

## The Impact of Voicemail Messages on RDD Cell-Phone Response Rates in the National Immunization Surveys

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The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

### Abstract

The National Immunization Surveys (NIS) are cell-phone random-digit-dial (RDD) telephone surveys used to assess vaccination coverage in the United States among children age 19-35 months (NIS-Child) and adolescents 13-17 years (NIS-Teen), and influenza vaccination coverage among children 6 months-17 years (NIS-Flu). Among working telephone numbers in the cell-phone RDD samples, the most common NIS call outcome is reaching a potential respondent's voicemail. Standard NIS protocol is to leave a message the fourth time a respondent's voicemail is encountered. Under current procedures, the message that is left is a pre-recorded message rather than a message left live by the interviewer making the call.

In Q3/2018, an evaluation was conducted in the NIS that varied both the timing of the message – i.e., whether the message was left on the first, second, third, or fourth voicemail event – and the gender and age (young versus mature) of the person associated with the pre-recorded voice. In Q4/2018, a similar evaluation was conducted that varied the timing, the gender of the person associated with the pre-recorded voice, and the pacing of the pre-recorded message being left.

In this paper, a comparison of respondent contact and cooperation rates is made among the various treatment groups to estimate the effect of (1) leaving vs. not leaving a voicemail message when a voicemail is encountered, (2) leaving a message on the first vs. the second voicemail event, (3) the voice used on the message, and (4) the pacing of the message. The study design, study results, conclusions, implications, and plans for future research are presented. We find that voicemail messages for a cell-phone RDD survey decreased contact rates but increased cooperation among the contacted, resulting in a much higher yield rate of completed interviews among the dialed numbers; we did not observe a difference in yield rates by whether the message was left on the first vs. second voicemail event; and we find that the voice used to record the message had an impact on survey participation.

**Key Words:** National Immunization Surveys, Answering Machine Message, Voicemail Message

## 1. Introduction

In surveys with telephone data collection, voicemail messages are a way to inform potential respondents about the survey even if they do not answer the phone (Holbrook et al. 2007). The literature on the effectiveness of such messages is mixed, with some studies finding no effect of messages on survey participation (e.g., Baumgartner, 1990; Daves 1990; Tuckel and Schulman, 2000) and others finding a positive effect (e.g., Harlow et al., 1993; Xu et al., 1993; Koepsell et al., 1996; Roth et al., 2001; Benford et al., 2010). All but one of these studies were based on surveys using landline samples; only Benford et al. (2010) utilized cell-phone samples, finding lower contact rates but higher cooperation rates when voicemail messages were left compared to when voicemail messages were not left.

In this paper, we present results of a study to gauge the impact of leaving voicemail messages in the National Immunization Surveys (NIS), which are large, national cell-phone random-digit-dial (RDD) telephone surveys. Our research questions are:

1. What is the impact of leaving vs. not leaving voicemail messages on survey participation in a cell-phone RDD survey?
  - a. What is the impact on the outcome of the next call?
  - b. What is the impact on the survey campaign as a whole?
  - c. Does the impact differ if the messages are left on the first versus the second voicemail event?
2. Do the voice characteristics of a pre-recorded voicemail message impact survey participation in a cell-phone RDD survey?
  - a. What is the impact of the voice characteristics of the person leaving the message?
  - b. What is the impact of the pacing of the message?

Further details of our evaluations are provided below. In Section 2, we describe the NIS and its voicemail message protocol; in Section 3, we present the design of our study; in Section 4, we present the methods and results of our evaluations; in Section 5, we discuss the results and their implications; in Section 6, we state the limitations of our study; and in Section 7, we discuss future research.

## 2. Description of the NIS and the NIS Voicemail Protocol

The NIS family of surveys are annual RDD telephone surveys to provide U.S. national, state, and selected local area estimates of vaccination coverage among children age 19-35 months (NIS-Child) and adolescents age 13-17 years (NIS-Teen), and influenza vaccination coverage estimates among children age 6 months-17 years (NIS-Flu). These surveys are sponsored by the Centers for Disease Control and Prevention (CDC), and, since 2005, have been conducted by NORC at the University of Chicago. NIS data are collected via a RDD telephone survey of parents and guardians of children in the target age ranges. From 2011 through 2017, the NIS was a dual-frame RDD survey, sampling both landline and cell-phone numbers; as of 2018, the NIS is a single-frame RDD survey, sampling only cell-phone numbers. For NIS-Child and NIS-Teen, the RDD telephone interview is followed by a mail survey sent to the vaccination providers of the children and adolescents identified in the RDD phase to obtain their vaccination histories with consent from a parent or guardian.

Because the telephone survey targets a rare population (children in specific age ranges) and has sample size requirements at the state- and local-area levels, the NIS places a very large number of dials each year – over 60 million in 2018. While a large portion of those dials are to numbers that turn out to be not in service, among working numbers the most common call outcome is reaching a potential respondent’s voicemail; over 75 percent of NIS calls to working numbers reached a voicemail in 2018. Leaving live messages on all of those calls would be quite expensive. Therefore, the long-standing NIS protocol has been to leave a message, read live by the interviewer, on the fourth voicemail event and on every third voicemail event thereafter.<sup>1</sup>

Because leaving live messages before the fourth event has been cost-prohibitive, in recent years the NIS has been exploring alternatives to live messages. Beginning in Quarter 4 of 2017 and continuing through Quarter 2 of 2018, the NIS conducted an evaluation of the use of pre-recorded messages. Pre-recorded messages were found to be nearly as effective as live messages in inducing post-message survey participation with respondents and were found to be more cost effective than live messages because the interviewer no longer had to spend time reading the message (Skalland et al., 2018).

When leaving pre-recorded messages from Quarter 4 of 2017 to Quarter 2 of 2018, interviewers would wait for the beep before initiating the pre-recorded message. Since Quarter 3 of 2018, to further reduce data collection costs, the interviewer simply identifies a call outcome as a voicemail event, and an automated telephony system waits for silence after the beep and initiates the pre-recorded message.

As interviewers are no longer waiting for the beep and leaving live messages but are instead simply coding call outcomes as voicemails and letting an automated system wait for the beep and leave the message, the amount of interviewer time spent on a call on which a message is left is now very similar to the amount of interviewer time spent on a call on which a message is not left. The reduction in interviewer time on calls on which messages are left means that instead of waiting for the fourth voicemail event before leaving a message, as has been the long-standing NIS protocol, it is now cost effective to leave messages earlier in a potential respondent’s call history. Furthermore, the use of pre-recorded messages allows for experimentation with the voice and pacing used on the pre-recorded message. In Quarters 3 and 4 of 2018, evaluations were conducted that varied the timing of when messages were left and the voice and pacing of the pre-recorded message, as described in the next section. Throughout Quarters 3 and 4 of 2018 and across the conditions in these studies, the content of the voicemail message remained constant:

“Hello. I am calling on behalf of the Centers for Disease Control and Prevention. We are conducting a survey about childhood immunization. Would you please call us at 1-877-XXX-XXXX to let us know whether or not there are any children between 12 months and 4 years old living or staying in this household? The number again is 1-877-XXX-XXXX. Thank you.”

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<sup>1</sup> There are a few rare exceptions to this protocol. For example, if the respondent had scheduled an appointment but a voicemail is reached when the respondent is called for that appointment, a message is always left on that call.

### 3. Design of the NIS Voicemail Studies

In Quarters 3 and 4 of 2018, the NIS-Child sample was randomly divided into four voicemail timing treatments, as depicted in Figure 1. For those in the Treatment 1 group, voicemail messages were left on the first voicemail event, i.e., the first time a call reached a respondent's voicemail; in Treatment 2, voicemail messages were left on the second voicemail event; in Treatment 3, voicemail messages were left on the third voicemail event; and in Treatment 4, voicemail messages were left on the fourth voicemail event.

**Figure 1:** Voicemail Timing Treatments, Quarters 3 and 4, 2018

Voicemail Event Number	Treatment 1	Treatment 2	Treatment 3	Treatment 4
1	Leave Message	X	X	X
2	X	Leave Message	X	X
3	X	X	Leave Message	X
4	X	X	X	Leave Message

Independent of the assignment of cases to a voicemail timing treatment group, in Quarter 3 of 2018 cases were also randomly assigned to one of four pre-recorded message groups that differed in the age and gender of the person recording the voicemail message, as shown in Figure 2. One recording used a mature (i.e., older) female voice, one used a young female voice, one used a mature male voice, and one used a young male voice. As noted earlier, the content of the message was the same across these treatment groups; only the voice on the recorded message differed.

**Figure 2:** Voicemail Pre-Recorded Voice Treatments, Quarter 3, 2018

Treatment 1	Treatment 2	Treatment 3	Treatment 4
Mature Female Voice	Young Female Voice	Mature Male Voice	Young Male Voice

In Quarter 4 of 2018, independent of the assignment of cases to a voicemail timing treatment group, cases were also randomly assigned to one of four pre-recorded message groups that differed in the pacing of the pre-recorded message and gender of the person recording the voicemail message, as shown in Figure 3. One recording used a female voice with a slower pacing (the duration of the message was ~30 seconds), one recording used the same female voice but with a faster pacing (~24 seconds), one recording used a male voice with a slower pacing (~30 seconds), and one recording used the same male voice but with a faster pacing (~24 seconds).

**Figure 3:** Voicemail Pre-Recorded Pacing and Voice Treatments, Quarter 4, 2018

Treatment 1	Treatment 2	Treatment 3	Treatment 4
Slow Pacing, Female Voice	Fast Pacing, Female Voice	Slow Pacing, Male Voice	Fast Pacing, Male Voice

#### 4. Methods and Results

Data from the evaluations in Quarters 3 and 4 were used to estimate the impact of leaving versus not leaving a voicemail message on the outcome of the next call, the impact of leaving vs. not leaving voicemail messages on the survey campaign as a whole, the impact of leaving messages on the first versus the second voicemail event, the impact of the age and gender of the person that recorded the voicemail message, and the impact of the pacing of the message and the gender of the person that recorded the message.

##### 4.1 Impact on the Outcome of the Next Call

To estimate the impact of leaving a message on the outcome of the next call, the analysis was limited to cases that had a voicemail call outcome on their first dial, and comparisons of key outcome rates on the next call were made between cases that had a voicemail message left versus not left on the first dial. By limiting to first-dial voicemail cases and examining the outcome of the next dial, the impact of leaving versus not leaving a message on the first-dial voicemail event can be directly estimated by comparing cases in Treatment 1 to cases in Treatments 2-4, as shown in Figure 4.

**Figure 4:** Estimating the Impact of Leaving a Message versus Not Leaving Message on the Outcome of the Next Dial

Voicemail Event Number	Treatment 1	Treatment 2	Treatment 3	Treatment 4
1	Leave Message	X	X	X
2	X	Leave Message	X	X
3	X	X	Leave Message	X
4	X	X	X	Leave Message

*Note:* By limiting to first-dial voicemail event outcome cases and comparing the outcome of the second dial between cases in Treatment 1 and cases in Treatment 2-4, the impact of leaving versus not leaving the message on the first-dial voicemail call can be directly estimated.

When looking at the next call after the first-dial voicemail event, the key outcome rates examined were:

- **Contact rate among working numbers:** Of calls to working numbers (i.e., numbers that are in service), the proportion for which a human being answered the phone.
- **Age-screener completion rate among contacts:** Of calls on which a human being answered the phone, the proportion that completed the screener to determine age-eligibility for the NIS-Child.
- **Age-eligibility rate among age-screener completes:** Of calls on which a human being answered the phone and completed the age-screener, the proportion that were age-eligible for the NIS-Child.
- **Interview completion rate among age-eligibles:** Of calls on which a human being answered the phone and completed the age-screener as age-eligible for NIS-Child, the proportion that completed NIS-Child interview.
- **Consent-to-contact-providers rate among interview completes:** Of calls on which a human being answered the phone, completed the age-screener as age-eligible for NIS-Child, and completed the NIS-Child interview, the proportion that gave consent to contact the child's vaccination providers to obtain vaccination records.

We refer to the outcome rates above as *component rates*, because each measures completion of a key component of the NIS data collection process: gaining human contact, completing the age-screener, identifying eligible households, completing the interview, and obtaining consent to contact vaccination providers. We also examined a key *summary rate*:

- **Yield rate of completed interviews with consent to contact providers among working numbers:** Of calls to working numbers (i.e., numbers that are in service), the proportion on which a human being answered the phone, completed the age-screener as age-eligible for NIS-Child, completed the NIS-Child interview, and gave consent to contact the child's vaccination providers to obtain vaccination records.

This summary rate is an overall productivity rate and is equal to the product of the component rates listed above.

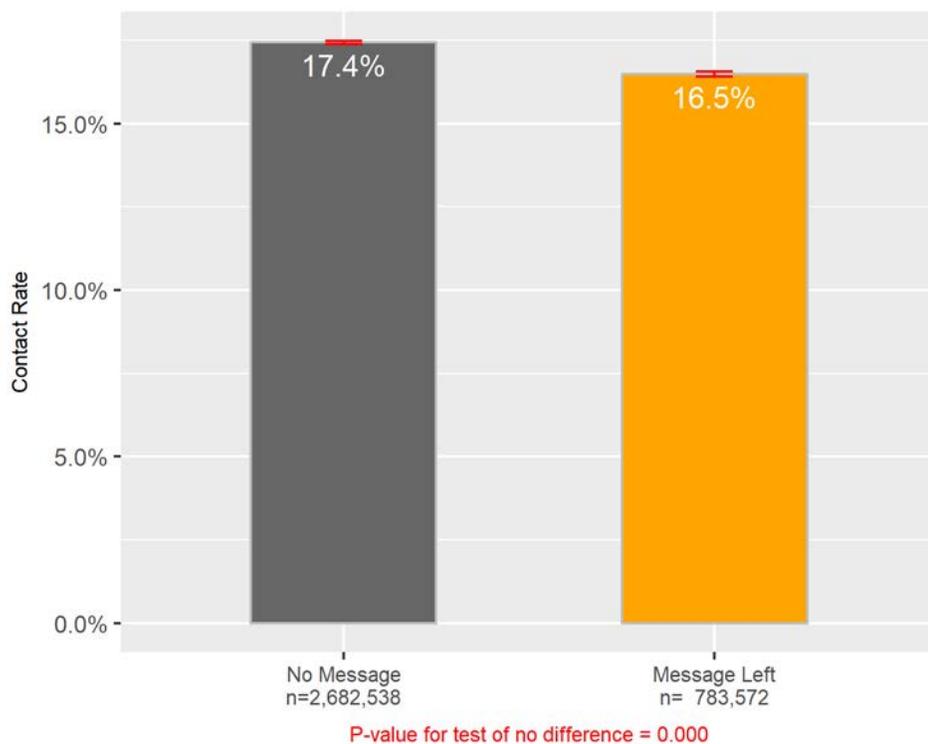
Figures 5-9 present the component rates for the call after the first-dial voicemail event, first for cases that did not have a voicemail message left and then for cases that had a voicemail message left. Also shown are 95 percent confidence intervals for the estimated rates and the p-value of a chi-square test of no difference in outcome rate between those with and without a voicemail message left.

Contrary to expectation, leaving a message on the first-dial voicemail event actually *decreased* the contact rate among working numbers on the next dial, as can be seen in Figure 5. Figures 5a and 5b offer an explanation. Figure 5a presents the rate of inbound calls (i.e., the respondent calling us) immediately following a first-dial voicemail event, and Figure 5b presents the next-dial contact rate following a first-dial voicemail event, excluding cases that called inbound from both the numerator and denominator. The rate of inbound dials was significantly lower when a voicemail message was left than when a

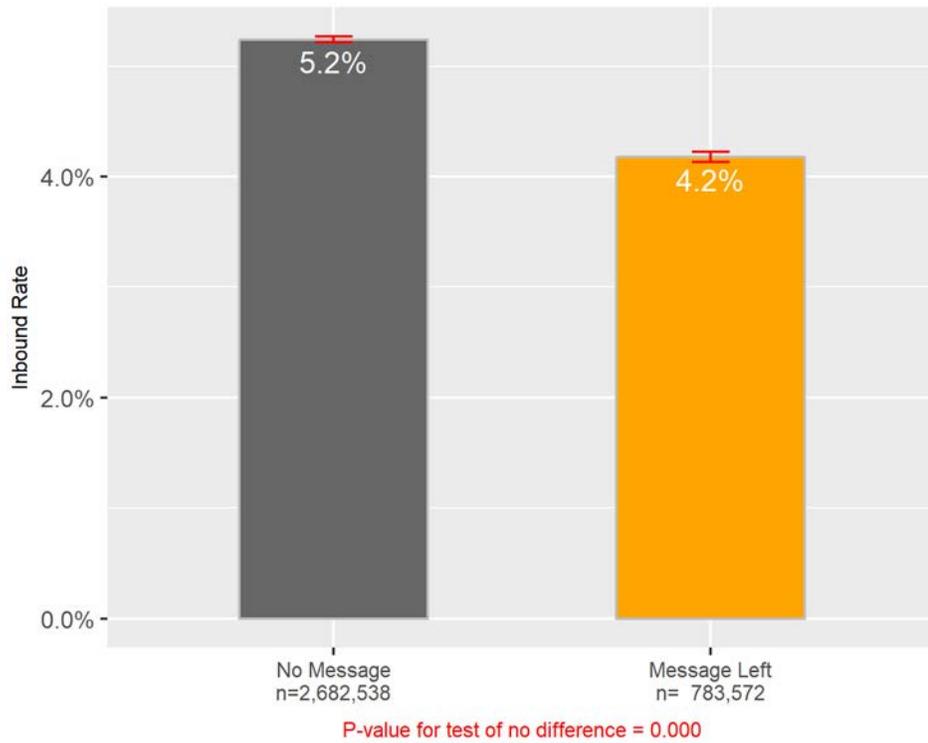
message was not left (Figure 5a); after excluding those inbound dials, we do not observe a difference in the contact rate between cases where a voicemail message was left versus not left. This suggests that the lower overall contact rate when a message was left was entirely driven by a lower inbound call rate when a message was left.

Among cases where contact was made, cooperation rates were higher when a message was left on the first-dial voicemail event than when a message was not left (Figures 6 through 9). The age-screener completion rate ( $p=0.000$ ), the age-eligibility rate ( $p=0.011$ ), the interview completion rate ( $p=0.010$ ), and the consent rate to contact providers ( $p=0.143$ ) were all higher when a message was left.

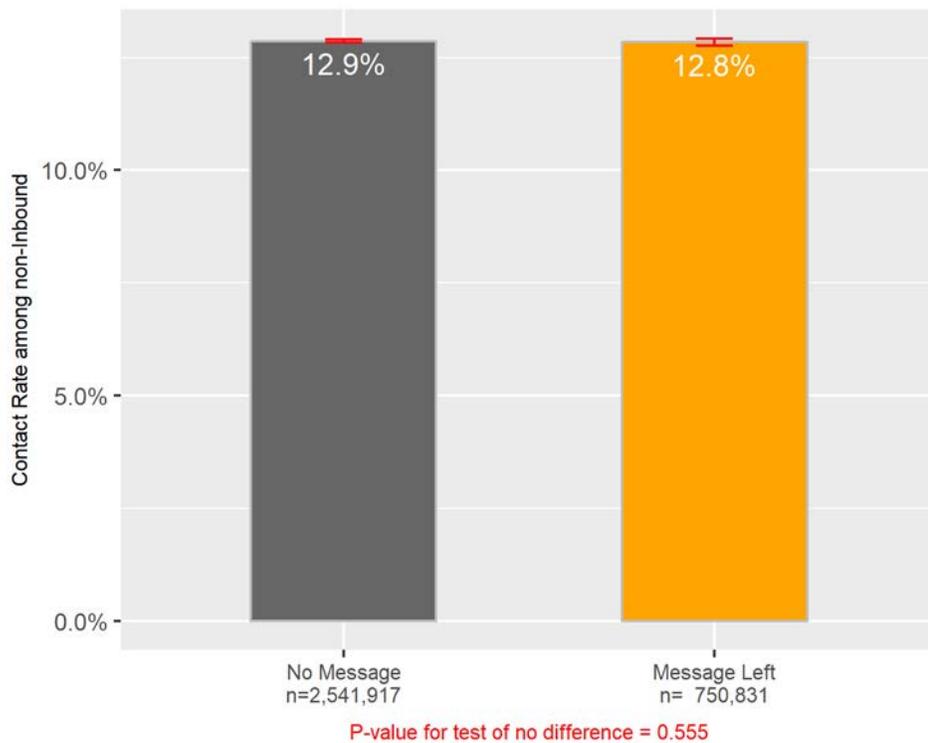
**Figure 5:** Second Dial Outcome among First-Dial Voicemail Cases: Contact Rate among Working Numbers



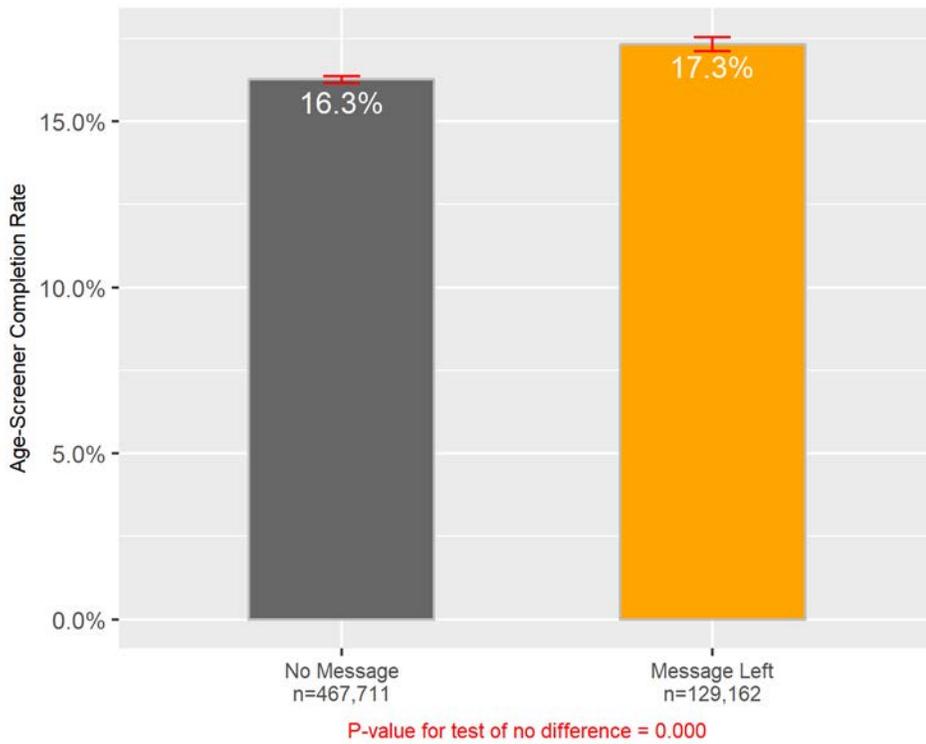
**Figure 5a:** Second Dial Outcome among First-Dial Voicemail Cases: Inbound Call Rate



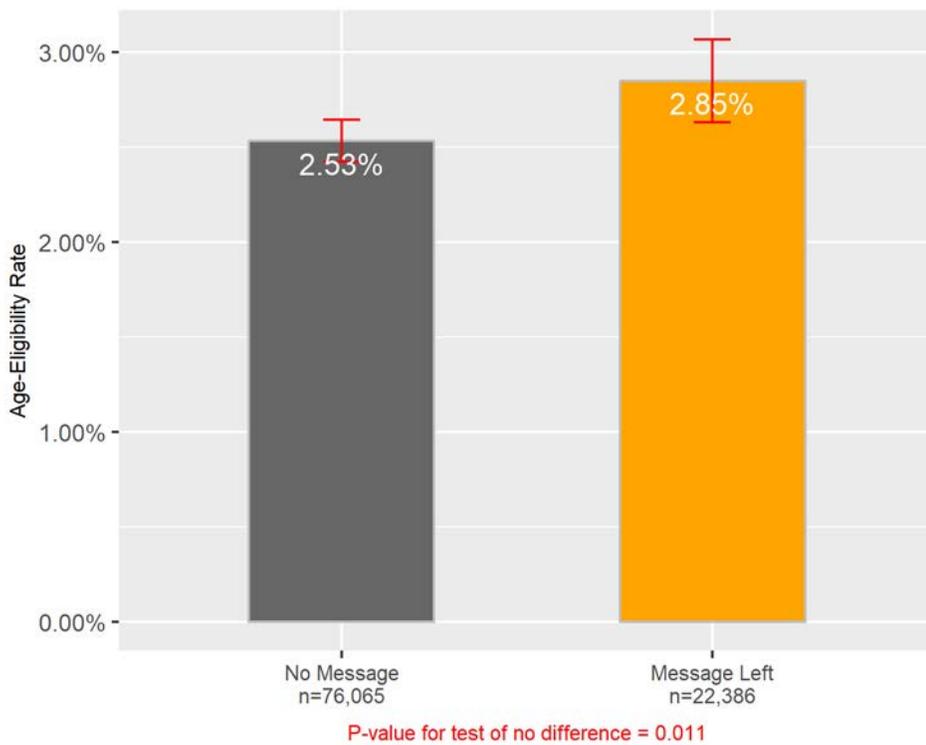
**Figure 5b:** Second Dial Outcome among First-Dial Voicemail Cases: Contact Rate among Non-Inbound Call Working Numbers



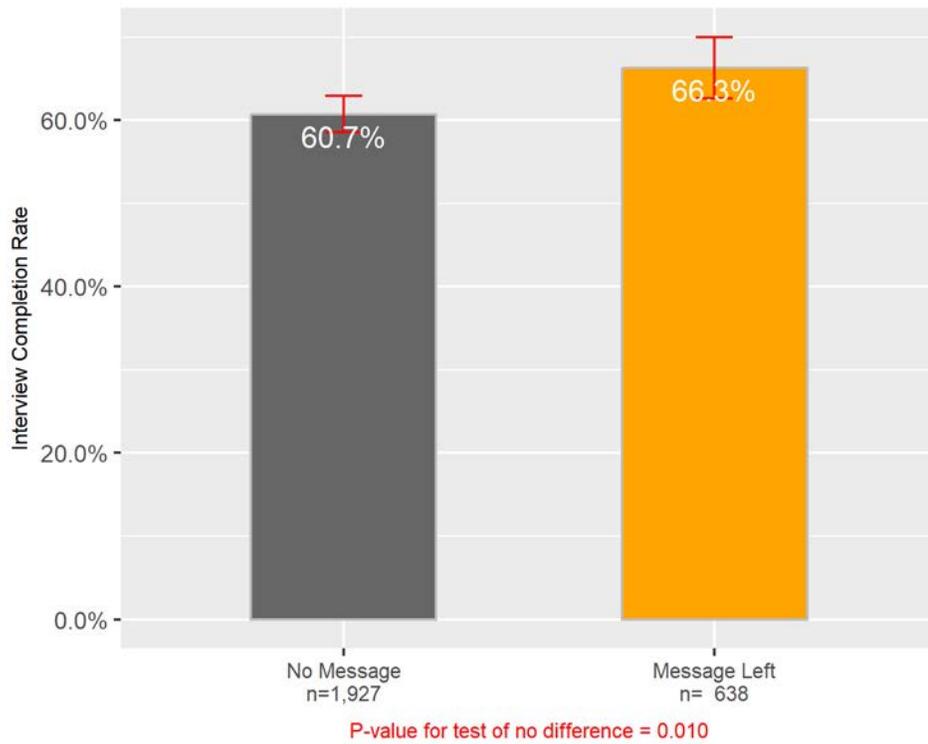
**Figure 6:** Second Dial Outcome among First-Dial Voicemail Cases: Age-Screener Completion Rate among Contacts



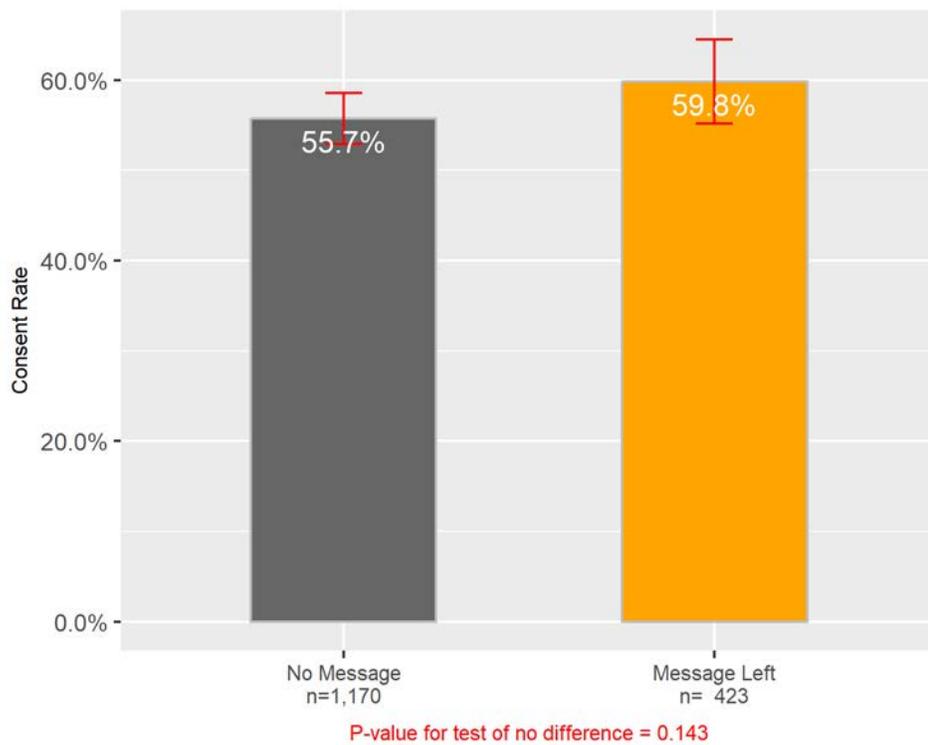
**Figure 7:** Second Dial Outcome among First-Dial Voicemail Cases: Age-Eligibility Rate among Age-Screener Completes



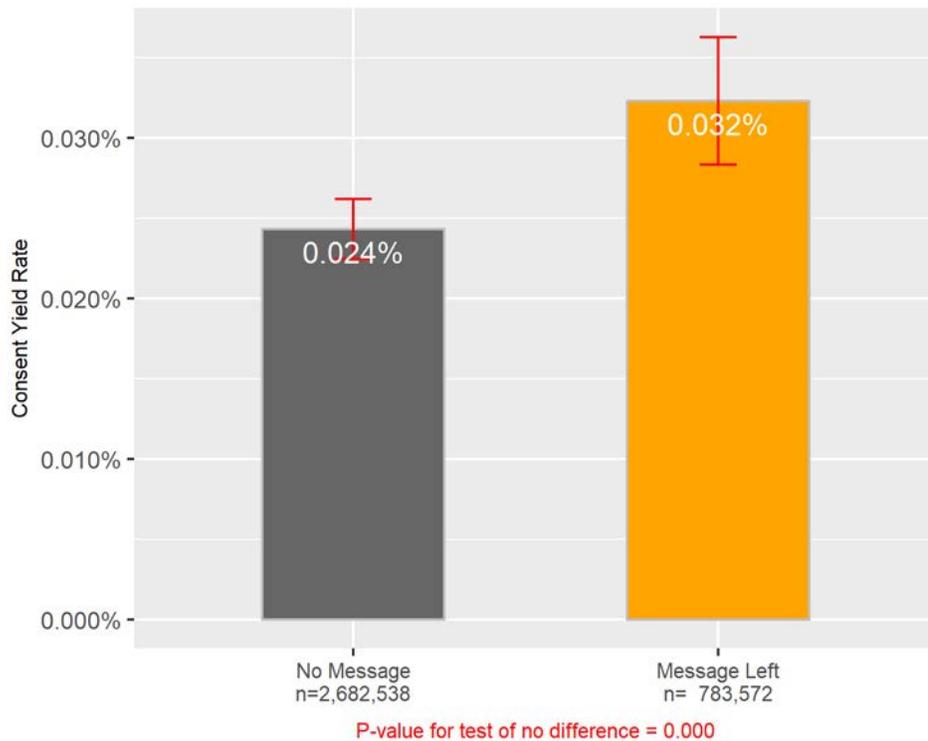
**Figure 8:** Second Dial Outcome among First-Dial Voicemail Cases: Interview Completion Rate among Age-Eligibles



**Figure 9:** Second Dial Outcome among First-Dial Voicemail Cases: Consent Rate to Contact Providers among Interview Completes



**Figure 10:** Second Dial Outcome among First-Dial Voicemail Cases: Yield Rate of Completed Interviews with Consent to Contact Providers among Working Numbers



The overall yield rate of completed interviews with consent to contact providers among the working numbers was significantly higher ( $p < 0.001$ ) when a message was left (Figure 10). That is, despite the lower contact rate when a message was left, the other component rates were so much higher when a message was left that the resulting overall yield rate was higher when a message was left (0.032 percent) than when a message was not left (0.024 percent), for a very large effect size of 33 percent ( $(0.032/0.024 - 1)$ ).

#### 4.2 Impact on the Survey Campaign as a Whole

The previous section examined the impact on the outcome of the second dial of leaving versus not leaving a voicemail message on the first dial, among cases with a voicemail event on the first dial. In this section, we examine the impact of leaving versus not leaving a voicemail message on outcomes for a survey campaign as a whole. To estimate the impact on a survey campaign as a whole, all cases were included in the analysis, not just those with a voicemail event, and cumulative case outcomes as of the end of the third dial were examined. By examining the outcomes as of the end of the third dial, we can directly estimate the impact of leaving versus not leaving a message by comparing cases in Treatments 1 and 2 to cases in Treatments 3 and 4, as shown in Figure 11. By examining outcomes as of the end of the third dial, this analysis simulates the impact for a survey with a three-dial protocol.

**Figure 11:** Estimating the Impact of Leaving a Message vs. Not Leaving Message on a Survey with a Three-Dial Protocol

Voicemail Event Number	Treatment 1	Treatment 2	Treatment 3	Treatment 4
1	Leave Message	X	X	X
2	X	Leave Message	X	X
3	X	X	Leave Message	X
4	X	X	X	Leave Message

*Note:* By comparing the cumulative outcomes as of the end of the third dial between cases in Treatments 1-2 and cases in Treatment 3-4, the impact of leaving versus not leaving a voicemail message on the first or second dial can be directly estimated for a survey with a three-dial protocol.

**Figure 12:** Survey Campaign as a Whole for a Three-Dial Protocol: Yield Rate of Completed Interviews with Consent to Contact Providers among Working Numbers

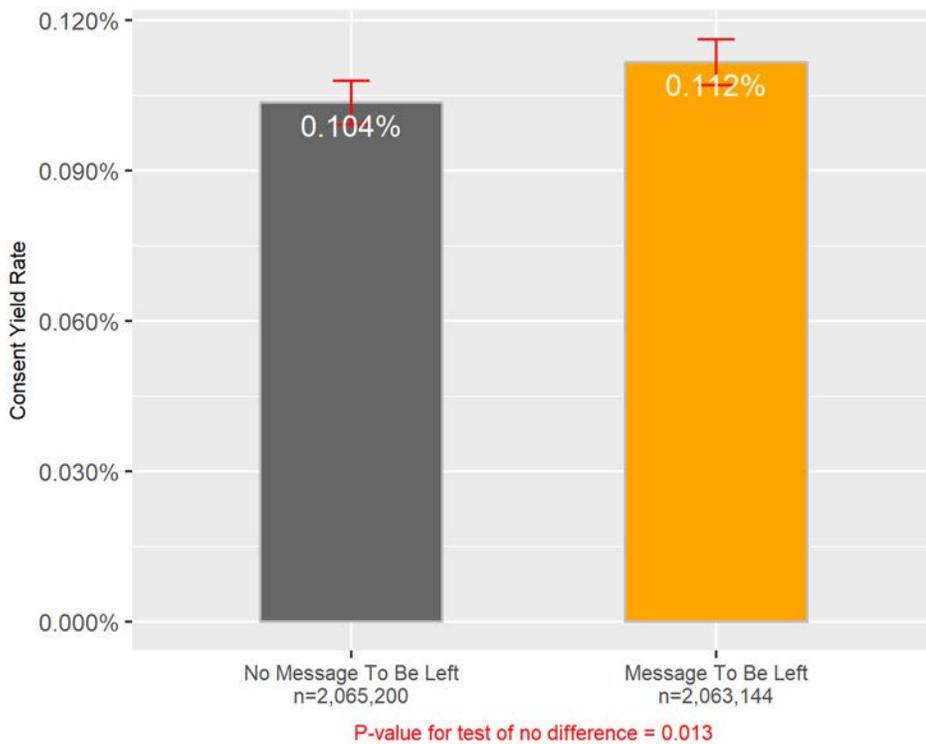


Figure 12 presents the overall yield rate of completed interviews with consent to contact providers among the working numbers, as of the end of the third dial, for cases with no voicemail message to be left if a respondent's voicemail is encountered before the third dial (Treatments 3 and 4) versus cases with a message to be left if a respondent's voicemail is encountered before the third dial (Treatments 1 and 2). The overall yield rate of completed interviews with consent to contact providers among the working numbers was significantly higher ( $p=0.013$ ) when messages were to be left (0.112 percent) than when messages were not to be left (0.104 percent), for an effect size of 8 percent ( $0.112/0.104 - 1$ ).

### 4.3 Impact of First- versus Second-Event Messages on the Survey Campaign as a Whole

The study design can also be used to examine the impact on the survey campaign as a whole of leaving a voicemail on the first voicemail event versus the second voicemail event. By examining case outcomes as of the end of the third dial separately for cases in Treatment 1 and cases in Treatment 2 (see Figure 13), we can simulate and compare case outcomes for a three-dial protocol for a survey in which voicemail messages are left on the first versus second voicemail event.

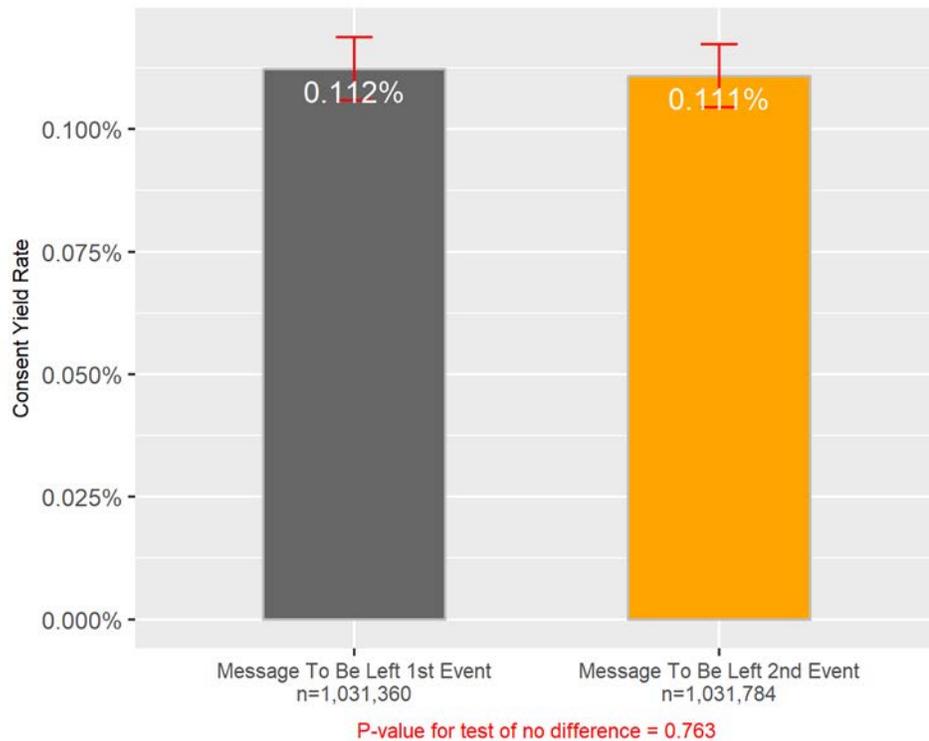
Figure 14 presents the overall yield rate of completed interviews with consent to contact providers among the working numbers, as of the end of the third dial, for cases with a voicemail message to be left on the first versus second voicemail event if a respondent's voicemail is encountered. The overall yield rate of completed interviews with consent to contact providers among the working numbers was not different ( $p=0.763$ ) when messages were to be left on the first voicemail event (0.112 percent) than when messages were to be left on the second voicemail event (0.111 percent).

**Figure 13:** Estimating the Impact of First-Event vs. Second-Event Voicemail Messages on a Survey with a Three-Dial Protocol

Voicemail Event Number	Treatment 1	Treatment 2	Treatment 3	Treatment 4
1	Leave Message	X	X	X
2	X	Leave Message	X	X
3	X	X	Leave Message	X
4	X	X	X	Leave Message

*Note:* By comparing the cumulative outcomes as of the end of the third dial between cases in Treatment 1 and cases in Treatment 2, the impact of leaving a message on the first voicemail event versus the second voicemail even can be directly estimated for a survey with a three-dial protocol.

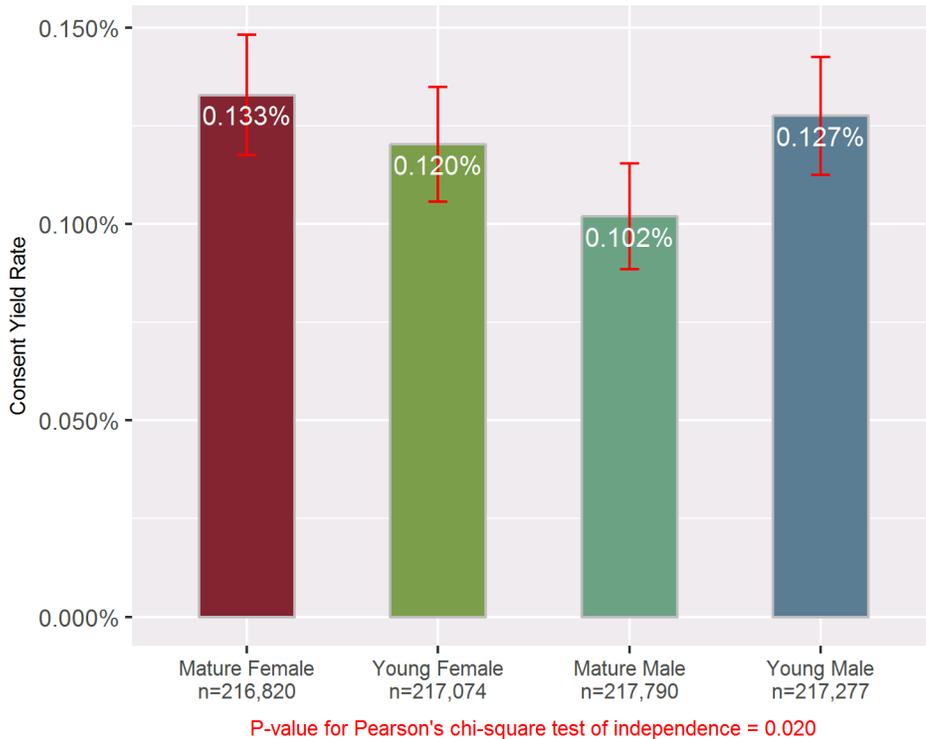
**Figure 14:** Survey Campaign as a Whole for a Three-Dial Protocol: Yield Rate of Completed Interviews with Consent to Contact Providers among Working Numbers



#### 4.4 Impact of the Age and Gender of the Person Recording the Voicemail Message

In Quarter 3 of 2018, cases were randomly assigned to one of four treatment groups that differed in the age and gender of the person who recorded the voicemail message that the case would receive if a voicemail was encountered: a mature female voice, a mature male voice, a young female voice, or a young male voice. Figure 15 presents the overall yield rate of completed interviews with consent to contact providers among the working numbers for the simulated three-dial protocol by treatment group. The consent yield rate differed significantly by treatment group ( $p=0.020$ ), with cases assigned to receive the mature male voice recorded message performing significantly worse than cases assigned to receive the mature female or young male voice.

**Figure 15:** Impact of Pre-Recorded Message Voice on Survey Campaign as a Whole for a Three-Dial Protocol: Yield Rate of Completed Interviews with Consent to Contact Providers among Working Numbers

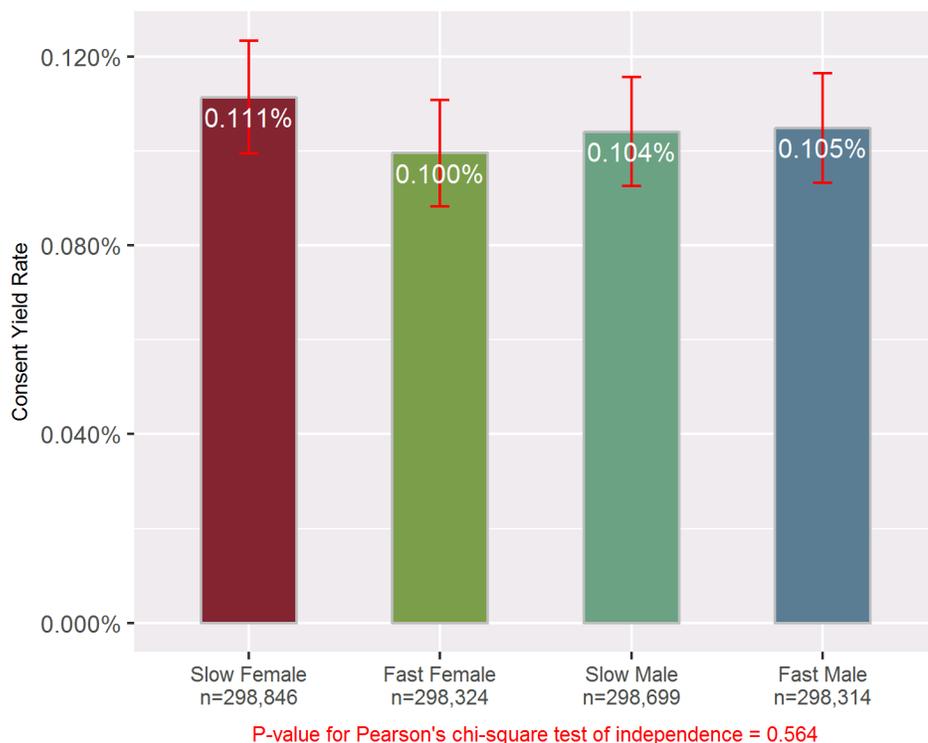


#### 4.5 Impact of the Pacing of the Pre-Recorded the Voicemail Message

In Quarter 4 of 2018, cases were randomly assigned to one of four treatment groups that differed in the pacing of the pre-recorded message that the case would receive if a voicemail was encountered and the gender of the person who recorded the message: a slower-paced female voice, a faster-paced female voice, a slower-paced male voice, or a faster-paced male voice.<sup>2</sup> Figure 16 presents the overall yield rate of completed interviews with consent to contact providers among the working numbers for the simulated three-dial protocol by treatment group. The consent yield rate did not differ significantly across the treatment groups ( $p=0.564$ ).

<sup>2</sup> The female voice used in the slower- and faster-paced female voice treatments was the same as the mature female voice used in the Quarter 3 experiment; the male voice used in the slower- and faster-paced male voice treatments was a new, middle-aged male voice that had not been used in Quarter 3.

**Figure 16:** Impact of Pre-Recorded Message Pacing and Voice on Survey Campaign as a Whole for a Three-Dial Protocol: Yield Rate of Completed Interviews with Consent to Contact Providers among Working Numbers



## 5. Discussion

Reaching a respondent's voicemail is the most common call outcome among working numbers in the NIS, and leaving voicemail messages can inform potential respondents about the survey. Consistent with Benford et al. (2010), we found that voicemail messages for a cell-phone sample decreased contact rates but increased cooperation among the contacted, and we uncovered a possible explanation for the effect: leaving messages decreased the rate of respondents calling back following the voicemail event. Perhaps some cell phone users redial following a missed call from an unrecognized number out of curiosity as to the identity of the caller and the purpose of the call; if a message is left indicating the caller's identity and purpose, the curiosity factor is removed and these potential respondents may therefore be less likely to redial following the missed call, lowering the inbound call rate and ultimately lowering the contact rate.

Despite the lower contact rate, the increased cooperation rate resulted in a much higher overall yield rate of completed interviews with consent to contact vaccination providers when a message was left. When looking just at the outcome of the second dial for cases with a first-dial voicemail event, the overall yield rate was 33 percent higher when a message was left; when looking at the outcomes for the survey campaign as a whole under a simulated three-dial protocol, the effect remained fairly large, with the overall yield rate being 8 percent higher when a message was left. These results suggest that voicemail messages are an effective way to increase survey participation in the NIS.

We did not observe a difference in the overall yield rate of completed interviews with consent to contact vaccination providers by whether the message was left at the first voicemail event or the second voicemail event, suggesting that it is the act of leaving an early message rather than the timing of the message (first event or second event) that is important.

The NIS utilizes pre-recorded voicemail messages, and we found that the voice used to record the message can have an impact on survey participation. Our study used four particular voices, so we cannot draw general conclusions about how male versus female voices or young versus mature voices perform, but our results demonstrate that the voice can make a difference. No effect was observed for the pacing of the pre-recorded message.

## **6. Limitations**

Our evaluations and conclusions are subject to several limitations. In this study, pre-recorded messages initiated by an automated telephony system were utilized, as opposed to live voicemail messages left by an interviewer; our results may not apply to live messages. The NIS is a survey about the vaccination of children and is sponsored by the CDC; the effect of leaving messages may differ for surveys with a different target population, subject matter, or sponsorship. A particular voicemail message script was used; our conclusions may not be applicable to messages with different content. We used particular male and female, mature and young voices on the pre-recorded messages in this study; our conclusions may not hold for other voices or vocal characteristics (e.g., accent, pitch, etc.). All of the messages in this study were in English; our conclusions may not apply to other languages.

## **7. Future Research**

The use of pre-recorded messages facilitates not only the testing of different voices on the message, but also the testing of different message content. Beginning in Quarter 1 of 2019, the NIS is testing four different versions of the content of the voicemail message:

- The current NIS message;
- A more informal message;
- An informal message, without including the eligibility criteria of the survey;
- A message emphasizing the purpose and importance of the survey, without including the eligibility criteria.

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