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Subject: 2020 Census Experiment: Optimization of Self-Response in the 2020 Census Experiment Study Plan

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This memorandum releases the final version of the 2020 Census Experiment: Optimization of Self-Response in the 2020 Census Experiment Study Plan, which is part of the 2020 Census Program for Evaluations and Experiments (CPEX). **This updated study plan replaces the version originally released on June 3, 2019.** For specific content related questions, you may also contact the authors:

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2020 Census Experiment

Optimization of Self-Response in the 2020 Census Experiment
Study Plan

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I.   Introduction

Self-response in the 2020 Census includes several major differences relative to the 2010 Census, including: 1. An internet response option that allows for response with or without a unique Census ID; 2. Tailored mail contact strategies in which different geographic areas receive different mail materials for a total of up to five mailings; 3. A telephone number for Census Questionnaire Assistance (CQA) available on all mailings that allow callers to provide their census data by phone; 4. Responses in multiple modes, using multiple device types, and in multiple languages; 5. An integrated partnership and communications program that features local and national partnerships and micro targeted advertising to promote self-response; 6. Instead of delivering the mailings to the whole country on a single day, each of the five mailings will be stretched out over a one-week period into groups of four different mail cohorts. All of these response features are a part of the innovation area called Optimizing Self-Response (OSR) for the 2020 Census, and they primarily apply to the Type of Enumeration Area (TEA) called Self-Response. Other TEAs will be contacted and enumerated, but are out of the scope of this experiment.

This experiment seeks to understand the net impacts of the OSR innovation area in the 2020 Census. In particular, the focus is to evaluate the quantitative impacts of the mailing strategy, the overall influence of the internet response option, and the impact of the communications campaign on internet and phone response. Therefore, the following experimental treatments will be tested (strategies discussed in further detail in the next section):

- A sample of housing units will receive the 2010 Census mail strategy.
- A sample of housing units will receive the 2020 Census mail strategy with no mention of the option to respond via the internet.
- A sample of housing units will have their mail contact strategy switched between Internet Choice and Internet First.
- A sample of housing units will receive no direct mailings from the Census Bureau.

II.   Background

Maximizing rates of self-response, both overall (paper, internet, and Census Questionnaire Assistance) and on the internet, is an important way to lower cost for the 2020 Decennial Census. Any household that does not self-respond will be sent to Nonresponse Followup, which is a much costlier operation. Among the self-response modes, internet self-response is the most cost-effective. Results of prior OSR research embedded within earlier census tests or other survey operations, contributed to the design of the contact strategies for the 2020 Census. Middecade testing between 2010 and 2020 was designed to improve self-response rates, with the 2010 Census as the starting point. Discussion of the results from the 2010 Census and the middecade tests follows.

2010 Census. The 2010 Census used a mailing strategy consisting of multiple contacts, which included the use of a replacement questionnaire, a second questionnaire sent to housing units that

had already received the first questionnaire, not used in the 2000 Census. The multiple contacts in the 2010 Census included:

- An advance letter alerting households that the census questionnaire would be sent to them soon.
- The initial questionnaire.
- A direct mail postcard to select areas, providing information to Chinese, Korean, Vietnamese, and Russian speaking households on how to obtain assistance in completing their questionnaire.
- The reminder postcard, which served as a reminder to those who had not yet mailed back their questionnaire, and as a thank you to those who had.
- An English-only replacement questionnaire distributed in one of three treatments:
    - Blanket replacement mailing – where all households within the treatment area received a replacement questionnaire, regardless of whether or not they sent back their initial questionnaire.

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    - Target replacement mailing – where households within treated areas only received a replacement questionnaire if their initial questionnaire had not been received and scanned into the system by a predetermined date. Postal tracking data were used to identify Undeliverable as Addressed that were not yet checked in, so that the addresses were not sent a questionnaire.
    - No replacement mailing – where households within treated areas did not receive a replacement questionnaire, regardless of whether or not they sent back their initial questionnaire.

The final mail response rate after the Nonresponse Followup operation was approximately 67 percent, with approximately 3 percentage points coming from the replacement questionnaire. Mail response rates followed a similar pattern to mail response rates from the 2000 Census, which did not have a replacement mailing. Results also indicated that a full-scale replacement questionnaire ought to be mailed to the entire country, not just certain areas. (Letourneau, 2012).

To determine which housing units would receive a bilingual Spanish/English questionnaire in the initial mailout of the 2010 Census, data from the 2005-2007 American Community Survey (ACS) were used. Spanish language assistance is defined as those housing units in which at least one adult (age 15 or older) in the household speaks Spanish and does not speak English "very well." An entire geographic tract is identified as bilingual, meaning that all housing units in the tract receive the bilingual mailing materials, if the number of Spanish language assistance housing units is at least 20 percent of the occupied units in the tract. This threshold was operationally feasible as well since the number of bilingual questionnaires produced was budgeted to be approximately 10 percent of the mailout workload, or about 13 million housing units. Data from the 2000 Census long form were used for comparison and analytical purposes (Bentley, 2008). The same threshold was used in subsequent middecade tests.

Unlike the design of the 2020 Census, the 2010 Census: 1. Did not include an internet response option; 2. Offered telephone interviews only during a limited window of time; 3. Had fewer

mailings to encourage response; 4. Provided a replacement paper questionnaire to some geographic areas only; 5. Provided a Be Counted Form option for people who may not have received a questionnaire or felt they were not counted; 6. Offered assistance in fewer languages; 7. Included an integrated partnership and communications program but with less emphasis on partnerships and targeted advertising to promote responses; 8. Delivered the mailings to the entire country in a single day. In this experiment, the 2010 Census Panel will be similar to that of the actual 2010 Census but will exclude the Be Counted Form option and include the 2020 Census integrated partnership and communications program that emphasizes partnerships and targets advertising to promote responses.

2012 National Census Test. In the 2012 National Census Test, six contact strategy panels were experimentally tested, in addition to other content testing. The Internet Push panel, which did not include the advance letter used in the 2010 Census and included a second reminder postcard before the questionnaire, had a positive impact on both internet and overall self-response rates. As a result, this panel was recommended for self-response in future testing (Bentley et al., 2014).

Because of timing and resource constraints, the 2012 National Census Test was only able to test materials and the internet response mode in English. It was therefore recommended to test the inclusion of another language in order to determine whether response patterns differ for those with limited English proficiency (Bentley et al., 2014). This was done in the 2015 National Content Test with the testing of three language panels using Spanish as the second language.

2013 American Community Survey. The American Community Survey (ACS) gave respondents the opportunity to use the internet to self-respond for the first time in 2013. The ACS used a push notification strategy to encourage internet self-response. In this strategy, respondents were first presented with an internet invitation before receiving a paper questionnaire. Analysis of the first quarter ACS 2013 data investigated whether hard-to-interview groups (as defined by Joshipura, 2008) were more likely to self-respond when presented an internet option. The analysis showed that households with a respondent over 65 years old and households with a respondent without a high school education had statistically significant lower self-response proportions (by 3.32 and 8.06 percentage points, respectively) when given the internet option, and not given a paper questionnaire until approximately two weeks later (Nichols, Horwitz, and Tancreto, 2014). In an attempt to improve the self-response rates for these specific groups, three OSR panels in the 2015 National Content Test provided the mail questionnaire earlier.

2014 Census Test. The 2014 Census Test used the successful Internet Push strategy from the 2012 National Census Test as the control panel, since this panel had the highest overall weighted response rate (64.8 percent) of the six panels tested. Other Internet Push panels for the 2014 Census Test were modified versions of this panel. The modifications included replacing postal mail invitations, as well as postal reminders, with email reminders.

Three of the eight panels tested in the 2014 Census Test were sent the initial invitation and first reminder via email in lieu of postal mail. None of these three panels had a higher response rate than the panels that did not receive the invitation and first reminder via email (Bentley and

Rothhaas, 2015). This suggests that email is not an effective replacement for postal mail as an invitation strategy.

Other studies have researched the impact of sending invitations and reminders via email on response. One recent study conducted a longitudinal survey in the United Kingdom and found that while the invitations and reminders sent via email did not affect response propensity, email contact did increase the likelihood that those who responded did so on the internet (Cernat and Lynn, 2014).

2015 Optimizing Self-Response Test. One important aspect of this test was that it was the first time the Census Bureau looked at targeting housing units for what would eventually become Internet First and Internet Choice. This began as a method, tested in the Savannah, GA Designated Marketing Area, that aimed to enhance sampling stratification using internet connection data from the Federal Communications Commission (FCC) and the low response propensity score (LRS) from the Planning Database (PDB). The study tested whether using the internet connection data provided by the FCC, or the LRS data provided by the PDB, was better or the same at predicting overall and internet response rates (Mathews and Rothhaas, 2015). The use of the FCC and LRS data helped us to make the contact strategy assignments in later tests. This test also delivered a robust communications campaign that included paid TV, radio, print, out-of-home, and digital advertisements. This allowed the Census Bureau to understand the source of internet responses (i.e. from mail materials versus traditional advertisements versus digital ads).

2015 National Content Test. The 2015 National Content Test tested modifications to the timing, order, type and number of contacts for the Internet Push strategy. It also investigated whether sending the first reminder via email and postal mail (rather than just by email) had an impact on self-response rates, particularly internet self-response rates. Building on previous research, the 2015 National Content Test stratified the sample and tailored contact strategies based on information about the prevalence of internet connectivity from the FCC and the estimated LRS from the PDB (Mathews, 2015).

Results from the OSR portion of the 2015 National Content Test show that a fifth mailing should be implemented, as sending a third postcard reminder resulted in the highest overall response rates for the panels. Another finding is that housing units in low response areas which received a paper questionnaire in the first mailing, had a significantly higher overall response rate than all but one of the other panels, suggesting that using the Internet Choice contact strategy in low response areas increases overall self-response. One panel of the 2015 National Content Test did not receive a paper questionnaire, which resulted in the lowest overall response rate. This result suggests that not providing a paper questionnaire negatively affects overall self-response rates. This test also found that the first reminder postcard should be sent earlier to improve response among Spanish-speaking households, and that the swim-lane or dual-sided letter format should be used (Phelan, 2016).

2016 Census Test. The 2016 Census Test expanded on middecade research by: 1. Testing the replacement of the first reminder postcard with a letter; 2. Sending a brochure instead of a letter;

and 3. Including a language insert with the letter. The analysis of the 2016 Census Test found that self-response rates improve when using a letter instead of a postcard in the second mailing, and when including a language insert with the first mailing, especially for limited English proficiency households (Coombs, Lestina, and Phelan, 2017).

2017 Census Test. The 2017 Census Test was the first middecade test to incorporate the updated definition of the Internet Choice contact strategy. The tracts that received the Internet Choice contact strategy for the 2017 Census Test were those that fell into the following definition (Mathews and Phelan, 2018):
Any tract that, based on American Community Survey self-response rates, responds by mail more than by internet and has at least one of the following additional attributes:

- Is a low responding tract when an Internet First strategy is used, based on American Community Survey self-response rates[1] (<41.3 percent overall self-response rate).
- Is a tract with higher older population, based on American Community Survey estimates (at least 22 percent of the population is age 65 and over).
- Is a tract with less internet access, based on FCC data (no more than 400 household internet connections, per 1,000 households in the tract).

The remaining tracts received the Internet First contact strategy (previously referred to as Internet Push). Results for the 2017 Census Test are forthcoming.

2018 End-to-End Census Test. The cut-off values used for the 2017 Census Test Internet Choice definition were reevaluated and it was determined that the FCC cutoff should be adjusted. This adjustment would allow for a more accurate representation of the availability of internet access for tracts that prefer responding by mail rather than by internet.

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[1] Any tracts missing American Community Survey self-response rates were automatically assigned to the Internet Choice contact strategy.

The tracts chosen to receive the Internet Choice contact strategy for the 2018 End-to-End Census Test were those that fell into the following definition (Mathews and Phelan, 2018):

Any tract that, based on ACS self-response rates, responds by mail more than by internet and has at least one of the following additional attributes:

- Is a low responding tract when an Internet First strategy is used, based on American Community Survey self-response rates[1] (<41.3 percent overall self-response rate).
- Is a tract with higher older population, based on ACS estimates (at least 22 percent of the population is age 65 and over).
- Is a tract with less internet access, based on FCC data (no more than 600 household internet connections, per 1,000 households in the tract).

The remaining tracts received the Internet First contact strategy. The forthcoming 2018 OSR Operational Assessment will contain some results of the 2018 End-to-End Census Test.

All of the middecade research helped construct the contact strategies for the 2020 Census (see Table 1). The Internet First contact strategy is divided into four cohorts that will all receive the same mailing materials but at different times in order to reduce call volumes for the Census Questionnaire Assistance centers. Additionally, if a tract contains more than 20 percent of housing units that have Spanish language assistance needs, according to 5-year ACS estimates, the tract will receive mailing materials that are bilingual. A household that has Spanish language assistance needs is defined as a household that has at least one person (age 15 or older) who speaks Spanish and does not speak English "very well." Otherwise, the mailing materials will be in English with a short message in Spanish about how to respond.

Note that for this experiment, all mailings (treatment and control) will be mailed at once rather than in cohorts.

Table 1. 2020 Census Self-Response Mailing Strategy with In-Home Dates

Panel	Cohort	Mailing 1 *Letter (Internet First) or Letter + Questionnaire (Internet Choice)*	Mailing 2 *Letter*	Mailing 3* *Postcard*	Mailing 4* *Letter + Questionnaire*	Mailing 5* *"It's not too late" Postcard*
Internet First	1	3/12/2020	3/16/2020	3/26/2020	4/08/2020	4/20/2020
	2	3/13/2020	3/17/2020	3/27/2020	4/09/2020	4/20/2020
	3	3/19/2020	3/23/2020	4/02/2020	4/15/2020	4/27/2020
	4	3/20/2020	3/24/2020	4/03/2020	4/16/2020	4/27/2020
Internet Choice	N/A	3/13/2020	3/17/2020	3/27/2020	4/09/2020	4/20/2020

(*) Targeted only to nonresponding households

III. Assumptions

1. The Census Data Lake will contain 2020 Census responses and operational data required for analysis.

2. Mail materials can be printed, assembled, and mailed by staff at the National Processing Center.

3. The sample to assess the communications campaign can be removed from the mailing stream.

IV. Research Questions

1. What was the overall impact of all of the 2020 mailing strategy innovations, on self-response rates and costs, compared to the 2010 Census strategy?

2. Does mentioning the option to respond on the internet yield higher self-response rates?

3. Were the Internet Choice and Internet First strategies efficiently targeted, and effective, in improving response rates for those respective areas?

4. What is the impact of the 2020 mailing strategy, specifically (i.e., controlling for the addition of the internet option), on self-response rates and costs, compared to the 2010 Census strategy?

5. What is the impact of sending the bilingual mailing to all households in the experiment and control groups (as opposed to English-only tracts receiving the English-only mailing, and bilingual tracts receiving the bilingual mailing)?

6. What is the impact of the communications campaign on internet response in the absence of any direct mailings from the Census Bureau? Among different audience segments of the 2020 campaign?

7. What is the impact of the communications campaign on phone response in the absence of any direct mailings from the Census Bureau? Among different audience segments of the 2020 campaign?

V.   Methodology

A. Experimental Design

This experiment seeks to understand the net impacts of the OSR innovation area in the 2020 Census. In particular, the focus is on evaluating the quantitative impacts of the mailing strategy, and on the overall influence of the internet response option. Specifically:

a. A sample of housing units will receive the 2010 Census mail strategy and timing.

   This will provide a treatment to quantitatively compare all innovations in the 2020 mailing strategy to the 2010 approach, including: additional mailings, the addition of an internet option, the phone number provided in all mailings, and the timing of receiving the materials. The 2010 materials will be updated, as appropriate, with necessary 2020 elements such as the logo, mandatory legal language, dates, and the 2020 survey questions. Housing units in this sample will not be told about the internet instrument or provided a URL to respond. However, if they hear about the internet option through the communications campaign, word of mouth, or other general awareness, they could still respond online (either without an ID, or with their ID that would still be present above the barcode on the mail materials).

b. A sample of housing units will receive the 2020 Census mail strategy with no mention of the option to respond via the internet.

   This will provide a treatment to quantitatively compare the addition of the internet response option to the 2020 Census. Housing units in this sample will receive all of the 2020 Census mailing materials, but will not mention the internet instrument or the URL for response. However, if they hear about the internet option through the communications campaign, word of mouth, or other general awareness, they could still respond online (either without an ID, or with their ID that would still be present above the barcode on the mail materials). These housing units will receive the 2020 Census mailing timing.

c. Switch the mail contact strategy for a sample of housing units between Internet Choice and Internet First.

The Internet Choice strategy will be targeted to areas expected to benefit from a paper questionnaire in the initial mailing. Based on extensive research, this includes census tracts with relatively low overall self-response rates in the ACS that tend to respond by paper more than by internet, tracts with an older population based on ACS estimates, and tracts with lower internet subscribership based on data from the FCC. In order to evaluate the effectiveness of this design, a sample of housing units in the Internet Choice areas will be randomly selected to receive the Internet First strategy instead (and vice versa). We will also control for the presence of Internet using data from ACS. If the opposite mail strategy elicits higher response rates, or if the different strategies yield similar rates, that may indicate that we need to reassess this design in the future. These housing units will receive the 2020 Census mailing materials and timing.

d. A sample of housing units will be removed from the production mail stream of all materials.

This will provide a treatment to measure the effect of the communications campaign (and larger overall census environment) on internet and phone response. The campaign will consist of many different components including paid advertising, earned media, Statistics in Schools, and a local and national partnership program. Many of these communications will include the URL to the census web form. Others will contain the CQA phone numbers. This sample of Master Address File Identifiers (MAFIDs) will not receive any direct mailings from the Census Bureau. Thus, any internet or phone responses received will have come from one of the communications campaign components, word-of-mouth, or general awareness. All treatment responses will be non-ID, but we hypothesize the matching rates will be high given the sample comes from MAF extracts. All sampled MAFIDs will be included in NRFU in the case that an internet or phone response is not completed.

In order to answer the research questions, five experimental panels are planned. As a way to minimize the burden on the printer, all households within the treatment groups will receive bilingual materials. This blanketed language assignment for the treatment groups does not match the production language assignment, in which ACS language data is used to determine if a tract should receive English-only materials or bilingual materials. As a result, a defined control group is needed for appropriate comparison. The control panel and the five experimental panels will help in the evaluation of the OSR operation. Table 2 below has the description of all panels, including the control. The experimental panels (E1 through E4) are compared to the control panel (C2). A second panel (C1) is compared to C2 in order to determine the impact of using the bilingual form for all tracts.

Table 2. Descriptions of the Panels

Panels	Description
C1: 2020 Census Materials	All mail materials and mailing timing are the same as the materials sent to production 2020 Census housing units.
C2: 2020 Census Materials (all bilingual)	All mail materials and mailing timing are the same as the materials sent to production 2020 Census housing units. All households will receive the bilingual form.
E1: 2010 Census Materials and 2010 Census Mailing Timing (all bilingual)	Mail materials and mailing timing will closely resemble the materials sent to production 2010 Census housing units, with updates where needed. In particular, no mention of the internet instrument will be made in the materials.
E2: 2020 Census Materials without Internet Response Option (all bilingual)	All mail materials will not mention the internet instrument. The mailing timing will be the same as the materials sent to production 2020 Census housing units. Note that these housing units will receive the Internet Choice contact strategy mailing regardless of their originally assigned contact strategy.
E3: Internet Choice Cases Given Internet First Contact Strategy (all bilingual)	Census tract was assigned to the Internet Choice strategy but will receive Internet First materials instead. The mailing timing will be the same as the materials sent to production 2020 Census housing units.
E4: Internet First Cases Given Internet Choice Contact Strategy (all bilingual)	Census tract was assigned to the Internet First strategy but will receive Internet Choice materials instead. The mailing timing will be the same as the materials sent to production 2020 Census housing units.
E5: No mailings	All mail materials will be suppressed.

Table 3 and Table 4. illustrate the difference between the mail materials and mail timing for Panels C1, C2, E1, E2, and E5. Table 3 shows the general sequence of mailings, while Table 4. shows the in-home mailing delivery dates. Housing units in Panel E1 will receive the same type of materials along with a similarly spaced mail timing as the 2010 Census. For this experiment, the replacement questionnaire in the 2010 Census Mailing 4 will be sent to all nonresponding housing units in Panel E1.

Table 3. General Sequence of Mailings for the Panels

	Mailing 1	Mailing 2	Mailing 3	Mailing 4	Mailing 5
2010 Census/ Panel E1	Advance letter	Initial questionnaire	Reminder postcard	*Replacement questionnaire	
2020 Census/ C1, C2, E2, E3, E4	Letter w/internet option OR Questionnaire w/internet option	Reminder letter	*Reminder postcard	*Questionnaire w/internet option	*"It's not too late" postcard
E5	na	na	na	na	na

(*) Targeted only to nonresponding households

Table 4. Approximate In-Home Delivery Mailing Dates for the Panels

	Mailing 1	**Mailing 2**	**Mailing 3**	**Mailing 4**	**Mailing 5**
2010 Census/ Panel E1	Tuesday, March 10, 2020	Tuesday, March 17, 2020	Tuesday, March 24, 2020	*Friday, April 10, 2020	
2020 Census/ C1, C2, E2, E3, E4	Friday, March 13, 2020	Tuesday, March 17, 2020	*Friday, March 27, 2020	*Thursday, April 9, 2020	*Monday, April 20, 2020
E5	N/A	N/A	N/A	N/A	N/A

(*) Targeted only to nonresponding households

The OSR sample for this experiment will be selected at the same time as the National Mailing sample for a similar experiment. The OSR sample and the National Mailing sample together make up the Overall sample. The Overall sample selection along with details on the OSR sample selection are presented below. For further details on the National Mailing sample, please see the Extending the Census Environment to the Mail Materials Study Plan.

The Overall sample is preselected from the Self-Response TEA (TEA = 1) housing units. Housing units with TEA = 1 from the MAF file are split up into seven groups, each of which is representative of the United States. Tracts are fully contained within one of the seven groups. This split into seven groups is necessary, as different experiments are conducted at different geographic levels, which leads to nonrandom gaps within the population, and therefore potential bias in the frame. One of the seven groups is then chosen to be the eligible universe for this experiment and the national mailing portion of the Extending the Census Environment to the Mail Materials experiment. Before selecting the Overall sample, the eligible universe is split into two strata: Internet First and Internet Choice. Each stratum will be sorted by state, county, language flag, tract, ineligibility flag, internet flag, and MAFID.

A random sample of 72,786 housing units will be selected from each of the two strata. Then, within each stratum, one of the nine panels (five panels are for the OSR sample, E1-E5, two panels are for the Mailing sample, M10 and M11, with the two control panels, C1 and C2, being shared by both the OSR and Mailing sample) will be systematically assigned to a housing unit, depending on the strata. See Table 5 for eligible panel assignments.

Other direct mailers outside of the five production mailings are in the process of being developed. These mailers will be sent before or during self-response in order to promote response in subpopulations of interest. Though the addresses identified to receive these additional mailers will not be known until after sampling for this experiment is underway, it is possible that the sample selected in this experiment may overlap with the additional mailers being proposed. One of the proposed mailers may target up to 20 percent of all mailable addresses. To account for this possible overlap in samples, all of the panels will be sampled at 120 percent of the minimum sample size calculated in the appendix.

Table 5. Panels Eligible for Assignment for each Stratum

Panels		Number Assigned from Each Stratum	
		Internet First	Internet Choice
Panels	C1	12,478	12,478
	C2	12,478	12,478
	E1	6,239	6,239
	E2	6,239	6,239
	E3	0	12,478
	E4	12,478	0
	E5	12,478	6,239
	M10	12,478	12,478
	M11	12,478	12,478

Using an alpha of 0.10, beta of 0.20, and a detectable difference of 3 percentage points in self-response rates, the sample size for the OSR sample (C1, C2, E1, E2, E3, E4, E5) is 118,541 housing units. The OSR sample size was calculated using the conservative estimate of the 2020 Census response rate of 57 percent and an estimated design effect of 1.75 based on the design effect found for the response rate variable in the 2015 National Content Test. See Appendix A for further sampling details.

B. Answering Research Questions

1. What was the overall impact of all of the innovations of the 2020 Census mailing strategy (panel C2), on self-response rates and costs, compared to the 2010 Census strategy (panel E1)?

We expect that the 2020 strategy will have a higher self-response rate since the changes made to the materials and mailing strategies were recommendations of the middecade testing, whose goal was to improve self-response. Although unprecedented, if the 2020 response rates are not higher than those in 2010, we will conduct a comprehensive reassessment of the 2020 mailing strategies. The self-response rates will be calculated and compared for the two experimental panels that manipulate mailing materials (panel E1 and C2). The following formula will be used to calculate self-response rates:

$$\text{Self-response rate} = \frac{\text{Number of Self-Responding Housing Units in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

To calculate the response rate by mode, the numerator will only include in-sample responses from that mode, but the denominator will remain as the number of housing units in the sample. Table 6 will be produced to display response by mode, and a t-test will be used to determine if the 2020 Census design yielded a higher total self-response rate than the 2010 Census design.

Table 6. Self-Response Rates for the Control Panel and 2010 Census Materials and 2010 Census Mailing Timing Panel by Mode

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate	Total Self-Response Rate*
C2: 2020 Census Materials (all bilingual)				
E1: 2010 Census Materials and 2010 Census Mailing Timing (all bilingual)				

*t-test will be performed on this statistic.

Table 7. shows the response rates over time, which can also be used to determine self-response patterns for each panel.

Table 7. Response Rates over Time

Panel	Response Rate after First Mailing	Response Rate after Second Mailing	Response Rate after Third Mailing	Response Rate after Fourth Mailing	Response Rate before NRFU	Final Response Rate	Final Return Rate
C2: 2020 Census Materials (all bilingual)							
E1: 2010 Census Materials and 2010 Census Mailing Timing (all bilingual)							
E2: 2020 Census Materials without Internet Response Option (all bilingual)							
E3: Internet Choice Cases Given Internet First Contact Strategy (all bilingual)							
E4: Internet First Cases Given Internet Choice Contact Strategy (all bilingual)							
E5: No Mailings							

Cost will be determined using the following formula.

Cost per Panel per treated case

$$= \frac{\text{Total Cost of treatment} + \Delta\text{Nonresponse X Nonresponse Followup Cost}}{\text{Number of Cases Receiving Treatment}}$$

2. Does mentioning the option to respond on the internet yield higher self-response rates?

We expect that mentioning the internet response option will result in a higher self-response rate. The following formula will be used to calculate self-response rates:

$$\text{Self-response rate} = \frac{\text{Number of Self-Responding Housing Units in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

To calculate the response rate by mode, the numerator will only include in-sample responses from that mode, but the denominator will remain as the number of housing units in the sample. Table 8 will be produced to display response by mode, and a t-test will be used to determine if the 2020 Census materials with an internet option displayed (panel C2) yielded a higher total self-response rate than the 2020 Census materials without the internet option (panel E2) displayed (see Table *8.*).

Table 8. Self-Response Rates for the Control Panel and 2020 Census Materials without Internet Option Panel by Mode

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate	Total Self-Response Rate*
C2: 2020 Census Materials (all bilingual)				
E2: 2020 Census Materials without Internet Response Option (all bilingual)				

*t-test will be performed on this statistic.

The communications campaign will make it virtually impossible to create an environment without any mention of the internet. That limitation will apply to all panels. In addition to the metrics mentioned above, we will examine the characteristics of households and people that respond via the internet when that is not a given option.

3. Were the Internet Choice and Internet First strategies efficiently targeted, and effective, in improving response rates for those respective areas?

We expect that the two contact strategies, Internet Choice and Internet First, were targeted effectively resulting in an improvement in self-response rates in each of their respective areas. Self-response rates will be calculated and compared for Internet Choice and Internet First strategies between the sample assigned to receive the alternative strategy (panels E3 and E4) and the respective baseline (Internet Choice or Internet First units from panel C2). The following formula will be used to calculate self-response rates:

$$\text{Self-response rate} = \frac{\text{Number of Self-Responding Housing Units in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

To calculate the response rate by mode, the numerator will only include in-sample responses from that mode, but the denominator will remain as the number of housing units in the sample. A t-test will be used to determine if the Internet Choice baseline sample (from C2) yielded a higher total self-response rate than the Internet Choice switched to Internet First alternative sample. A t-test will also be used to determine if the Internet First baseline sample (from C2) yielded a higher self-response rate than the Internet First switched to Internet Choice alternative sample (see Table 9).

Table 9. Self-Response Rates for the Control Panel, Internet Choice Cases Given Internet First Contact Strategy Panel, Internet First Cases Given Internet Choice Contact Strategy Panel by Mode

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate	Total Self-Response Rate*
C2: 2020 Census Materials (all bilingual)				
E3: Internet Choice Cases Given Internet First Contact Strategy (all bilingual)				
E4: Internet First Cases Given Internet Choice Contact Strategy (all bilingual)				

*t-test will be performed on this statistic.

In addition to the metrics above, we will examine the characteristics of households and people that respond from the experimental and control panels.

4. What is the impact of the 2020 mailing strategy, specifically (i.e., controlling for the addition of the internet option), on self-response rates and costs, compared to the 2010 Census strategy?

Again, because of the changes made to the materials and mail strategy from results of middecade testing, we expect that the 2020 Census panel without mention of the internet (panel E2) will have a higher self-response rate than the 2010 Census panel (panel E1). The following formula will be used to calculate self-response rates:

$$\text{Self-response rate} = \frac{\text{Number of Self-Responding Housing Units in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

To calculate the response rate by mode, the numerator will only include in-sample responses from that mode, but the denominator will remain as the number of housing units in the sample. Table 10 will be produced to display response by mode, and a t-test will be used to determine if the 2020 Census materials without mention of an internet option displayed yielded a higher total self-response rate than the 2010 Census materials.

Table 10. Self-Response Rates for the 2010 Census Materials and 2010 Census Mailing Timing Panel, and 2020 Census Materials without Internet Option Panel by Mode

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate	Total Self-Response Rate*
E1: 2010 Census Materials and 2010 Census Mailing Timing (all bilingual)				
E2: 2020 Census Materials without Internet Response Option (all bilingual)				

*t-test will be performed on this statistic.

Cost will be determined using the following formula.

$$\text{Cost per Panel per treated case} = \frac{\text{Total Cost of treatment} + \Delta\text{Nonresponse X Nonresponse Followup Cost}}{\text{Number of Cases Receiving Treatment}}$$

5. Is there a difference in response rate between the control group in which everyone receives the bilingual mailing and the group in which English-only tracts receive the English-only mailing and bilingual tracts receive the bilingual mailing)?

We do not expect to see a difference in the response rate between the two groups. We will reassess if our results suggest otherwise.

$$\text{Self-response rate} = \frac{\text{Number of Self-Responding Housing Units in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

To calculate the response rate by mode, the numerator will only include in-sample responses from that mode, but the denominator will remain as the number of housing units in the sample. Table 11 will be produced to display response by mode, and a t-test will be used to determine if the 2020 Census materials with all bilingual forms (C2) yields a different total self-response rate than the 2020 Census materials with the appropriate language assignments (C1).

Table 11. Self-Response Rates for the Two Control Panels

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate	Total Self-Response Rate*
C1: 2020 Census Materials				
C2: 2020 Census Materials (all bilingual)				

*t-test will be performed on this statistic.

6. What is the impact of the communications campaign on Internet response in the absence of any direct mailings from the Census Bureau? Among different audience segments of the 2020 campaign?

This comparison will allow us to estimate the proportion of housing units that self-respond via the non-ID Internet instrument in the absence of any mailed materials. Any difference in self-response rates between the experimental and control group will allow us to estimate the effectiveness of the mailed materials. It will also allow us to estimate the effectiveness of the partnership and communications campaign on non-ID internet and phone response in absence of any mailings.

$$\text{Internet self-response rate} = \frac{\text{Number of Self-Responding Housing Units via the Internet in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

Housing units sampled for the No Mailings group (E5) will be drawn from tracts assigned to both contact strategies (i.e., Internet First and Internet Choice), so they will be compared to different control groups. E5 housing units drawn from Internet First tracts will be compared to the Internet First units in the control group receiving standard 2020 materials (Internet First units from panel C1, see Table 12). The E5 housing units drawn from Internet Choice tracts will be compared to both the experimental group given Internet First materials in place of Internet Choice as well as the standard control (E3 and Internet Choice units from panel C1, see Table 13). This design allows us to compare Internet First and Internet Choice panels in E5 to Internet First and Internet Choice units that received only an invitation to respond via the Internet until Mailing 4 (C1 and E3, respectively). It will also allow us to compare Internet First and Internet Choice panels in E5 to units that receive "business as usual" 2020 mailings (C1).

Table 12. Self-Response Rates for Control Panel and Internet First Housing Units Not Receiving Mailed Materials Panel

Panel	Mail Self-Response Rate	Internet Self-Response Rate*	CQA Self-Response Rate	Total Self-Response Rate
C1: 2020 Census Materials (Internet First units)				
E5: No Mailings (Internet First units)				

*t-test will be performed on this statistic.

Table 13. Self-Response Rates for Control Panel, Internet Choice Cases Given Internet First Contact Strategy Panel, and Housing Units in Internet Choice Tracts Not Receiving Mailed Materials Panel

Panel	Mail Self-Response Rate	Internet Self-Response Rate*	CQA Self-Response Rate	Total Self-Response Rate
C1: 2020 Census Materials (Internet Choice units)				
E3: Internet Choice Cases Given Internet First Contact Strategy (all bilingual)				
E5: No Mailings (Internet Choice units)				

*t-test will be performed on this statistic.

Results can be further analyzed by separately calculating the response rates of respondents in different audience segments. (Segments were developed as part of the 2020 Communications Campaign; U.S. Census Bureau, *in preparation.*).

7. What is the impact of the communications campaign on phone response in the absence of any direct mailings from the Census Bureau? Among different audience segments of the 2020 campaign?

This comparison will provide an estimate of the rate at which housing units self-respond via CQA in the absence of other avenues of response. Housing units who receive no mailed materials will only have the option of responding via CQA or Internet without an ID.

$$\text{CQA self-response rate} = \frac{\text{Number of Self-Responding Housing Units via the CQA in Sample}}{\text{Number of Housing Units in Sample}} * 100 \text{ percent}$$

The comparisons between treatment and control groups are the same as in the previous section.

Table 14. Self-Response Rates for Control Panel and Housing Units in Internet First Tracts Not Receiving Mailed Materials Panel

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate*	Total Self-Response Rate
C1: 2020 Census Materials (Internet First Tracts)				
E5: No Mailings (Internet First Tracts)				

*t-test will be performed on this statistic.

Table 15. Self-Response Rates for Control Panel, Internet Choice Cases Given Internet First Contact Strategy, and Housing Units in Internet First Tracts Not Receiving Mailed Materials Panel

Panel	Mail Self-Response Rate	Internet Self-Response Rate	CQA Self-Response Rate*	Total Self-Response Rate
C1: 2020 Census Materials (Internet Choice units)				
E3: Internet Choice Cases Given Internet First Contact Strategy (all bilingual)				
E5: No Mailings (Internet Choice units)				

*t-test will be performed on this statistic.

As with Question 7, this analysis will be repeated after grouping sampled housing units by audience segment assignment. By doing so, we can test how audience segments differ in their self-response rates via CQA without the presence of mailed materials with exposure to the partnership and communications campaign and word-of-mouth as the only means of self-responding.

C. Interventions with the 2020 Census

Name of solution/system/process: Content and Forms Design IPT
Explicit intervention requested
- Develop experimental mailing materials and questionnaires
- Assign form types to the newly developed materials.
Estimated impact: Minimal impact on the 2020 Census

Name of solution/system/process: National Processing Center (NPC)
Explicit intervention requested
- Printing of mailing materials
- Addressing materials
- Assembling mail packages
- Sending mail packages
Estimated impact: Minimal impact on the 2020 Census

Name of solution/system/process: Forms, Printing and Distribution
Explicit intervention requested
- Printing of mailing materials
- Assembling mail packages
Estimated impact: Minimal impact on the 2020 Census

Name of solution/system/process: CaRDS
Explicit intervention requested:
- Create the sample delivery file for the experiment
Estimated impact: Minimal impact on the 2020 Census

Name of solution/system/process: ECaSE-OCS
Explicit intervention requested
- Ingest the sample delivery file for the experiment
- Create workloads for each contact
- Send created workloads to NPC
Estimated impact: Minimal impact on the 2020 Census

Name of solution/system/process: Paper Data Capture
Explicit intervention requested:
- Receive and process experimental questionnaires
Estimated impact: Minimal impact on 2020 Census

Name of solution/system/process: iCADE
Explicit intervention requested:
- Data capture of experimental questionnaires
Estimated impact: Minimal impact on 2020 Census

Name of solution/system/process: Response Processing Operation
    Explicit intervention requested:
- Process responses from experimental questionnaires
Estimated impact: Minimal impact on 2020 Census

D. Implications for 2030 Census Design Decisions and Future Research and Testing

This is an evaluation of the optimization of self-response in the 2020 Census. However, results from this experiment can potentially be used to improve or enhance the strategies for encouraging and motivating self-responses during the research and testing phase of the 2030 Census program and in the 2030 Census.

VI. Data Requirements

Data File/Report	Source	Purpose	Expected Delivery Date
2020 Census Decennial Response File	Census Data Lake	Analysis	Fall 2020

VII. Risks

1. This experiment relies on NPC to assemble and mail packages. If NPC has commitments to other surveys during this experiment's mailout time, then the mail packages may not be sent at the same time as the production 2020 Census materials.
2. If the data are not available in the Census Data Lake, then the analysis report cannot be completed.
3. If sufficient funds are not granted for this experiment, than the scope of the experiment may be reduced.
4. If the 2010 Census materials response rates are significantly higher than the response rates from the 2020 Census materials, then further investigation would be warranted to determine next steps.
5. Other Census Bureau groups will be sending additional mailers. It is possible that these mailings will overlap with the mailings in this experiment. The minimum sample size is being increased by twenty percent to account for possible overlap. If the overlap is not random and significant, then the ability to make adequate conclusions about the effect of the planned treatments may be negatively affected.

VIII. Limitations

1. Because of laws passed or updated after the 2010 Census, such as the Privacy Act and the Cybersecurity Act, we are unable to use the exact same letters and postcard that were sent in the 2010 Census.
2. There is an independence limitation since the 2020 Census communications campaign will be advertising that the census can be completed online. It is virtually impossible to create a "2010 no-internet environment" even though we will try to control for it by not mentioning the internet option in the mailing materials.
3. Because of the fact that housing units within close proximity of each other may fall into different categories (i.e., treatment versus control), it is difficult to control for the possibility of communication between treatment and control groups. However, we believe the likelihood, and therefore impact, of such communication is low.
4. When measuring the effects of withholding mailings on Internet and CQA response rates, we will lack a comparison to a panel in which conditions are inverted, i.e., where there are households that received mailed materials but were not exposed to the advertising campaign.
5. Treatment E5 (i.e. No Mailout) will be reliant on non-ID procedures for internet and CQA responses, so we will be unable to disentangle the effect on response rates because

of a non-ID environment from the effect on response rates because of offering no mail. For example, we will be unable to measure whether non-ID procedures were more burdensome than entering an ID, thereby decreasing internet and CQA response rates in the treatment group.

6. Because of the fact that the URL and phone numbers used by households that respond by the Internet or phone in the No Mailout panel will be identical to those used by control households, we cannot tease out which component of the communication campaign drove the internet or phone response (e.g. TV ad versus, print ad, versus a partnership specialist material or event).

IX.   Issues That Need to be Resolved

X.   Division Responsibilities

Division or Office	Responsibilities
Decennial Statistical Studies Division	- Plan and manage the experiment - Design the panels - Select the sample - Monitor the results - Analyze the data - Write and release the report

XI.   Milestone Schedule

Experimental Milestone	Date
Select Sample	Winter 2019
2020 Census Self-Response	March – August 2020
Receive, Verify, and Validate Data for Optimizing Self-Response Experiment	September 2020
Distribute Initial Draft of the Optimizing Self-Response Experiment Report to the Decennial Research Objectives and Methods (DROM) Working Group for Pre-Briefing Review	January 2021
Decennial Census Communications Office (DCCO) Staff Formally Release the FINAL Optimizing Self-Response Experiment Report in the 2020 Memorandum Series	June 2021

XII. Review/Approval Table

Role	Approval Date
Primary Author's Division Chief (or designee)	09/17/2018
Decennial Census Management Division ADC for Nonresponse, Evaluations, and Experiments	03/20/2019
Decennial Research Objectives and Methods (DROM) Working Group	03/20/2019
Decennial Census Communications Office	06/03/2019

XIII. Document Revision and Version Control History

Version/Editor	Date	Revision Description
0.1	08/15/2018	Draft sent for team review
0.2	09/17/2018	Draft sent for division chief review
1.0	09/21/2018	Initial draft for DROM review
1.2	03/8/2019	Second draft for DROM review
1.3	03/29/2019	Final study plan submitted
1.4	06/03/2019	Incorporated comments from Decennial Census Communications Office
1.5	08/07/2019	Updated sample sizes and corresponding text

XIV. Glossary of Acronyms

Acronym	Definition
ACS	American Community Survey
ADC	Assistant Division Chief
DROM	Decennial Research Objectives and Methods Working Group
FCC	Federal Communications Commission
IPT	Integrated Project Team
LRS	Low Response Score
MAFID	Master Address File Identification
OSR	Optimizing Self-Response
PDB	Planning Database
TEA	Type of Enumeration Area

XV. References

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XVI. Appendix A

The formula used to calculate the minimum sample size necessary for the desired comparisons is

$$n \geq \frac{\left(\left(Z_{\alpha*/2} + Z_{\beta}\right)^2 \left(p_1\left(1 - p_1\right) + p_2\left(1 - p_2\right)\right) \times deff\right)}{\delta^2}$$

where

n	=	minimum sample size
δ	=	minimum detectible difference
$\alpha*$	=	alpha level adjusted for multiple comparisons (Bonferroni)
$Z_{\alpha*/2}$	=	critical value for set alpha level assuming a two-sided test
Z_{β}	=	critical value for set beta level
p_1	=	proportion for group 1
p_2	=	proportion for group 2
$deff$	=	design effect due to unequal weighting

Wang, H. and Chow, S. (2007). "Sample Size Calculation for Comparing Proportions," *Wiley Encyclopedia of Clinical Trials* (eds R.B. D'Agostino, L. Sullivan, and J. Massaro).

δ	=	0.014
$\alpha*$	=	0.014
$Z_{\alpha*/2}$	=	0.8416212
Z_{β}	=	0.841621
p_1	=	0.57
p_2	=	0.54
$deff$	=	1.75

n with deff =	**10,396.8503**
n without deff =	**5,941.0573**

- The sample sizes for the Optimization of Self-Response Experiment and the national sample of the Extending the Census Environment to the Mailing Materials Experiment were calculated simultaneously. The samples share a production language control, where housing units are given mail materials as specified by production definitions, and a bilingual control, where housing units are given bilingual mail materials regardless of the production definitions and will be selected simultaneously.

- The value of p_1 is the expected 2020 Census response rate after six weeks, which is between the minimum and average expected 2020 Census response rate.

- The estimated design effect is 1.75, based on 2015 NCT data evaluation of the variable *analysis_response*. The OSR sample for 2015 NCT is the most complex, and has a deff = 1.2351. The design effect of the entire 2015 NCT is 1.9513.

- The values of *n* found here are the numbers needed in both group 1 and group 2 to detect a 3 percentage point difference. For example, if only two groups were to be compared, we would need 20,796 housing units with the given parameters. The sample for the Optimization of Self-Response Experiment includes 11 groups that will be compared: Panels C1 and C2, contain two groups each with the sample being split between Internet

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First and Internet Choice. Panels Panel E1 and E2 contain one group with the sample split between Internet First and Internet Choice. Panel E3 has two groups with the sample only in Internet Choice while Panel E4 has two groups with the panel only in Internet First. Panel E5 has three groups where the sample is two-thirds Internet First and one-third Internet Choice. For the 11 groups, the total sample size is 98,781.