRs restarting a case (six percent for the ACS), and the rest were caused by pressing a function key to exit after manually launching the CHI in the Case Management system.

For ghost records generated by the “just looking” option, it was unclear when FRs selected this to bypass the CHI after making a contact attempt, as opposed to when FRs selected this to exit after performing an activity other than a contact attempt that caused the CHI to launch. For the latter, these activities include (i) reviewing, correcting or adding case information, (ii) readying a case for transmission, (iii) performing geocoding verification (ACS only), (iv) locating activities, (v) verifying sample units as ineligible, or (vi) exiting a case opened by mistake. Given past research on potential underreporting of contact attempts and its implications for total survey error, the high frequency of ghost records in CHI is troubling. Despite extensively exploring the data, the authors were not able to definitively identify which ghost records were bypassed contact attempts and which were not contact attempts at all (Nelson et al. 2014).

Other potential causes of error in CHI paradata are order effects and screen usability. Bates and Piani (2005) point out that the “Concern/Reluctance/Behavior” screen and the “Contact Strategies Attempted” screen each contain a lengthy list of twenty-three response options and state that these could produce an order effect. Nelson et al. (2014) find that these screens produce a primacy effect whereby the options at the top of the screen layout are selected with greater frequency than those at the bottom. They do not interpret this to be a result of an order effect, however, since the response options were ordered in the instrument so that the most common concerns were listed first (except for “None” and “Other” at the bottom of each). They argue that the number of response options on these screens may negatively affect the usability of the CHI instrument.

Aside from measurement error, Nelson et al. (2014) point to several reports of applied factor analyses for the CHI “Concern/Reluctance/Behavior” screen (Maitland et al. 2008; Maitland et al. 2009; Dahlhamer & Simile 2009; Gonzalez & Kreuter 2010; Erdman 2012). Despite analyzing different surveys and/or different years, the reports consistently found similar emerging factors; Dahlhamer and Simile (2009) identified four factors from the 2007 NHIS and labeled these as “Survey content/privacy,” “Time constraints,” “Hostility/hard refusal,” and “Gate-keeping.” Gonzalez & Kreuter (2010) identified another factor from the 2009 CE reflecting only longitudinal-type concerns and labeled this “prior experience with the survey;” this factor is not applicable to non-longitudinal surveys such as the NHIS. Nelson et al. (2014) argue that these constructs are major reasons cited for survey nonresponse, and identifying them

would allow the Census Bureau to make an informed decision to reduce the number of options on this screen.

Other reports have analyzed CHI data to understand reluctance reasons specifically within the ACS, and/or to what extent these may reflect respondent burden due to an excessive number of contact attempts or other factors (Zelenak & Davis 2013; Griffin 2014; Griffin & Nelson 2014). These findings were used to implement changes in the ACS for the allowable number of contact attempts per housing unit. These changes were implemented after the data collection period discussed in the upcoming sections, and do not affect our results.

### 2.3. 2014 Contact History Instrument Redesign

In order to address the issues of CHI paradata quality, the Census Bureau established a CHI Change Control Board in May 2013. This group implemented substantial changes to many of the CHI screens, and the redesigned instrument was launched in January 2014. One primary change was removal of the “just looking” option on the first screen, and replacement with a “Not Attempting Contact” option on a new screen identifying the mode of the contact attempt. This was done to understand the reasons why FRs may prematurely exit out of CHI, and thereby generate a ghost record. Ideally, this new option would eliminate ghost record generation as FRs now have a way to record other forms of effort associated with interview completion. In addition to the “Not Attempting Contact” option, the first screen introduced new options to differentiate between incoming and outgoing telephone contact attempts. These were implemented at the request of Census Bureau FRs. Figure 2 displays the first CHI screen as it appeared before and after the 2014 redesign.

**Figure 2: First Screen, Original Versus Revised CHI**

Original*	Revised
<p>• CONTACT HISTORY INSTRUMENT</p> <p>• Are you making a contact attempt or just looking at a case?</p> <hr/> <p>☐ 1. Contact attempt ☐ 2. Looking at a case - not CHI</p>	<p>• CONTACT HISTORY INSTRUMENT</p> <p>• Describe this contact attempt.</p> <hr/> <p>☐ 1. Personal visit ☐ 2. Telephone (outgoing) ☐ 3. Telephone (incoming) ☐ 4. Not attempting contact</p>

Source: Contact History Instrument, Original Version (2004-2013) and Revised Version (2014-Present)

\*In the original CHI instrument, the mode of a contact attempt is asked on a second screen if the FR marks “Contact attempt” on the first screen. The options on the second screen are “Personal” and “Telephone.”

If the FR selected the “Not Attempting Contact” option from the revised screen, they were then directed to a new screen in which they could select what action(s) they were performing other than a contact attempt. This was intended to capture the missing information regarding FR effort directed to the case. This screen is displayed in Figure 3. Note that the options include “Doing ACS geocode verification,” an activity unique to the ACS that may explain the high occurrence of ghost records in ACS relative to other surveys.

**Figure 3: Not Attempting Contact Screen, Revised CHI Only**

♦ **NOT ATTEMPTING CONTACT**

♦ What were you doing?  
♦ Enter all that apply, separate with commas.

1. Reviewing or changing case information  
 2. Ready case for transmission  
 3. Doing ACS geocode verification  
 4. Locating activities (canvassing, management or government office, FastData, ALMI, etc.)  
 5. Verification of Type B/C  
 6. Opened case / CHI by mistake  
 99. Other - specify

Source: Contact History Instrument, Revised Version (2014-Present)

Several existing screens also underwent changes to remove response options that were rarely selected by FRs. Two screens in particular were most affected by these changes: the “Concern/Reluctance/Behavior” screen had six options removed, reducing the total options from twenty-three to seventeen, and the “Contact Strategies Attempted” screen had nine options removed, reducing the total options from twenty-three to fourteen. Ideally, this would improve usability for each screen. Both of these screens and others also had some response options renumbered or reworded. See Figure 4 and Figure 5 for changes made to the CHI “Concern/Reluctance/Behavior” screen and “Contact Strategies Attempted” screen, respectively.

**Figure 4: Concern/Reluctance/Behavior Screen, Original Versus Revised CHI**

Original	Revised
<p><b>• CONCERN / BEHAVIOR / RELUCTANCE</b></p> <p>• Select the categories that describe respondent concerns, behaviors, or reluctance during this contact attempt.</p> <p>• Enter all that apply, separate with commas.</p> <p><input type="checkbox"/> 1. Not interested / Does not want to be bothered</p> <p><input type="checkbox"/> 2. Too busy</p> <p><input type="checkbox"/> 3. Interview takes too much time</p> <p><input type="checkbox"/> 4. Breaks appointments (puts off FR indefinitely)</p> <p><input type="checkbox"/> 5. Scheduling difficulties</p> <p><input type="checkbox"/> 6. Survey is voluntary</p> <p><input type="checkbox"/> 7. Privacy concerns</p> <p><input type="checkbox"/> 8. Anti-government concerns</p> <p><input type="checkbox"/> 9. Does not understand survey / Asks questions about the survey</p> <p><input type="checkbox"/> 10. Survey content does not apply (injured, healthy, no crimes to report)</p> <p><input type="checkbox"/> 11. Hang up / slams door on FR</p> <p><input type="checkbox"/> 12. Hostile or threatens FR</p> <p><input type="checkbox"/> 13. Other household members tell respondent not to participate</p> <p><input type="checkbox"/> 14. Talk only to specific household member</p> <p><input type="checkbox"/> 15. Family issues</p> <p><input type="checkbox"/> 16. Respondent requests same FR as last time</p> <p><input type="checkbox"/> 17. Gave that information last time</p> <p><input type="checkbox"/> 18. Asked too many personal questions last time</p> <p><input type="checkbox"/> 19. Too many interviews</p> <p><input type="checkbox"/> 20. Last interview took too long</p> <p><input type="checkbox"/> 21. Intends to quit survey</p> <p><input type="checkbox"/> 22. No concerns</p> <p><input type="checkbox"/> 23. Other - specify</p>	<p><b>• CONCERN / BEHAVIOR / RELUCTANCE</b></p> <p>• Select the categories that describe respondent concerns, behaviors, or reluctance during this contact attempt.</p> <p>• Enter all that apply, separate with commas.</p> <p><input type="checkbox"/> 1. Not interested</p> <p><input type="checkbox"/> 2. Too busy</p> <p><input type="checkbox"/> 3. Interview takes too much time</p> <p><input type="checkbox"/> 4. Scheduling difficulties</p> <p><input type="checkbox"/> 5. Survey is voluntary</p> <p><input type="checkbox"/> 6. Privacy concerns</p> <p><input type="checkbox"/> 7. Local / State / Federal government concerns</p> <p><input type="checkbox"/> 8. Asks questions about the survey</p> <p><input type="checkbox"/> 9. Hang-up / slams door on FR</p> <p><input type="checkbox"/> 10. Hostile or threatens FR</p> <p><input type="checkbox"/> 11. Family issues (death, illness, block participation in survey)</p> <p><input type="checkbox"/> 12. Gave that information last time</p> <p><input type="checkbox"/> 13. Asked too many personal questions last time</p> <p><input type="checkbox"/> 14. Too many interviews</p> <p><input type="checkbox"/> 15. Intends to quit survey</p> <p><input type="checkbox"/> 98. No concerns</p> <p><input type="checkbox"/> 99. Other - specify</p>

Source: Contact History Instrument, Original Version (2004-2013) and Revised Version (2014-Present)

**Figure 5: Contact Strategies Attempted Screen, Original Versus Revised CHI**

Original	Revised
<p><b>• CONTACT STRATEGIES ATTEMPTED</b></p> <p>• Select the categories that describe the strategies used on this contact attempt.</p> <p>• Enter all that apply, separate with commas.</p> <p><input type="checkbox"/> 1. Advance letter given</p> <p><input type="checkbox"/> 2. Scheduled appointment</p> <p><input type="checkbox"/> 3. Left note / appointment card</p> <p><input type="checkbox"/> 4. Left promotional packet / informational brochure</p> <p><input type="checkbox"/> 5. Called household</p> <p><input type="checkbox"/> 6. Left message on answering machine</p> <p><input type="checkbox"/> 7. FR will request No One Home Letter</p> <p><input type="checkbox"/> 8. FR will request Refusal Letter</p> <p><input type="checkbox"/> 9. FR will request Better Understanding Letter</p> <p><input type="checkbox"/> 10. Called contact persons</p> <p><input type="checkbox"/> 11. Stake-out</p> <p><input type="checkbox"/> 12. Checked with neighbors</p> <p><input type="checkbox"/> 13. Contacted other family members</p> <p><input type="checkbox"/> 14. Contacted property manager</p> <p><input type="checkbox"/> 15. Visited county assessor / post office / permit office</p> <p><input type="checkbox"/> 16. On-line tracking database</p> <p><input type="checkbox"/> 17. Sought help from SFR / RO</p> <p><input type="checkbox"/> 18. Reassignment</p> <p><input type="checkbox"/> 19. Offered incentive</p> <p><input type="checkbox"/> 20. CED double placement</p> <p><input type="checkbox"/> 21. Used MAF or ALMI</p> <p><input type="checkbox"/> 22. No Strategies</p> <p><input type="checkbox"/> 23. Other - specify</p>	<p><b>• CONTACT STRATEGIES ATTEMPTED</b></p> <p>• Select the categories that describe the strategies used on this contact attempt.</p> <p>• Enter all that apply, separate with commas.</p> <p><input type="checkbox"/> 1. Advance letter given</p> <p><input type="checkbox"/> 2. Scheduled appointment</p> <p><input type="checkbox"/> 3. Left note / appointment card</p> <p><input type="checkbox"/> 4. Left promotional packet / informational brochure</p> <p><input type="checkbox"/> 5. Called household</p> <p><input type="checkbox"/> 6. Left message on answering machine</p> <p><input type="checkbox"/> 7. Waited for respondent</p> <p><input type="checkbox"/> 8. Checked with neighbors</p> <p><input type="checkbox"/> 9. Contacted other family members</p> <p><input type="checkbox"/> 10. Contacted property manager / doorman</p> <p><input type="checkbox"/> 11. Offered incentive</p> <p><input type="checkbox"/> 12. CED double placement</p> <p><input type="checkbox"/> 98. No Strategies</p> <p><input type="checkbox"/> 99. Other - specify</p>

Source: Contact History Instrument, Original Version (2004-2013) and Revised Version (2014-Present)

Appendix A and B provide flowcharts describing the sequence of CHI screens based on FR responses for the old and new CHI, respectively.

In addition to the CHI changes, the CAPI training for Census Bureau FRs was revised to include more details on what is and is not a contact attempt. A review of existing CAPI training manuals

for the ACS and other surveys showed little explanation in the written text of a contact attempt (Nelson et al., 2014). Ideally, this would help FRs understand which instances are “true” contact attempts and which are not, and record these actions appropriately in CHI to improve the paradata quality.

This paper aims to evaluate how the 2014 CHI redesign impacted paradata quality. This paper also aims to help expand the literature on measurement error in survey paradata, as this error type is often not addressed but has serious implications for estimates of total survey error as previously discussed.

### 3. DATA & METHODS

The Census Bureau first launched the ACS in 1996 in a sample of counties across the country, and in 2005 the survey was expanded to include all U.S. counties. The sampling frame is derived from the Census Bureau’s Master Address File (MAF). Upon national implementation the Census Bureau first selected approximately 2.9 million housing unit (HU) addresses in the U.S. and 36,000 HU addresses in Puerto Rico per year, but in June 2011 the HU sample selection was increased to 3.54 million addresses per year. In addition the survey initially consisted of three modes (mail, telephone, and personal visit) but in January 2013 Internet was included as a fourth option (U.S. Census Bureau, 2014).

The annual ACS sample is further divided into twelve monthly independent samples. Data collection for each sample lasts for three months, with Internet and mail returns accepted during this entire period. If no response is received by Internet or mail within the first month, the Census Bureau follows up with computer-assisted telephone interviewing (CATI) when a telephone number is available. If still no response is received by Internet, mail, or telephone within the first two months, the address may be selected for CAPI; unmailable addresses<sup>2</sup> are also eligible for CAPI (U.S. Census Bureau, 2014).

In order to evaluate the impact of the 2014 CHI redesign on paradata quality, we conduct analyses on CHI data collected in the ACS. We compare distributions for several types of CHI data collected between January and June 2013, prior to the CHI redesign, with data collected between January and June 2014, after the redesign. One limitation of our analyses is that the CHI data are not collected in a controlled experiment. Although differences in CHI data between 2013 and 2014 may be due to the redesign, it is unknown to what extent some confounding factors may influence these differences as well.

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<sup>2</sup> An address is unmailable if the address is incomplete or directs mail to only a post office box.

Recall that the CHI is used by Census Bureau FRs to record information on contact attempts for CAPI cases only; thus, CHI data for the ACS are limited to sampled HUs with an unmailable address or that had not yet completed an Internet, mail, or telephone survey. Still, we are fortunate to have a large dataset of CHI records in ACS, since it is by far the largest survey for which CHI data are collected. Each six-month period in our analyses contains over 1.3 million CHI records from over 350,000 households. Table 2 lists the total number of CHI records in each period, as well as the number of households in each period associated with at least one CHI record. In total the average number of CHI records per household was similar in each period (3.74 in 2013, versus 3.78 in 2014).

**Table 2. ACS CHI Records and Households, January-June 2013 Versus January-June 2014**

	Year	
	Jan-June 2013	Jan-June 2014 *
CHI Records	1,322,851	1,378,221
Households	353,600	364,344

Source: ACS Contact History Instrument, January-June 2013 and January-June 2014.

\* A small number of ACS interviewers in the January-June 2014 period used the older version of CHI for some cases; these are excluded from the table and from all analyses presented here.

We first examine the possible impact of the revised options on the first CHI screens – that is, removing the “just looking” option and replacing it with the “Not Attempting Contact” option, as well as removing the “telephone” option and replacing it with new “telephone (incoming)” and “telephone (outgoing)” options. We compare distributions in mode for each period, including ghost records for which the mode field is blank. We expect that the new “Not Attempting Contact” option will reduce the occurrence of ghost records in 2014. Also, the distribution in “Not Attempting Contact” records versus ghost records in 2014 may give us an idea of how many ghost records in 2013 were due to (i) FRs bypassing the CHI after making a contact attempt, versus (ii) FRs performing actions other than contact attempts that the CHI could not capture. The new telephone options should provide new information for 2014 and may give us an idea of the 2013 split between these call types as well.

Second, we look at the possible impact of the follow-up screens for the new “Not Attempting Contact” option by analyzing the distribution of actions performed by FRs for these cases in 2014. Recall that past research found a higher proportion of CHI ghost records for the ACS than for other surveys; we expect that the “Doing ACS geocode verification” option will be selected frequently for 2014 cases since this is an activity unique to ACS and would explain the high occurrence of ghost records in ACS prior to the CHI redesign.

Third, we examine the possible impact of the changes to the CHI screens for respondent concerns and contact strategies by comparing distributions in the options selected from these screens in each period. We may see a sizable increase in selection of the “Other” option due to

the reduced categories, though we do not expect this to be the case, given these options were removed in 2014 because they were rarely selected in 2013. We may also see differences between years for those options that were reworded, though we will not be able to say definitively whether these differences are due to a clearer understanding of these options or due to factors independent of the CHI redesign.

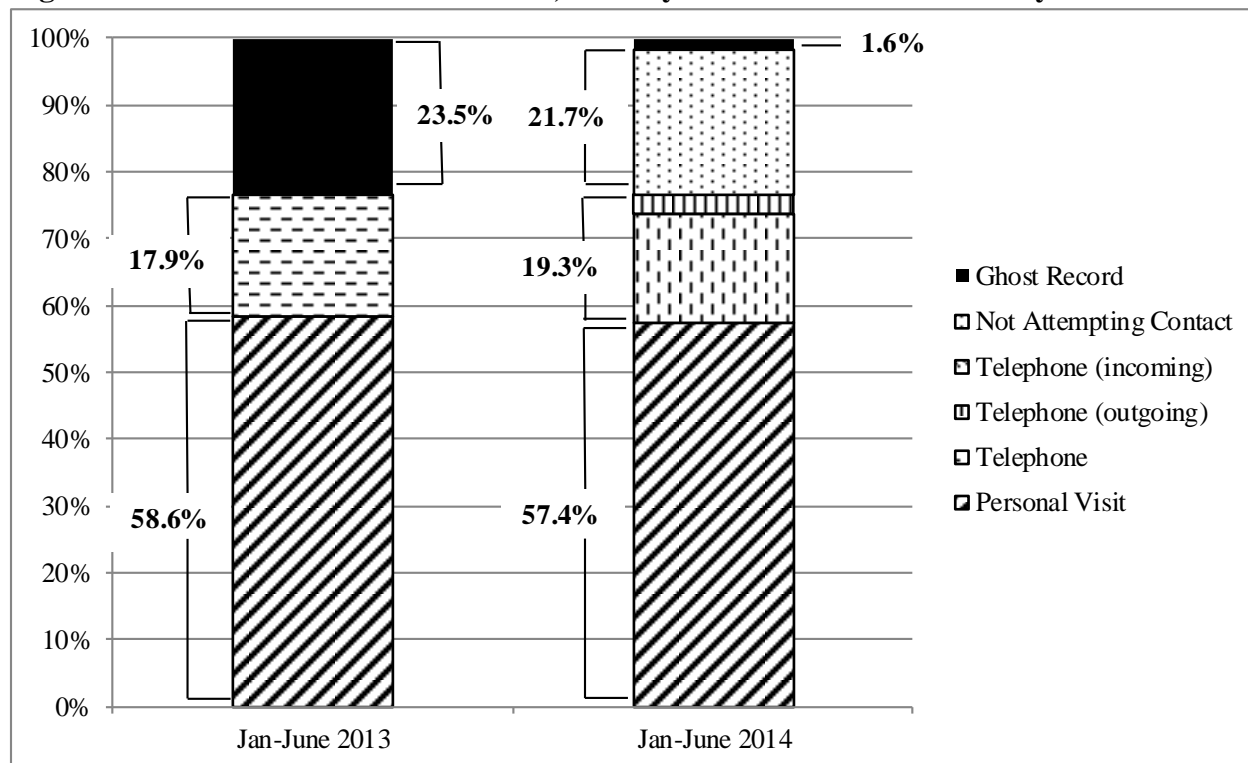
Fourth, we examine whether Census FRs were clearer on what does and does not comprise a contact attempt by comparing distributions for the average number of CHI records per household that were recorded as “true” contact attempts (that is, with a recorded mode of personal visit or telephone rather than “Not Attempting Contact” or ghost record) in each period. Past debriefing sessions with FRs found that prior to the CHI redesign some FRs filled out CHI records for activities that were not truly contact attempts, such as geocode verification, thereby inflating the number of perceived contact attempts. The CHI redesign clarified that this activity and others are not considered contact attempts, and were listed as response options under the follow-up screen for the new “Not Attempting Contact” option introduced in 2014. If we find the average number of “true” contact attempts decreased in 2014 it could suggest that FRs had a clearer understanding of how to define contact attempts.

Finally, we examine whether underlying constructs noted in prior research from the CHI respondent concerns screen are still being captured by conducting a factor analysis on these options before and after the redesign. Earlier studies consistently found four underlying constructs for CHI records from non-longitudinal surveys such as ACS, and five constructs for CHI records from longitudinal surveys (Maitland et al. 2008; Maitland et al. 2009; Dahlhamer & Simile 2009; Gonzalez & Kreuter 2010; Erdman 2012).

#### **4. RESULTS**

Figure 6 displays the mode distribution for all ACS CHI records from the January through June 2013 period - under the old instrument - and from the January through June 2014 period - under the new, redesigned instrument. This includes “Not Attempting Contact” situations for the new 2014 version as well as ghost records for both versions. Comparing 2013 and 2014, we find similar proportions for personal visits and for telephone contacts. The percentage of personal visits differs by about one percent (58.6 percent in 2013, versus 57.4 percent in 2014), as does the percentage of telephone contacts (17.9 percent in 2013, versus 19.3 percent in 2014). Most of the telephone contacts in 2014 were outgoing (16.4 percent) as opposed to incoming (2.9 percent). In both years, the combined percentage of personal visits and telephone contacts made up over three-quarters of all CHI records (76.5 percent in 2013, and similarly, 76.7 percent in 2014).

**Figure 6. ACS CHI Mode Distributions, January-June 2013 Versus January-June 2014**



Source: ACS Contact History Instrument, January-June 2013 and January-June 2014.

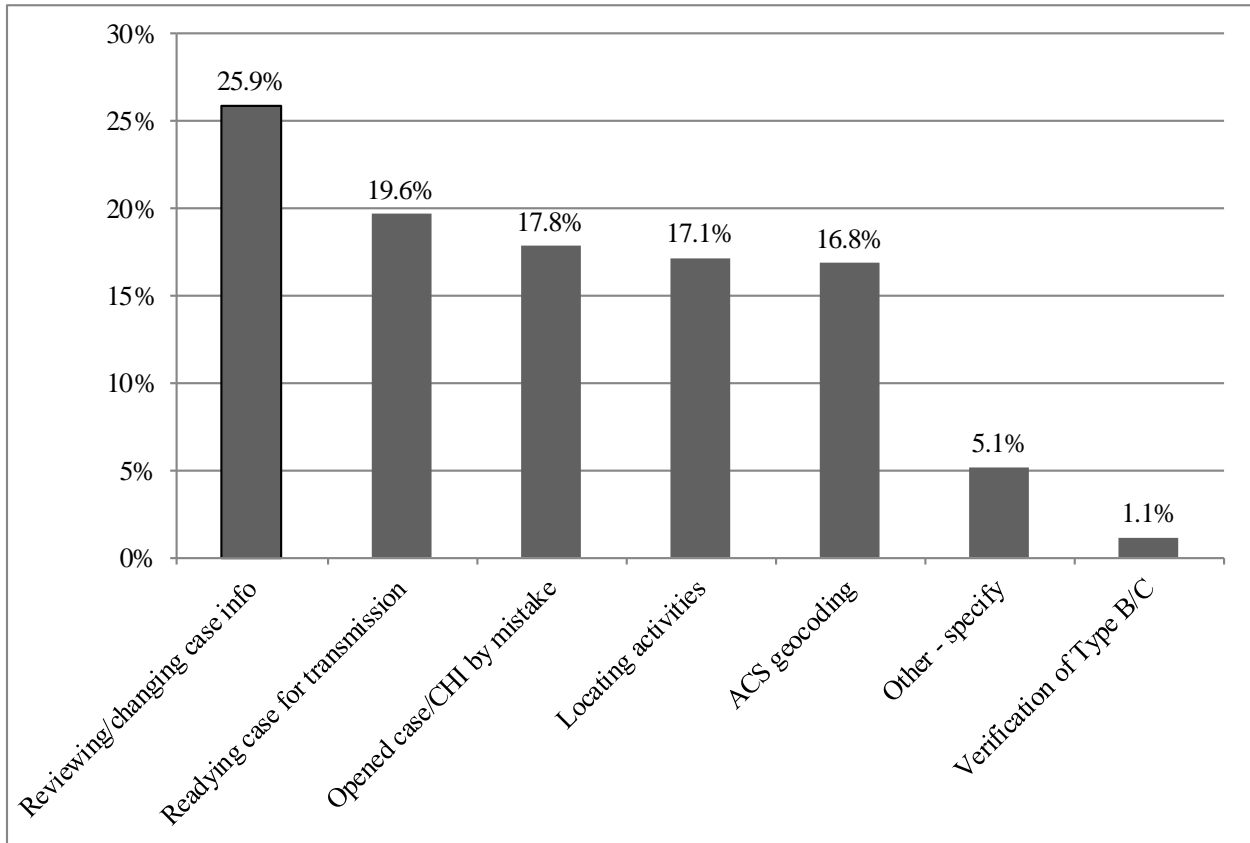
In addition, we find a reduction in ghost records in 2014. While ghost records made up nearly twenty-four percent of all CHI records in 2013, they made up less than two percent of all CHI records in 2014. The new “Not Attempting Contact” option made up nearly twenty-two percent of all records in 2014, thereby reducing the number of ghost records by ninety-three percent! Given the similarities in distribution between years otherwise, this makes a strong case that most ghost records on the old instrument were due to FRs performing actions other than contact attempts, and that these blank records were not bypassed contact attempts.

Figure 7 displays the ACS distribution of “Not Attempting Contact” records on the new instrument in January through June 2014. The most common occurrence was “reviewing/ changing case info” in about twenty-six percent of all cases. The next four – “reading case for transmission,” “opened case/CHI by mistake,” “locating activities,” and “ACS geocoding” – each made up between fifteen and twenty percent of all cases. Recall that geocoding is an activity unique to the ACS. The frequency of this activity in the ACS in 2014 provides a likely explanation of why more CHI ghost records were generated for the ACS than for other surveys – FRs were probably geocoding at a similar rate in ACS in 2013, prior to the CHI redesign.



“Verification of Type B/C,” which refers to verifying sample units as ineligible, was the least common occurrence at about one percent.

**Figure 7. ACS CHI “Not Attempting Contact” Distribution, January-June 2014**



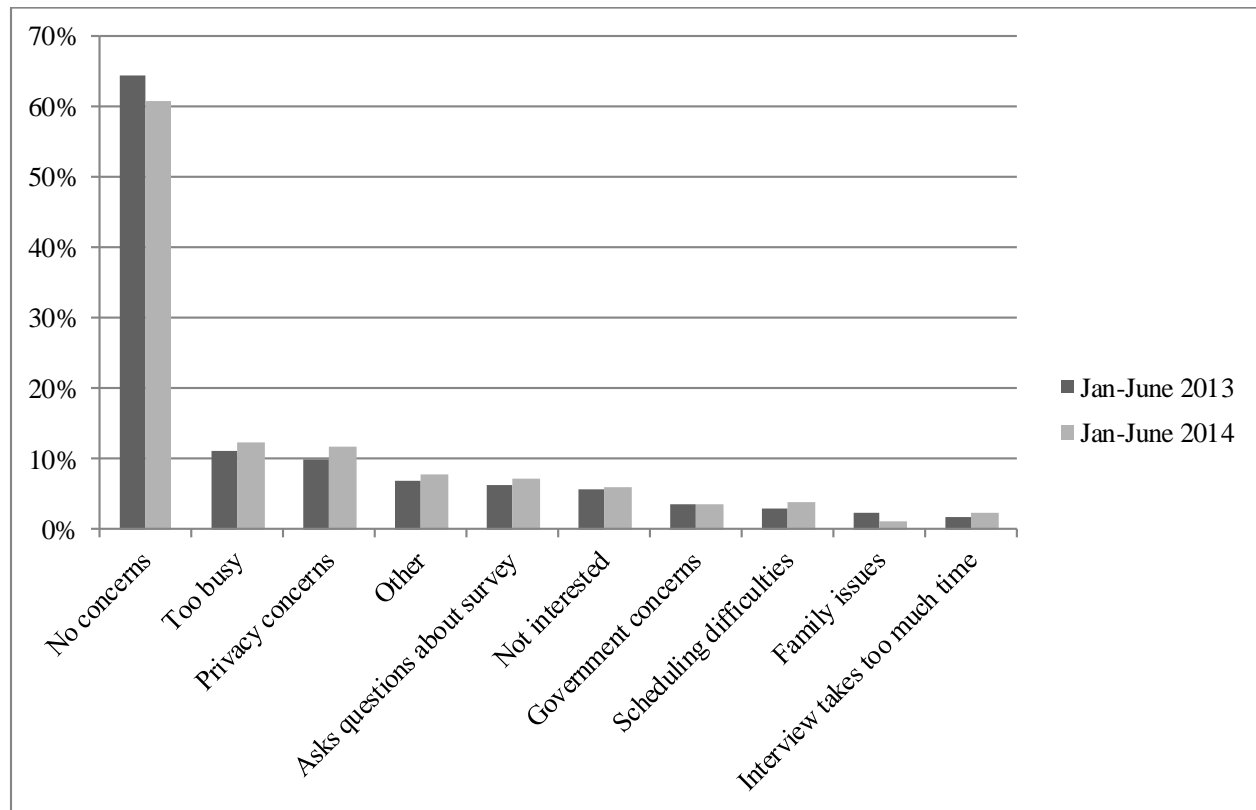
Source: ACS Contact History Instrument, January-June 2014

The “Other” option was only selected in about five percent of all cases; hence, the new options for this path appear to provide a good representation of FR activities when they are not attempting contact.

Figure 8 displays the distributions of the ten most frequently selected reluctance observations within each period for cases in which contact was made with a respondent or nonrespondent. Each of these observations was selected in at least two percent of these cases in one year or both; the observations selected less frequently than this are not displayed here. The distributions are similar for each year in spite of the revised options in 2014. “No concerns” is the most frequent selection and had about a three percent drop in 2014 (64.3 percent in 2013, versus 60.9 percent in 2014). For all remaining options that existed in both years the difference was about two percent or less. We find that the increase in 2014 for the “Other” option is about one percent (7.0 percent in 2013, versus 7.7 percent in 2014). None of the options that were unique to 2013 were

part of the top ten selected that year – had these been more frequently selected in 2013 but still removed, we may have found a higher increase in selection of the “Other” option in 2014.

**Figure 8. ACS CHI Top Ten “Concern/Behavior/Reluctance” Distributions, January-June 2013 Versus January-June 2014**



Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

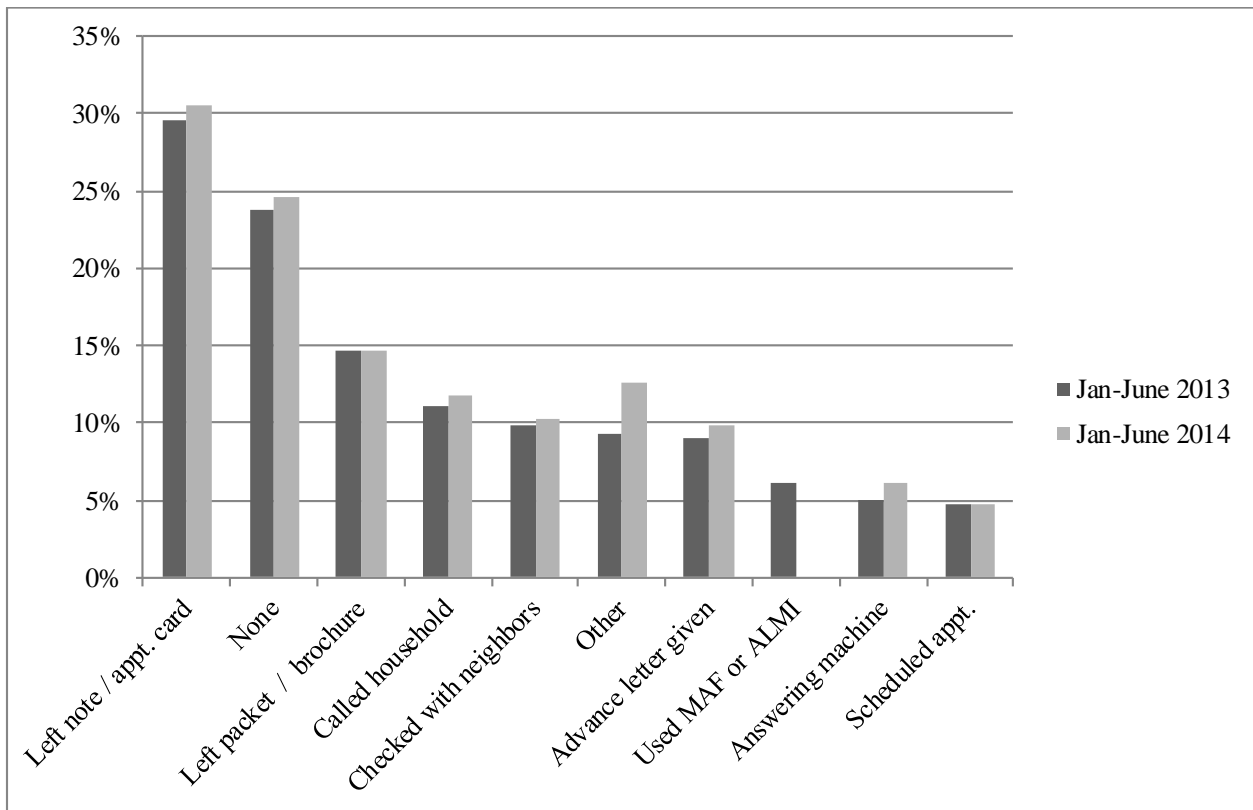
For 2013, the label “Asks questions about survey” refers to the option “Does not understand survey/asks questions about survey,” “Not interested” refers to the option “Not interested/does not want to be bothered,” “Government concerns” refers to the option “Anti-government concerns,” and “Family issues” refers to any of three options (“Other household members tell respondent not to participate,” “Talk only to specific household member,” or “Family issues”).

For 2014, the label “Government concerns” refers to the option “Local/state/Federal government concerns,” and “Family issues” refers to the option “Family issues (death, illness, block participation in survey).”

Figure 9 displays the distributions of the ten most frequently selected contact strategies used by FRs within each period. Except for the tenth most common strategy (“Scheduled appointment”), each of these was selected in at least five percent of these cases in both years; the remaining strategies are not displayed here. Again, the distributions are similar in spite of the revised options in 2014. “Left note/appt. card” is the most frequent selection and had about a one percent increase in 2014 (29.5 percent in 2013, versus 30.6 percent in 2014). For most remaining options that existed in both years the difference is about one percent or less. The “Other” option, however, had about a three percent increase (9.3 percent in 2013, versus 12.6

percent in 2014). This is likely driven by the reduction in options from twenty-three to fourteen (versus twenty-three to seventeen for respondent concerns).

**Figure 9. ACS CHI Top Ten “Contact Strategies Attempted” Distributions, January-June 2013 Versus January-June 2014**



Source: ACS Contact History Instrument, January-June 2013 and January-June 2014.

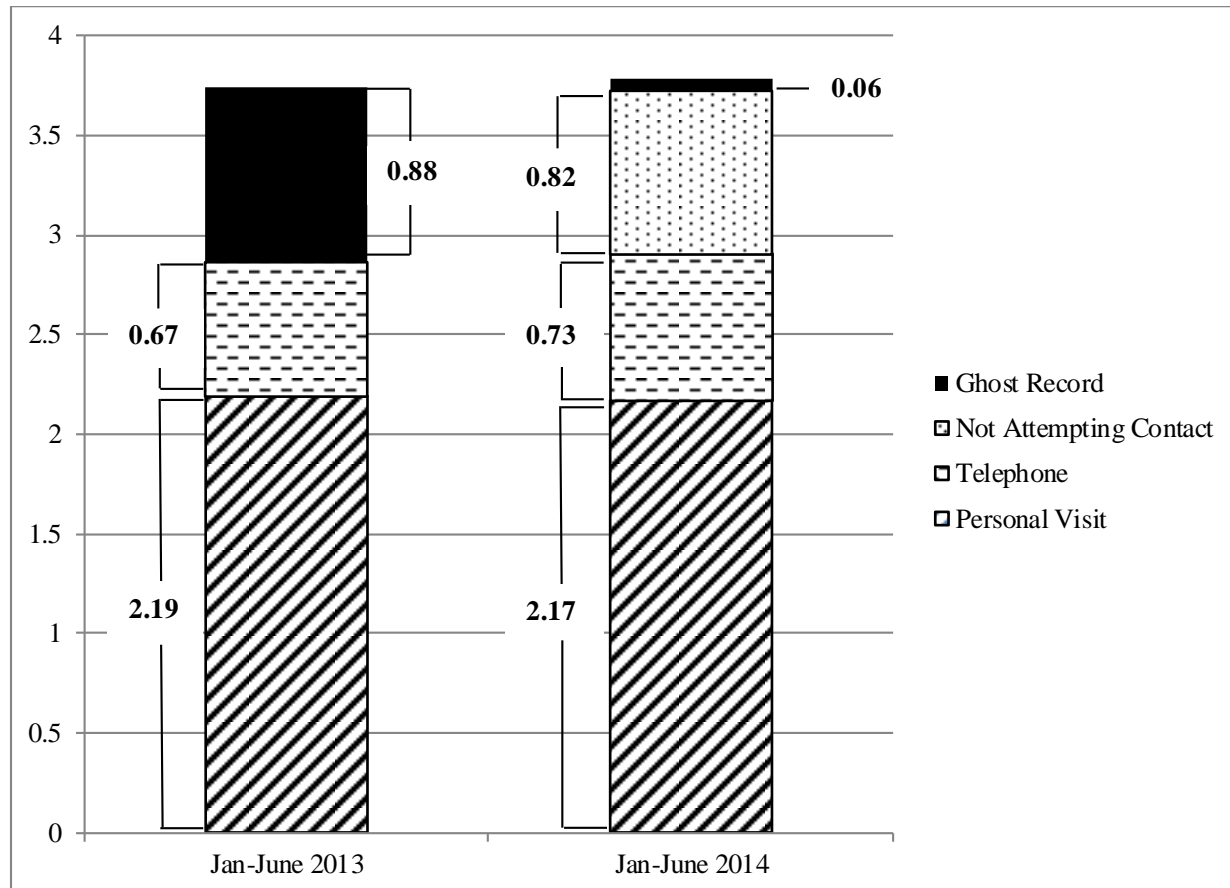
For 2013, the label “Called household” refers to either of two options (“Called household” or “Called contact persons”).

Figure 9 also shows that the “Used MAF or ALMI” option was part of the top ten contact strategies selected in 2013; this was among the options removed for 2014. Past debriefing sessions revealed that this option was interpreted in many ways by FRs and was sometimes used to record actions besides contact attempts, such as geocoding or locating activities. On the 2014 instrument these were listed as options under the “Not Attempting Contact” screen. This raises the question of whether the total number of contact attempts dropped in 2014, since FRs were clearer in 2014 on what cases were “true” contact attempts and what cases were not.

In Figure 10, we revisit the distribution of all ACS CHI records by mode, but show the average number of records per housing unit instead of the percent of total records. The “true” contact attempts are, in theory, those records marked with a mode of “Personal Visit” or “Telephone” (we combine incoming and outgoing telephone cases for 2014 here). The average number of “true” contact attempts per household is similar from 2013 (at 2.86) to 2014 (at 2.90), with a

difference of about 0.04 (with about 0.02 fewer personal visits and about 0.06 more telephone attempts in 2014). Although FRs in 2013 occasionally completed CHI information when they were not attempting contact, it appears this did not occur enough to result in greater inflation of the number of “true” contact attempts.

**Figure 10. ACS CHI Mode Distributions (Average No. Records per Housing Unit), January-June 2013 Versus January-June 2014**



Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

In 2013 the average number of ghost records per household was about 0.88, and this was reduced to about 0.06 in 2014 due to the “Not Attempting Contact” option. In total the average number of CHI records per housing unit was similar as well (3.74 in 2013, versus 3.78 in 2014).

Finally, Table 3 provides the results of a factor analysis on the “Concern/Behavior/Reluctance” options on the old and new versions of CHI. In following with the underlying constructs named by Dahlhamer and Simile (2009) in their factor analysis of the options in the 2007 NHIS, we omit longitudinal-type options as well as “No Concerns” and the “Other” option.

**Table 3. ACS CHI Factor Analysis for “Concern/Behavior/Reluctance” Options, January-June 2013 Versus January-June 2014**

<b>Factor</b>	<b>CHI Option</b>	<b>Jan-June 2013</b>	<b>Jan-June 2014</b>
F1 (“Survey content/privacy”)	Survey is voluntary	✓	✓
	Privacy concerns	✓	✓
	Government concerns	✓	✓
	Asks questions about the survey	✓	✓
	Survey content does not apply (retired, healthy, no crimes to report)	✓	NA
F2 (“Time constraints”)	Too busy	✓	✓
	Interview takes too much time	✓	✓
	Breaks appointments (puts off FR indefinitely)	✓	NA
	Scheduling difficulties	✓	✓
	Family issues (death, illness, block participation in survey)	NA	✓
F3 (“Hostility/hard refusal”)	Not interested	✓	✓
	Hang-up/slams door on FR	✓	✓
	Hostile or threatens FR	✓	✓
F4 (“Gate-keeping”)	Other household members tell respondent not to participate	✓	NA
	Talk only to specific household member	✓	
	Family issues	✓	

Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

For 2013, the label “Government concerns” refers to the option “Anti-government concerns,” “Asks questions about survey” refers to the option “Does not understand survey/asks questions about survey,” and “Not interested” refers to the option “Not interested/does not want to be bothered.”

For 2014, the label “Government concerns” refers to the option “Local/state/Federal government concerns.”

Also in keeping with Dahlhamer and Simile (2009), we use tetrachoric correlations as an input; a factor analysis of fifteen concerns was performed for 2013, and a factor analysis of eleven concerns was performed for 2014. Using a promax rotation of the initial factor solution, we find that four factors are derived from the fifteen concern options in 2013. Further, our results are the same as those of Dahlhamer and Simile (2009) in that the same options correspond to the same factors. Five options correspond to “F1” (or “Survey content/privacy,” as named by the authors), four options correspond to “F2” (or “Time constraints”), three options correspond to “F3” (or “Hostility/hard refusal”), and three options correspond to “F4” (or “Gate-keeping”). Thus, these four underlying constructs remained across surveys. See Appendix C for detailed tables with coefficients, based on output from a factor analysis run in SAS.

After the CHI redesign, however, we find that only three factors are derived from the eleven concern options in 2014. Four options which are the same as or reworded from options in the earlier CHI version correspond to “F1” (“Survey content/privacy”). Three options which are the

same as or reworded from options in the earlier CHI version correspond to “F3” (“Hostility/hard refusal”) - this is unchanged from the results prior to redesign. However, the remaining four options which are the same as or reworded from options in the earlier CHI version correspond to “F2,” and none correspond to “F4.”

Three of these four options – “Not interested,” “Too busy,” and “Interview takes too much time” – also corresponded to “F2” (“Time constraints”) in 2013. The last 2014 option, “Family issues (death, illness, block participation in survey)” corresponds to “F2” as well. In theory this option would encompass the three options from 2013 that corresponded to “Gate-keeping” (“F4”) before they were removed – these were “Other household members tell respondent not to participate,” “Talk only to specific household member,” and “Family issues.” However, it appears that removing these three options and replacing them with a single option causes two of the underlying constructs – “Time constraints” and “Gate-keeping” – to combine into a single construct.

## **5. DISCUSSION**

Overall, the 2014 CHI redesign and the revised CAPI training for FRs appear to have impacted ACS paradata collection by reducing measurement error, and thus improving paradata quality with more complete records. We observed a ninety-three percent reduction in ghost records – these records comprised nearly twenty-four percent of all CHI records in 2013 but less than two percent in 2014. This reduction was driven by the new “Not Attempting Contact” option. Aside from this difference, the similarity in mode distribution before and after the redesign suggests that prior to the redesign most CHI ghost records were due to FRs performing actions other than contact attempts, rather than FRs bypassing contact attempts.

The “Not Attempting Contact” option and its accompanying follow-up screen provided new information on the FR level of effort activities in addition to survey contact attempts. These activities made up nearly twenty-two percent of all CHI records in 2014, and probably made up about the same proportion in 2013 but could not be identified as such prior to the redesign. The six specific options on the follow-up screen were a good representation of these activities, since the “Other” option was only selected in about five percent of these cases. FRs were doing ACS geocode verification in about seventeen percent of these cases, which likely explains the higher proportion of ghost records in ACS than in other surveys prior to the CHI redesign.

The reduction in categories to the “Concern/Behavior/Reluctance” screen and to the “Contact Strategies Attempted” screen had minimal impact on the distribution of recorded concerns. The distributions for each were similar before and after the redesign; selection of the “Other” option was higher by about one percent for respondent concerns and by about three percent for contact

strategies after the redesign. None of the respondent concern options that were removed in 2014 were among the ten most frequently selected in 2013, and one of the contact strategy options that was removed in 2014 was among the ten most frequently selected in 2013 (“Used MAF or ALMI”). This option was sometimes selected for cases that were not true contact attempts, which was clarified by the CHI redesign.

The CHI redesign sought to clarify for FRs which cases are contact attempts and which are not, as did the revised CAPI training. While these may have had the desired result, our findings show that the average number of recorded “true” contact attempts per household was similar after the redesign. It is difficult to ascertain how often FRs entered other activities as contact attempts prior to the redesign other than explicit cases in which they selected the “Other” option to type in these activities, frequently selecting “Used MAF or ALMI” as well.

Finally, the reduction and rewording of options on the “Concern/Behavior/Reluctance” screen led to a reduction in the detectable underlying constructs. A factor analysis shows that the constructs “Survey content/privacy” and “Hostility/hard refusal” are still clearly detectable under the CHI redesign, while the previously detectable “Gate-keeping” construct becomes confounded with the “Time constraints” construct.

While the CHI redesign and revised FR training likely had an impact in reducing measurement error, which in turn improved paradata quality, the CHI data were not collected in a controlled experiment. Thus, it is unknown to what extent some factors other than the redesign may have influenced differences in data between 2013 and 2014. In addition, other sources of measurement error may remain. These include “drive-by” contact attempts by FRs that they may choose not to record, as this activity would not automatically launch either version of the instrument.

This research addresses the largely unexplored issue of measurement error in paradata and presents a case study in which this was successfully reduced. Given the similarities in distribution between years otherwise, this makes a strong case that most ghost records on the old instrument were due to FRs performing actions other than contact attempts, and that these blank records were not bypassed contact attempts. Although FRs in 2013 occasionally completed CHI information when they were not attempting contact, it appears this did not occur enough to greatly inflate the number of “true” contact attempts. Further research is needed on measurement error in survey paradata, as it may bear serious implications for total survey error.

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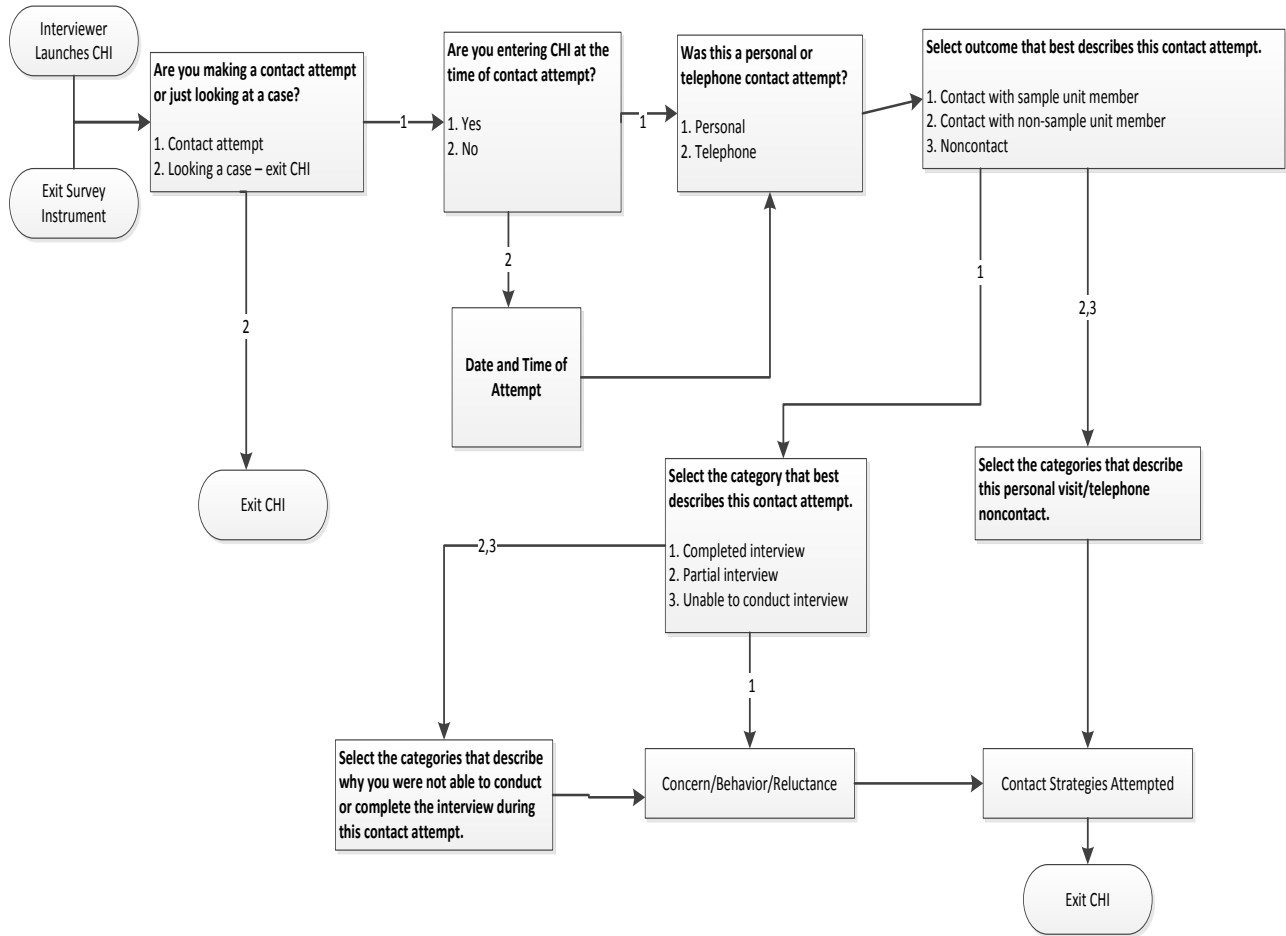
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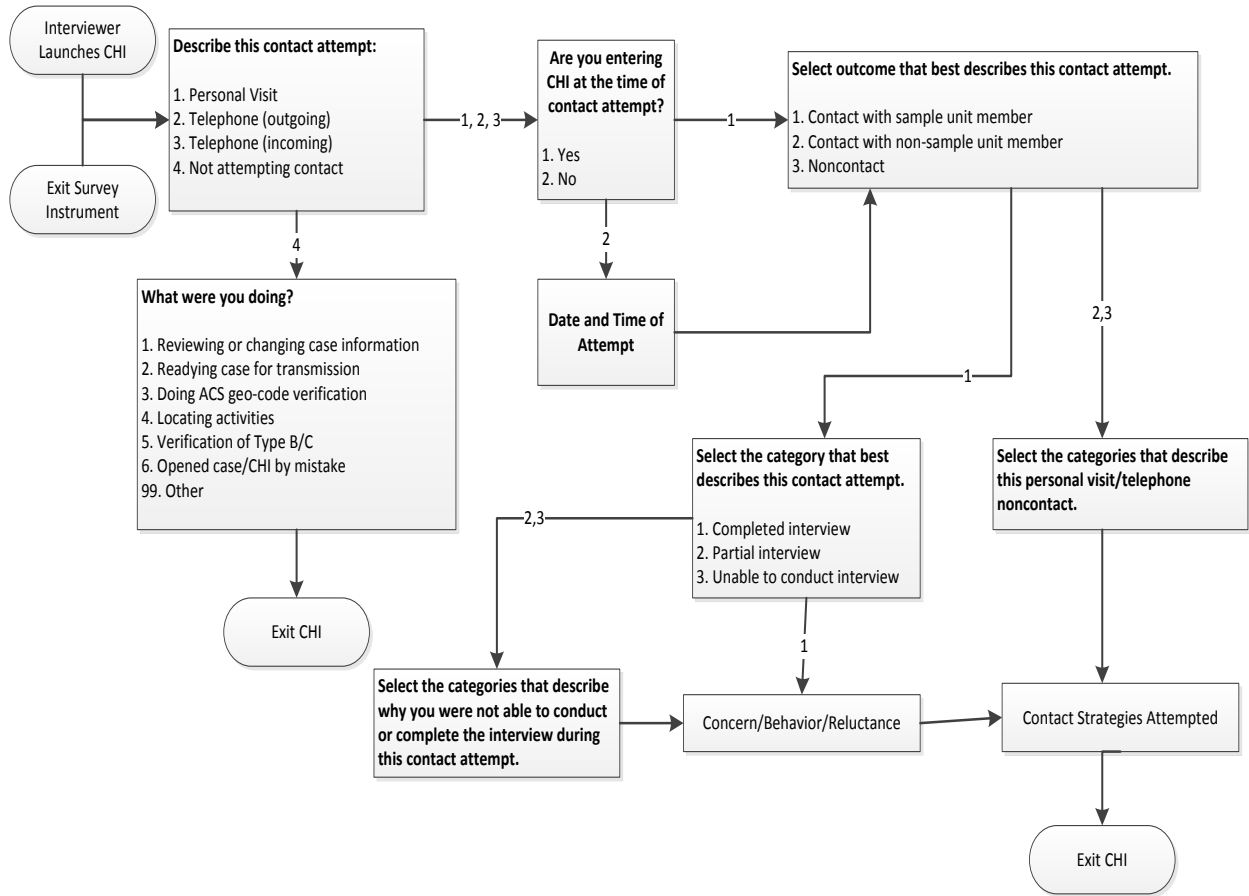
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## APPENDIX A – Contact History Instrument Flowchart, Original Version (2004-2013)



## APPENDIX B – Contact History Instrument Flowchart, Revised Version (2014-Present)



**APPENDIX C – SAS Output from ACS CHI Factor Analysis for  
“Concern/Behavior/Reluctance” Options, January-June 2013 Versus January-June 2014**

**Table C1. ACS CHI Factor Analysis Coefficients, Rotated Factor Pattern under Varimax Prerotation Method**

Factor	CHI Option	All CHI Records		CHI Records with Any Concern Options Recorded	
		2013	2014	2013	2014
F1 (“Survey content/privacy”)	Survey is voluntary	0.65	0.61	0.61	0.58
	Privacy concerns	0.84	0.84	0.84	0.85
	Government concerns	0.77	0.77	0.76	0.76
	Asks questions about the survey	0.67	0.70	0.61	0.64
	Survey content does not apply (retired, healthy, no crimes to report)	0.66	NA	0.64	NA
F2 (“Time constraints”)	Too busy	0.71	0.74	0.65	0.65
	Interview takes too much time	0.67	0.71	0.65	0.70
	Breaks appointments (puts off FR indefinitely)	0.62	NA	0.56	NA
	Scheduling difficulties	0.66	0.69	0.57	0.58
	Family issues (death, illness, block participation in survey)	NA	0.42	NA	0.28
F3 (“Hostility/hard refusal”)	Not interested	0.58	0.63	0.56	0.59
	Hang-up/slams door on FR	0.72	0.72	0.70	0.68
	Hostile or threatens FR	0.70	0.72	0.69	0.69
F4 (“Gate-keeping”)	Other household members tell respondent not to participate	0.52	NA	0.47	NA
	Talk only to specific household member	0.60		0.56	
	Family issues	0.51		0.47	

Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

For 2013, the label “Government concerns” refers to the option “Anti-government concerns,” “Asks questions about survey” refers to the option “Does not understand survey/asks questions about survey,” and “Not interested” refers to the option “Not interested/does not want to be bothered.”

For 2014, the label “Government concerns” refers to the option “Local/state/Federal government concerns.”

The column “All CHI Records” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the dataset of all CHI records in each period.

The column “CHI Records with Any Concern Options Recorded” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the subset of CHI records in which any concern option was recorded, including those not listed in the table.

**Table C2. ACS CHI Factor Analysis Coefficients, Target Matrix for Procrustean Transformation under Promax Rotation Method**

Factor	CHI Option	All CHI Records		CHI Records with Any Concern Options Recorded	
		2013	2014	2013	2014
F1 (“Survey content/ privacy”)	Survey is voluntary	0.75	0.63	0.70	0.58
	Privacy concerns	1.00	1.00	1.00	0.99
	Government concerns	0.81	0.85	0.73	0.78
	Asks questions about the survey	0.81	0.98	0.86	1.00
	Survey content does not apply (retired, healthy, no crimes to report)	0.78	NA	0.70	NA
F2 (“Time constraints”)	Too busy	1.00	0.91	1.00	0.99
	Interview takes too much time	0.67	0.67	0.60	0.68
	Breaks appointments (puts off FR indefinitely)	0.73	NA	0.58	NA
	Scheduling difficulties	0.88	1.00	0.69	1.00
	Family issues (death, illness, block participation in survey)	NA	0.65	NA	0.71
F3 (“Hostility/ hard refusal”)	Not interested	0.36	0.42	0.35	0.41
	Hang-up/slams door on FR	1.00	1.00	1.00	1.00
	Hostile or threatens FR	0.76	0.80	0.74	0.79
F4 (“Gate-keeping”)	Other household members tell respondent not to participate	0.39	NA	0.31	NA
	Talk only to specific household member	1.00		1.00	
	Family issues	0.54		0.53	

Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

For 2013, the label “Government concerns” refers to the option “Anti-government concerns,” “Asks questions about survey” refers to the option “Does not understand survey/asks questions about survey,” and “Not interested” refers to the option “Not interested/does not want to be bothered.”

For 2014, the label “Government concerns” refers to the option “Local/state/Federal government concerns.”

The column “All CHI Records” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the dataset of all CHI records in each period.

The column “CHI Records with Any Concern Options Recorded” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the subset of CHI records in which any concern option was recorded, including those not listed in the table.

**Table C3. ACS CHI Factor Analysis Coefficients, Rotated Factor Pattern with Standardized Regression Coefficients under Promax Rotation Method**

Factor	CHI Option	All CHI Records		CHI Records with Any Concern Options Recorded	
		2013	2014	2013	2014
F1 (“Survey content/ privacy”)	Survey is voluntary	0.65	0.57	0.60	0.54
	Privacy concerns	0.94	0.92	0.94	0.92
	Government concerns	0.79	0.80	0.75	0.77
	Asks questions about the survey	0.73	0.79	0.69	0.73
	Survey content does not apply (retired, healthy, no crimes to report)	0.67	NA	0.62	NA
F2 (“Time constraints”)	Too busy	0.74	0.78	0.69	0.69
	Interview takes too much time	0.64	0.67	0.63	0.67
	Breaks appointments (puts off FR indefinitely)	0.62	NA	0.54	NA
	Scheduling difficulties	0.69	0.76	0.58	0.62
	Family issues (death, illness, block participation in survey)	NA	0.40	NA	0.27
F3 (“Hostility/ hard refusal”)	Not interested	0.49	0.55	0.49	0.54
	Hang-up/slams door on FR	0.79	0.81	0.79	0.78
	Hostile or threatens FR	0.71	0.75	0.71	0.71
F4 (“Gate-keeping”)	Other household members tell respondent not to participate	0.46	NA	0.43	NA
	Talk only to specific household member	0.60		0.57	
	Family issues	0.45		0.43	

Source: ACS Contact History Instrument, January-June 2013 and January-June 2014

For 2013, the label “Government concerns” refers to the option “Anti-government concerns,” “Asks questions about survey” refers to the option “Does not understand survey/asks questions about survey,” and “Not interested” refers to the option “Not interested/does not want to be bothered.”

For 2014, the label “Government concerns” refers to the option “Local/state/Federal government concerns.”

The column “All CHI Records” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the dataset of all CHI records in each period.

The column “CHI Records with Any Concern Options Recorded” refers to an input of tetrachoric correlations between concern options in the table, when drawing from the subset of CHI records in which any concern option was recorded, including those not listed in the table.