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**Estimating Eligibility Rates:  
A Crucial Component of the  
Calculation for Response  
Rates**

By

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**TITLE:** Estimating Eligibility Rates: A Crucial Component of the Calculation for Response Rates

**ABSTRACT:** Response rates are used by analysts to assess survey quality: higher response rates are usually desired to reduce the incidence of non-response bias. The response rate is simply defined as the ratio of the number of completed interviews divided by the number of eligible sample units. However, due to the inconsistency of the definition of response rates often quoted in travel surveys, it is difficult to explicitly state that declining response rates are the result of less people willing to participate in surveys or are attributed to the calculation of response rates. It is most likely to be a combination of these two factors.

This paper describes two well known formulas used to calculate response rates; the Council of American Survey Research Organizations (CASRO) formula and the American Association for Public Opinion Research (AAPOR) formula. The real difference between these formulas lies in the estimate of eligible sample units amongst the sample units of unknown eligibility. Through examination of two call history files, the recruitment phase for two household travel surveys, eligibility rate estimates for the sample units of unknown eligibility were calculated and used in the response rate formulas.

It was found that the rates of eligibility for the sample units of unknown eligibility were higher than the eligibility rates for the units of known eligibility. These results were not expected and further confirm that agencies need to treat units of unknown eligibility carefully when calculating response rates.

**KEY WORDS:** *Disposition codes, eligibility status, response rates*

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## 1. Introduction

Until recently, the Council of American Survey Research Organizations, CASRO, was the only organization with its own method for calculating response rates. However, some years after the development of the CASRO method, the American Association of Public Opinion Research (AAPOR) developed another method for calculating response rates. Both the CASRO and AAPOR formulas are commonly used by survey practitioners. For example, the Advertising Research Council (ARF), Council of Marketing Opinion Research (CMOR) and Marketing Research Association (MRA) use a modified version of the AAPOR method for calculating response rates (CMOR, 1999). The World Association of Opinion and Marketing Research Professionals (ESOMAR) does not have its own method for calculating response rates.

Proper calculation of response rates is important because response rates are used by analysts to assess survey quality. Higher response rates are usually desired to reduce the likely incidence of non-response bias. For example, in household travel surveys, it has been found that non-respondents have different travel and demographic characteristics to those of respondents. Hence, the resulting data set is biased – not representative of the general population. This has been widely documented (De Heer and Moritz, 1997; Richardson, 2000; Kam and Morris, 1999).

The response rate is simply defined as the ratio of the number of completed interviews divided by the number of eligible sample units, where eligible sample units are the sample units that have met certain eligibility criteria (CMOR, 1999; CASRO, 1982; AAPOR, 2004; Ezzatic-Rice *et al.*, 1999; Richardson and Meyburg, 2003). The main difference between these CASRO and AAPOR methods lies in the estimation of the eligibility rate for sample units of unknown eligibility. In addition, despite the fact that the response rate formulas are rather simplistic, a complex issue arises when trying to determine the number of eligible sample units from the eligibility unknown sample units, especially when using the AAPOR method, given that the CASRO method assumes that the eligibility rate of the unknown sample units is equal to the eligibility rate of the known sample units. Furthermore, the number of non-contacts (eligibility unknown sample units) is increasing in sample surveys and this accentuates the need to appropriately estimate the eligibility rate for the sample units of unknown eligibility.

Given that many agencies use either the AAPOR or CASRO methods for calculating response rates, this paper looks at call history files to determine the eligibility status of the unknown sample units after ten call attempts: this is the number of calls made to the same sample unit to try to resolve the sample unit in relation to its eligibility status (eligible or ineligible). However, the status of some sample units will never be known (non-contacts). These are the sample units that remain as units of unknown eligibility after the ten call attempts have been made, in this analysis. In addition, later in this paper, a five call attempt will be set to show the difference in the response rate.

By looking at each call attempt, the rates at which previously unknown sample units become resolved are determined for each call attempt. This is important because the rates at which the unknown units become resolved are not fixed across the ten call attempts, and this information is vital when trying to establish a suitable eligibility rate to use in the AAPOR method for calculating response rates. In addition, this is

important when comparing this method to the CASRO method for calculating response rates.

## 2. Need for Standards

Before describing the formulas used to calculate response rates in more detail, broad classifications regarding eligibility status are discussed. This provides a better understanding of the problems encountered during the analyses of call history files and subsequently, the calculation of response rates.

In the literature on response rate calculations, a sample is divided first into two groups. The first group is called the “eligibility known” group, and the second group is called the “eligibility unknown” group. The first group – those with eligibility known – divide into two further subgroups: the eligible and ineligible. The second group, of eligibility unknown, comprises all sample units whose eligibility for the travel survey is never established. In the first group and subgroup, there is a further sub-grouping into respondents and non-respondents. This is shown diagrammatically in Figure 1. In many cases, in transportation surveys, the response rate is presented as the respondents divided by the eligible sample units (i.e., R/E). This is actually the cooperation rate, defined by the AAPOR (2004) and is similar to the response rate formula (RR5), also devised by the AAPOR (2004), except that the RR5 formula includes non-contacts in the denominator. The removal of these would in fact give the cooperation rate (COOP1). By definition, the COOP1 rate ignores the portion of the sample that have not been contacted successfully, and within which there is presumably a number of eligible sample units. However, this is also the case for RR5. Thus, the response rate (RR5) formula is not useful in relation to travel surveys and other surveys of the general population, because it assumes that the eligibility rate of the unknown cases is actually zero. In addition, the response rate formula (RR5) is likely to overestimate the response rate of surveys of the general population.

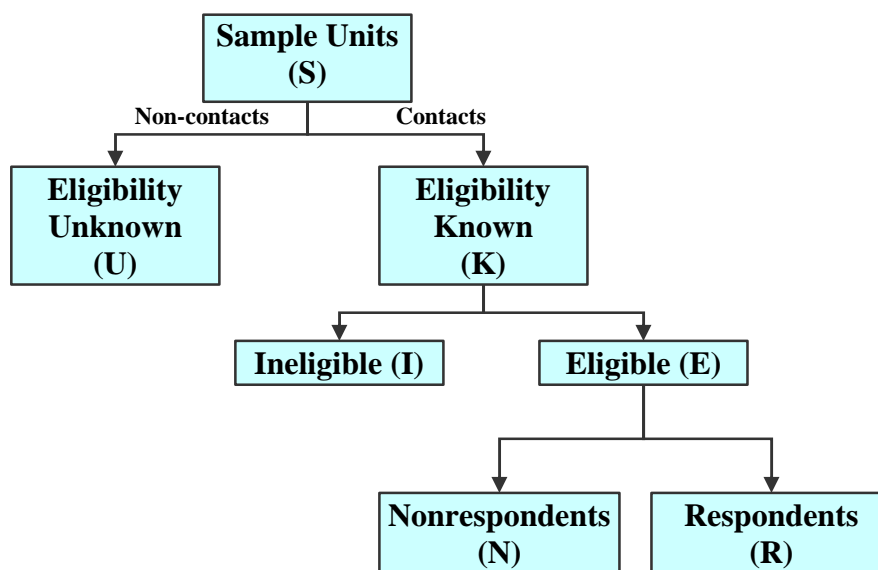


FIGURE 1: Sample Grouping by Eligibility.

Other possible definitions of response rate might include the number of respondents divided by the total sample units (R/S), which would provide a response rate that is generally considered too low. Many of the eligibility unknown units may prove to be ineligible, so that including them as though they are eligible produces a wrong estimate of response rate. Another, also generally erroneous calculation would be the respondents divided by the eligibility known units (R/K). In one paper consulted, this formula for the calculation of response rates was used (Singer *et al.*, 2000). The result was an under estimation of response rates because all known ineligible sample units were included in the calculation (denominator). The problem is accentuated if many of the attempted contacts are ineligible sample units.

Response rates are calculated by analysts to observe the overall quality of the completed survey (Beerten *et al.*, 2000; Lynn *et al.*, 2001). However, the response rate to a survey is only one survey quality indicator, therefore, one cannot assume that a high response rate relates to good quality data. Other data quality indicators include the level of proxy reporting in the final data set, the level of item non-response for key variables, the overall sampling technique used and the actual survey instrument. For example, response rates may be boosted through the use of pre-paid incentives and repeated mailings and reminders. However, the data coming from late respondents may be so poor that increasing response rates has not added to data quality. Furthermore, the use of other data quality indicators mentioned highlights the importance of the definition of a complete household response and the need for standards to be imposed in relation to this. Although response rates are not the only indicators of survey quality, they are important indicators that are readily quoted by survey practitioners, reinforcing the need for this item to also be standardized.

Response rates have become more of an issue because response rates have been falling over recent years (Dillman and Carley-Baxter, 2000; Dillman *et al.*, 2001; Kalfs and van Evert, 2003; Ezzatic-Rice *et al.*, 1999). In relation to travel surveys, it has also been widely documented that the differences in terms of key statistics, between respondents and non-respondents is significant (De Heer and Moritz, 1997; Richardson, 2000; Kam and Morris, 1999). This highlights the desire by most travel survey practitioners to obtain higher response rates to travel surveys. However, due to the inconsistency of the definition of response rates often quoted in travel surveys, it is difficult to state explicitly that declining response rates are the result of less people willing to participate in surveys or are attributable to the calculation of response rates. It is most likely to be a combination of the two. This then leads to the problem of incomparability, hence the need for a standard for the calculation of response rates.

The widely used CASRO method is:

$$RR = \frac{SR}{E + e_c * U}$$

where:

*RR* = response rate

*SR* = complete interviews,

*E* = eligible sample units,

*e<sub>c</sub>* = CASRO eligibility rate (eligible units divided by the sum of the eligible and ineligible units), and

*U* = unknown sample units refers to the sample units with unknown eligibility (unresolved).

The CASRO formula assumes that the proportion of eligible units amongst the eligibility unknown sample units is equal to the proportion of eligible units amongst the eligibility known sample units. For example, if a Random-Digit-Dialing survey was conducted and 20,000 telephone numbers are called, there may only be 4,800 people successfully recruited to participate in the survey, of which only 1,579 complete the survey. The rest of the sample is characterized by refusals (1,200), ineligible respondents (2,400) and 11,600 cases where eligibility is unknown. The eligibility rate for this survey is:

$(4,800+1,200) / (4,800+1,200+2,400) = 71$  percent. Applying the CASRO formula for response rates, the result is 11.1 percent, a very low response rate for the entire survey procedure. The real question, in relation to the calculation of response rates, is the determination of the eligibility rate for the unknown sample units (Ezzati-Rice *et al.*, 1999; Brick *et al.*, 2002; AAPOR, 2004). The AAPOR definition of response rates (RR3) states that the estimation of the eligibility rate is left to the discretion of the organization(s) and individual(s) undertaking the research, that the estimate for eligibility from unknown cases should be based on the best available scientific information, and that the basis of the estimate must be explicitly stated and explained. A relatively recent study used the AAPOR (RR3) formula to calculate response rates (Keeter *et al.*, 2000). In this study the eligibility rate for the unknown sample units was estimated to be around 20 percent due to investigations that indicated that around 20 percent of eligible units were amongst the unknown sample units.

The formula for response rates (RR3) devised by the AAPOR, is shown below:

$$RR3 = \frac{SR}{(SR+PI) + (RB+NC+O) + e_A (UH+UO)}$$

SR = complete interview/ questionnaire

PI= partial interview/questionnaire

RB= refusal and break-off

NC= non-contact

O= other

UH= unknown if household occupied

UO= unknown other

$e_A$  = estimated proportion of cases of unknown eligibility that are eligible (AAPOR eligibility rate: the same formula for calculating the eligibility rate is used).

Sample units labeled as non-contacts, according to the AAPOR formula, are allocated an eligibility known status. The AAPOR reasoning for this is that prior knowledge of the household has determined the household as an eligible sample unit.

Interestingly, another paper also categorized non-contacted sample units as eligible sample units (Lynn *et al.*, 2001). A diagram shown on page 7 of this report, labels a sampling unit as eligible before contact takes place: this does not seem correct. Furthermore, if eligibility criteria have to be met, than this is certainly incorrect and this does not seem relevant to surveys of the general population. However, it may be relevant to panel surveys, in relation to subsequent waves. With this in mind, the above response rate is re-written as:

$$RR3_A = \frac{SR}{(SR+PI) + (RB + O) + e_A (UH+UO+NC)},$$

where the same labeling occurs as shown in the RR3 formula, except that the non-contacts are part of the eligibility unknown group (UH + UO+ NC).

Apart from the different labeling in relation to the non-contacts, the AAPOR formula (RR3) is only slightly different from the CASRO formula, and this difference is in relation to the specification of  $e_A$ . The two methods are similar because the sum of SR, PI, RB, and O is simply the total of eligible units in the sample (E), and the sum of the UH, UO and NC is the total of the unknown eligibility units (U).

Despite the modification of the RR3 formula devised by the AAPOR in this analysis (we shall refer to this as  $RR3_A$ ), the AAPOR breakdown of disposition codes enables the research agency to understand better the possible contact outcomes and therefore label correctly the disposition codes, in terms of eligibility status. In addition, the AAPOR formula more or less requires the agency to distinguish between the responses that are complete and those that are partial. Even though this should be determined by the agency before fieldwork commences, the AAPOR formula reinforces the distinction and hence, does not allow for the over estimation of response rates.

### 3. Two or More Stage Surveys

There is a further complication in a survey that involves two or more steps. For example, most household travel surveys involve an initial recruitment contact, followed by a data retrieval procedure that may take place some days later, as shown in Figure 2.

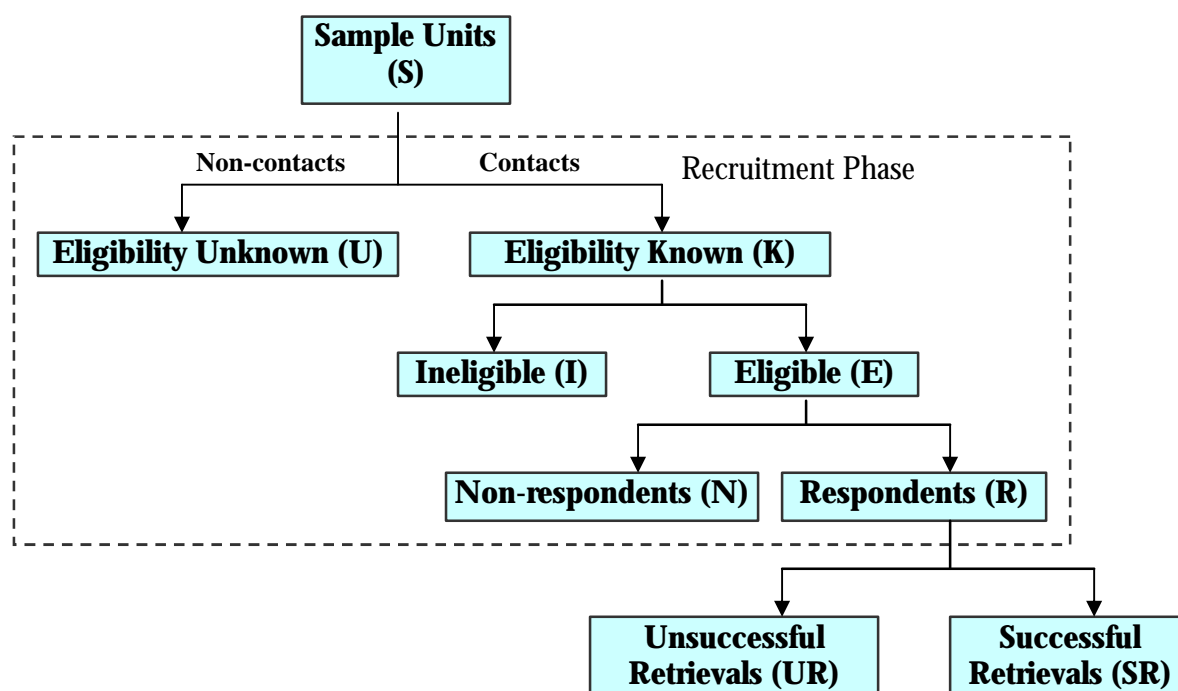


FIGURE 2 Two -Stage Survey Process: Recruitment and Retrieval.

This process often leads to incorrect estimates of response rates. Some surveys ignore the response rate from the recruitment, and report only the response rate of the retrieval process (SR/R). Others may calculate the response rate from the recruitment incorrectly using one of the methods discussed above, and then correctly multiply the resulting response rate from the retrieval. Agencies calculating response rates for two or more stage surveys should not encounter difficulties as long as disposition codes are correctly labeled in terms of known and unknown eligibility. This would allow for the overall response rate to be calculated directly as demonstrated in the following equation:

$$RR = \left( \frac{RH}{E + e * U} \right) * \left( \frac{SR}{RH} \right) \quad \text{where:}$$

RR= response rate,

SR =successful retrievals,

RH= recruited households (respondents in the recruitment phase),

E= eligible sample units,

e= eligibility rate, and

U= unknown sample units. Actually, this equation is very similar to standard 1-3-3 developed by the National Center for Education Statistics (NCES, 2002).

The first part of the formula gives the recruitment response rate and the second part calculates the retrieval response rate. The above equation reduces to:

$$RR = \frac{SR}{E + e * U}$$

the formula for response rates (CASRO, 1982; AAPOR, 2004; Groves and Couper, 1998). However, calculating the response rate for each stage of the survey may be useful for agencies to identify



problematic areas encountered during any phase of the survey process. For example, the recruitment response rate, calculated by using the formula:

$$RR = \frac{RH}{E + e * U},$$

may make agencies aware that recruiting methods and materials used were not suitable, if the response rate calculated for this stage of the survey is poor. This exercise is even more beneficial to agencies wishing to undertake follow-up studies to surveys that yielded very poor overall response rates.

Through analyses of two call history files for the recruitment phase for two recent household travel surveys, an attempt to propose standards or guidelines for the estimation of the eligibility rate across sample units of unknown eligibility was made. This is described in the following section.

#### 4. Call History Files

The prime purpose for undertaking the analyses of call history files is to determine eligibility rates of the eligibility unknown sample units. However, call history files are not commonly referred to and, therefore, it would be useful to provide a definition of such a file. A call history file is the file that houses disposition codes (labels) for each call attempt for each sample unit, during the recruitment phase of the survey process. It therefore contains temporary and final disposition codes for each call attempt for each sample unit (AAPOR, 2004). It also contains other information such as the type of recruitment, (for example whether a cold call is made or the intercept recruitment method is adopted), records the time, day, and date when the call was made, and importantly, the telephone number. Eligibility status is not explicitly shown in a call history file. However, if the number is re-called, this does not necessarily mean eligibility status of the number has not been determined. This depends on how the survey agency decides to categorize certain disposition codes. For example, some call history files categorize call backs as calls of known eligibility whereas other call history files categorize these as calls of unknown eligibility. This is so because a screener interview conducted may have been able to establish the eligibility of the number called, in relation to the bounds of the study undertaken. Thus, it is important to examine the call history file, in terms of the disposition codes used, and any relevant documentation before undertaking any analysis. Disposition codes for the two files are shown in Table 1 and Table 2.

*TABLE 1 Disposition codes, call history file 1*

<b>FILE 1 DISPOSITION (Labels)</b>	<b>code</b>	<b>ELIGIBILITY STATUS</b>
no answer	2	U
busy	3	U
disconnected/changed	4	I
answering machine	5	U
wrong number/ business number	6	I
language barrier/deaf	7	I
party not available	8	E
party terminated (refused)	10	E
scheduled for callback	11	U
terminated by quota	13	I
party terminated mid-survey	16	E
new number	17	I
completed interview	20	E

*TABLE 2 Disposition Codes, file 2*

<b>File 2 DISPOSITION (Labels)</b>	<b>code</b>	<b>ELIGIBILITY STATUS</b>
Complete	1	E
Hard refusals	2	E
Second refusals	3	E
Disconnected number	4	I
System default	6	I
Business number	8	I
Second language barrier not Spanish	13	I
Second fax machine/ modem	14	I
Terminated interview/ Q BR	18	E
Terminated Q1	50	E
Terminate out of area	51	I
Bad zip code	52	I
Terminate Q20	53	E
Terminate Q21 – household count	54	E
Refused to participate at invite	55	E
Refused address component(s)	56	E
Unable/Refuse to reassign date	58	E
Over quota cell	59	I
Over quota county	60	I
No answer	101	U
Busy	102	U
1/2 Busy	103	U
Call back specific	104	E
Call back non-specific	105	E
System default (live number)	110	U
First fax machine/modem	127	U
All other reasons	128	U
First refusals	140	E
Answering machine	141	U
First language barrier not Spanish	143	U
Wrong number but second attempt chain - live	144	U
Language barrier Spanish	191	U
Eligible	212	E
Ineligible	213	I

In Tables 1 and 2, a few differences can be noticed in terms of the disposition codes categorized as eligible sample units. The first call history file categorized requests for call backs as units of unknown eligibility whereas the second call history file categorized these as units of known eligibility. This was because, for the second call history file, a screener question determined the eligibility status of the household before a request for call back was made.

For the first household travel survey (relating to the first call history file), no attempt was made to convert households that refused to participate, and contacted households in which respondents did not speak English were not called back (this was a function of the bounds of the study as well as budget). The different temporary and final disposition codes, used in these two call history files, demonstrates the complexity of this analysis as well as highlights the need for agencies to use the AAPOR standards for temporary and final call disposition codes.

The second call history file had a more detailed breakdown of call dispositions. The research agency was able to provide Spanish speaking interviewers hence “language barrier Spanish” was not given an ineligibility status, but rather a status of unknown eligibility after first contact. These households were re-called by Spanish speaking interviewers to determine whether the households were eligible or ineligible. In the report by the AAPOR (3), it is indicated that language barriers can be allocated an unknown eligibility status if the survey can account for non-English speaking respondents.

Also in the second call history file, a distinction was made between hard and soft refusals;

- (i) Hard refusals refer to respondents who made it clear that they did not want to participate in the survey and they may have also specifically stated not to be called back, and
- (ii) Soft refusals (first refusals) were called again. If respondents refused a second time, the disposition was labeled as a *second refusal* and the households were not called again. In addition, these sample units were eligible that is why they were referred to as *households*.

*Hard refusals* were not re-called; hence, the call disposition is the final call disposition. Fax machines were allocated a separate disposition code. This should be adopted in call history files given that many households may have more than one phone line; however, first contact should be allocated a status of unknown eligibility. If the second call attempt confirmed that the line is dedicated to a fax machine or modem, then the number is given a status of ineligibility because telephone contact with an individual will never take place. The last two disposition codes listed in Table 2 were created to allow for the analysis of the call history file. Once eligibility is established, subsequent call dispositions cannot be categorized as unknown. This too has been suggested in the report by the AAPOR (2004). Therefore, these households’ disposition codes have to be recoded to temporary disposition codes that still represent eligibility. For example, if the request for call back is made after eligibility has been established, the call should be allocated a different disposition code to signify that the household has requested to be called back and that the eligibility status was known and determined as eligible. This clearly demonstrates the need to look across the disposition codes for all call attempts made for each specific number. In addition, it would not make any sense to call back a household determined as ineligible, because such a number has been resolved.

After consulting the documentation and examining the call history files, it was obvious that some disposition codes were incorrectly categorized in the second call history file, in terms of eligibility status. For example, in the documentation for the second call history file, call dispositions “All other reasons”, “Wrong number but second attempt

chain – live”, and “System default (live number)” were considered as ineligible sample units, which in turn, indicated that these numbers should not have been called again; the numbers were resolved. However, these numbers were called again meaning that these disposition codes should be grouped with the units of unknown eligibility. Correctly re-classifying these numbers was vital for the call history file analyses to yield meaningful results.

## 5. Analysis

An important step required was to devise a program that corrected for cases where eligibility was established but on later calls was labeled as unknown (as described above). A temporary or intermediate call disposition code was created. These are shown in table 2. To create this program, first, the data were examined and the disposition codes for calls one to ten were either categorized as eligibility known (eligible and ineligible) or eligibility unknown. For example, the disposition code labeled “refused” was categorized as eligible, the disposition code labeled “over quota” was categorized as ineligible, and the disposition code labeled “machine answering device” was categorized as unknown. These three categories need to be determined to calculate the eligibility rates, where the eligibility rate is defined as:

*the number of eligible units divided (eligible units + ineligible units), which reduces to the number of eligible units divided by the total number of eligibility known units.*

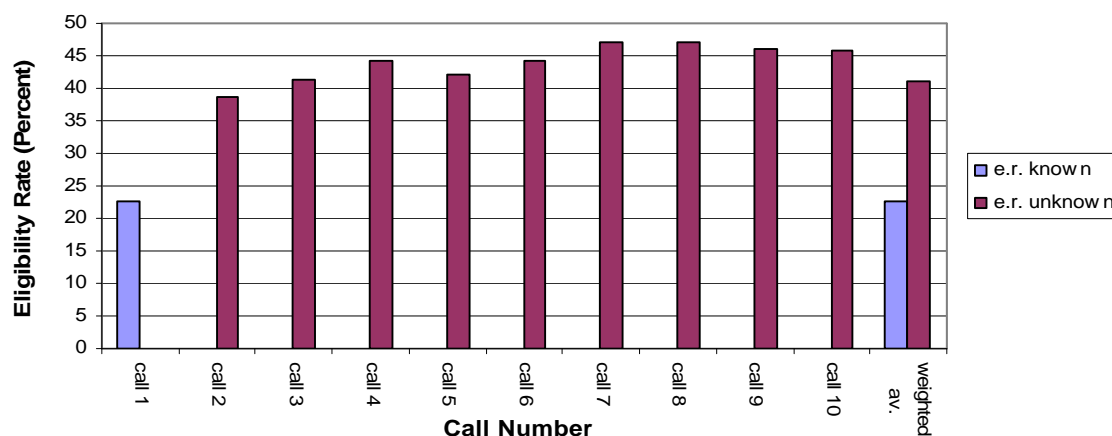
Second, for cases when a call back has been determined as an eligible sample unit and is given the disposition of no answer, busy, answering machine, or any other disposition code of unknown eligibility after subsequent call attempts, the program recoded all cases coded “unknown” to eligible. A number cannot be labelled as a known unit and on later calls be given a status of unknown eligibility.

For cases that were initially coded as call backs and later determined as ineligible sample units, the program also recoded these cases to ineligible and created a new variable. In addition, running a frequency count, in terms of call disposition codes for call one, enabled the calculation of the eligibility rate for the **known units** after call one.

Third, another new variable was created to group the eligibility known units (eligible and ineligible). The eligibility known units were allocated the code “0”, and the code “1” allocated to the eligibility unknown units. Finally, a cross tabulation was performed; call one from step three was cross tabulated against call two in step two. By looking at the eligibility unknown column for the variable created in step 3 (coded as 1) and looking at the disposition codes for the variable created in step 2, the eligibility rates for the **unknown units** (call 2 to call 10,) in the variables created in step 3, were determined by applying the eligibility rate formula. The results from the analyses of the two call history files are graphically displayed in Figures 3 and 4.

## 5.1 Results

In call history file one, no units of known eligibility were called on subsequent calls. Thus, the eligibility rate of the known units is the eligibility rate of the known units determined after the first call; units of unknown eligibility after call one are the sample units called in call two. Given this, the eligibility rate of the unknown units in call one can be determined from call two onwards. For example, the eligibility rate of the unknown units in call one equals the eligibility rate of the known units in call two. This pattern repeats itself for the remainder of the call attempts.



**FIGURE 3 Eligibility Rates for known and unknown sample units, file 1.**

Figure 3 shows that there is a substantial difference between the eligibility rate of the known units and the eligibility rate of the unknown units (weighted average) for call history file 1; the eligibility rate of the unknown units is higher than the eligibility rate for the known units. This is surprising and disputes what the CASRO formula states; the eligibility rate of the known units equals the eligibility rate of the unknown units. Despite the eligibility rate of the unknown units in call 1 equaling the eligibility rate of the known units in call 2, the weighted average should be used for the eligibility rate of the entire recruitment process, and not just the eligibility rate of an individual call attempt. If one was assessing the eligibility rate for every call attempt, then the CASRO definition of the eligibility rate would be correct (eligibility rate of the unknown units in call 1 equals the eligibility rate of the known units in call 2).

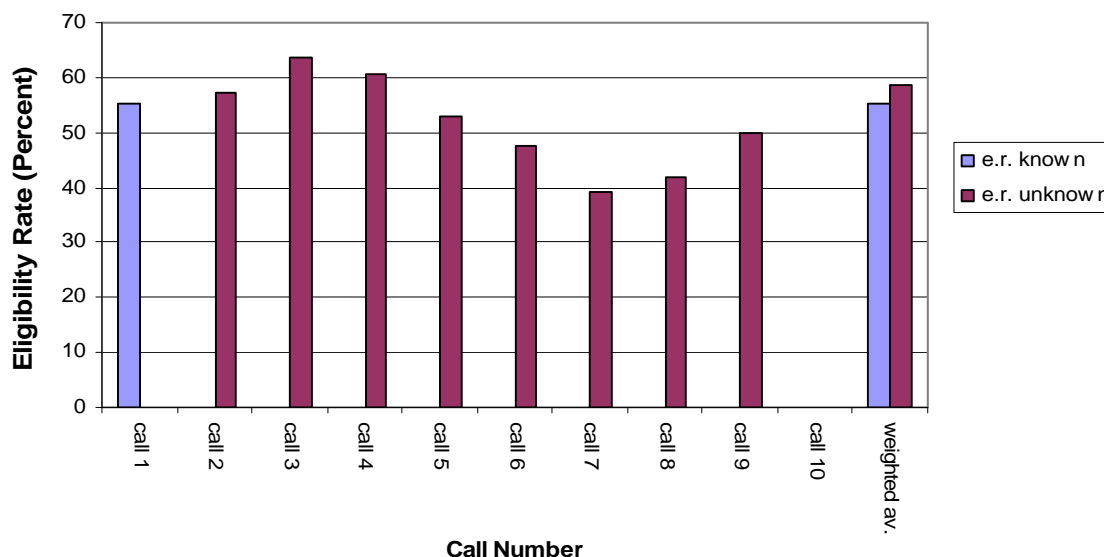
In addition, the percentage of calls for which eligibility status could not be determined (the total number of units of unknown eligibility divided by the total number of calls made on each call attempt), increased as the number of call attempts increased. This is because a high number of the units of unknown eligibility were non-contacts.

**TABLE 3 AAPOR and CASRO Response Rates, file 1**

CASRO		AAPOR	
<b>SR</b>	15064	<b>SR</b>	15064
<b>E</b>	117291	<b>E</b>	117291
<b>e</b>	e.r. unknown = e.r. of known units = 22.6%	<b>e</b>	e.r. unknown = average weighted for ten calls = 41.1 %
<b>U</b>	total unknowns= 174979	<b>U</b>	total unknowns= 174979
<b>RR</b>	$15064 / 117291 + (0.226 * 174979)$ = 9.6 %	<b>RR<sub>A</sub></b>	$15064 / 117291 + (0.411 * 174979)$ = 7.9%
<b>*RR</b>	9.3% (-0.3%)	<b>*RR<sub>A</sub></b>	7.6% (-0.3%)

\* Response rate if five call limit set

Table 3 shows the response rate for the first household travel survey, using the CASRO and AAPOR formulas. In this case, the CASRO formula yielded a higher response rate. This was expected given that the eligibility rate of the known units was lower than the eligibility rate for the unknown units.



**FIGURE 4 Eligibility rates for known and unknown sample units, file 2.**

The known and unknown eligibility rates determined for the second call history file are shown in Figure 4. There is only a slight difference between the eligibility rate of the known units and the eligibility rate of the unknown units (weighted average); 55.1 percent and 58.5 percent respectively. It is also important to note that these eligibility rates are in fact weighted averages for nine call attempts because it was not possible to determine the eligibility rate of the unknown units for the tenth call attempt.

As mentioned earlier in this section, this call history file involved calling numbers with an eligible status, on subsequent call attempts. When a cross tabulation was performed, the eligible cases depicted in the known column were the units where eligibility was pre-determined. Hence, performing the cross tabulation enabled the avoidance of double counting of eligible cases. This was not an issue for the first call history file because cases determined as eligible were not called on subsequent call attempts.

Comparing the eligibility rates of the two call history files, the eligibility rates for the second file are much higher than for the first. According to Ellis (2000), the national estimate of residential working numbers is around 41.8 percent. Given that both call history files involve the recruitment phase of the household travel survey, where the eligible unit is a household, the eligibility rates calculated conform to the national estimate.

The eligibility rates for the second file examined are higher. This may be the result of the survey being able to interview households that speak Spanish only; therefore, the eligibility status of these households could be determined. In addition, these sample units were not all pooled with the ineligible sample units, which is part of the denominator in the eligibility rate formula. Importantly, the eligibility criteria will affect the eligibility rates observed, and this will vary across surveys.

**TABLE 4 AAPOR and CASRO Response Rates, file 2**

	<b>CASRO</b>		<b>AAPOR</b>
<b>SR</b>	3996	<b>SR</b>	3996
<b>E</b>	19197	<b>E</b>	19197
<b>e</b>	e.r. of unknown = e.r. of known = 55.1%	<b>e</b>	e.r. of unknown = average weighted for nine calls = 58.5 %
<b>U</b>	total unknowns= 13029	<b>U</b>	total unknowns= 13029
<b>RR</b>	$3996 / 19197 + (0.551 * 13029)$ = 15.2%	<b>RR<sub>3A</sub></b>	$3996 / 19197 + (0.585 * 13029)$ = 14.9%
<b>*RR</b>	14.5% (-0.7%)	<b>*RR<sub>3A</sub></b>	14.3% (-0/6%)

\* Response rate if five call limit set

The above table shows that eligibility rates estimated using the CASRO and AAPOR methods gave almost identical response rates. This occurred because the difference between the eligibility rate for the known cases and unknown cases was very small.

Another important issue is how to set an appropriate call limit and how this may affect the overall response rate. For example, it has been proposed that non-contact and refusal conversions (that may also involve the temporary dispositions codes non-contacts and requests for call backs), as well as call back requests, should incur a five call limit. After this, the number will remain unresolved. From this research, the change in the conversion of non-contacts, call backs and first refusals, to complete household interviews, as a result of a five call limit instead of a ten call limit, was either non-existent or negligible<sup>1</sup>. Given these results, the effect on the overall response rates is shown in the last rows in Table 3 and Table 4.

The changes in overall response rates, as a result of a five call limit, range from a 0.3 percent reduction to a 0.7 percent reduction. It appears as though the CASRO method is slightly more sensitive to the five call limit than the AAPOR method; the reduction in the response rate for the CASRO method after a five call limit is greater than the reduction in response rate after a five call limit for the AAPOR method. Obviously, for file 2, the decrease in the response rate due to a five call limit is more pronounced than for file 1. This is because many of the unknown units in file 2 were actually resolved by

<sup>1</sup> Results of this research will be part of a future NCHRP publication on standards for household travel surveys.



the tenth call. Therefore, setting a call limit to five will decrease the response rate because many of these units are still of unknown eligibility after the fifth call (denominator in response rate calculation).

## 6. Proposed Guidelines

It is probably useful to propose some guidelines regarding the definitions of the components used in the calculation of response rates. Final disposition codes should be divided into four large groups, regardless of the survey modes to be used:

1. Complete interviews;
2. Eligible cases that were not interviewed (non-respondents);
3. Cases of unknown eligibility; and
4. Ineligible cases.

These categories can be sub-classified further, depending on the level required by the survey firm and the survey execution method(s) employed. Proposed standards for final disposition codes, adapted from the AAPOR standards for final disposition codes for random digit dialing surveys, are shown in Table 5.

*Table 5: Final Disposition Codes for RDD Telephone Surveys*

1. <b>Eligible Interview</b> -----(1.0)
Complete------(1.1)
Partial -----(1.2)
2. <b>Eligible, Non-Interview</b> -----(2.0)
Refusal and break-off------(2.10)
Refusal ------(2.11)
Household-level refusal------(2.111)
Break-off------(2.12)
Respondent never available after call back request------(2.21)
Telephone answering device (message confirms residential household)(2.22)
Miscellaneous------(2.35)
3. <b>Unknown Eligibility, Non-Interview</b> ------(3.0)
Unknown if housing unit------(3.10)
Not attempted or worked------(3.11)
Always busy------(3.12)
No answer------(3.13)
Telephone answering device (don't know if housing unit)(3.14)
Telecommunication technological barriers, e.g. call-blocking (3.15)
Technical phone problems------(3.16)
Housing unit, Unknown if eligible respondent(3.20)
No screener completed------(3.21)
Other------(3.90)
4. <b>Not Eligible</b> ------(4.0)
Out of sample------(4.10)
Fax/data line------(4.20)
Non-working number------(4.31)
Disconnected number------(4.32)
Temporarily out of service------(4.33)
Special technological circumstances------(4.40)
Number changed------(4.41)
Cell phone------(4.42)
Call forwarding------(4.43)
Business, government office, other organization(4.51)
Institution------(4.52)
Group quarters------(4.53)
No eligible respondent------(4.70)
Quota filled------(4.80)

Source: Adapted from AAPOR (2004).

To understand the breakdown of the disposition code standards for random digit dialing surveys adapted from AAPOR (2004), the following definitions are provided;

Eligible (non-response):

- Refusals and break-offs consists of cases where some contact has been made but the household member has declined to participate in the interview or questionnaire; and
- Others category is when the respondent did not refuse. However, due to unforeseen circumstances, was unable to provide a completed questionnaire or participate in the interview.

Unknown eligibility (non-interview):

- Non-contact - contact was never achieved therefore it was not known whether an eligible household resides at the address and this may be due to the fact that the number dialed is dedicated to a modem, answering machine, call screening device, or simply that the line was always busy and that the call limit was reached.

Not eligible:

- Line dedicated to a fax machine; therefore, the number was excluded from the eligible sample;
- Non-working/disconnected numbers;
- Duplicate listings; and
- Household was found to be ineligible in the screening process and therefore was excluded from the sample (AAPOR, 2004).

## 7. Conclusion

From the analyses of call history files and findings from survey literature, it would be wiser for any agency to use the AAPOR ( $RR_{3A}$ ) formula for the calculation of response rates given that we have disproved popular belief that the eligibility rate for the unknown sample units is equal to the eligibility rate for the known sample units.

The eligibility rate for the unknown sample units will vary from survey to survey. As long as careful consideration is given to disposition codes and the bounds of the research are clearly defined, the determination of the eligibility rate for the unknown sample units should not be problematic. Ultimately, more research is required to be able to say with any certainty that the eligibility rate of the unknown sample units is equal to the eligibility rate of the known units, after a particular number of calls.

It is also wise not to use the terms resolved and known, and unresolved and unknown, interchangeably. Depending on the bounds of the study conducted, cases labeled as eligible may not be resolved. This arises when call backs are given the eligible status. Clearly, however, these calls have not been resolved therefore using the terms interchangeably in this situation would be incorrect. In addition, given budget and time constraints, some survey practitioners may wish to impose a five call limit. As shown, the effect is a slight reduction in response rates.

## REFERENCES

Council of Marketing Opinion Research (1999), "Survey Response Definitions", accessed on 8/11/02, and retrieved from;

[www.cmor.org/downloads/resp\\_tools/cmor.pdf](http://www.cmor.org/downloads/resp_tools/cmor.pdf)

Council of American Survey Research Organizations (1982), "*On the Definition of Response Rates: A Special Report of the CASRO Task Force on Completion Rates*", accessed on the 6/11/02 and retrieved from; [www.casro.org](http://www.casro.org)

The American Association for Public Opinion Research (2004) "*Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*", 3<sup>rd</sup> Edition. Lenexa, Kansas: AAPOR., accessed on the 12/03/04, and retrieved from; [www.aapor.org/pdfs/standarddefs2004.pdf](http://www.aapor.org/pdfs/standarddefs2004.pdf)

Ezzati-Rice, T.M., Coronado, V.G., Frankel, M.R., Hoaglin, D.C., Loft, J.D., and Wright, R.A. (1999), "*Estimating Response Rates in Random-Digit-Dialing Surveys That Screen For Eligible Subpopulations*", Accessed on 7/11/02 and retrieved from;

[www.jpsm.umd.edu/icsn/papers/EzzatiRiceCoronado.htm](http://www.jpsm.umd.edu/icsn/papers/EzzatiRiceCoronado.htm)

Richardson, A.J. and Meyburg, A.H. (2003), "Definitions of Unit Non-Response in Travel Surveys" in *Transport Survey Quality and Innovation*, (eds) Stopher, P.R. and P.M. Jones.

De Heer, W.F. and Moritz, G. (1997), "*Data Quality Problems in Travel Surveys, An International Overview*", Workshop on Respondent Issues: Sampling, Weighting, and Non-response, Transportation Research Board Transportation Research Circular E-C008: Transport Surveys: Raising the Standard, Accessed on 28/01/03 and retrieved from; [www.trb.org/trb/publications/ec008/workshop\\_c.pdf](http://www.trb.org/trb/publications/ec008/workshop_c.pdf)

Richardson, A.J. (2000), "*Behavioral Mechanisms of Non-Response in Mailback Travel Surveys*", Paper Presented at 79<sup>th</sup> Annual Meeting, Transportation Research Board, Paper No. P00-2551.

Kam, H.B. and Morris, J. (1999), "Response Patterns in Travel Surveys: The VATS Experience", Accessed on 10/02/03, retrieved from;

[www.trc.rmit.edu.au/Publications/Papers/responsepatterns.pdf](http://www.trc.rmit.edu.au/Publications/Papers/responsepatterns.pdf)

Singer, E., Van Hoewyk, J., and Maher, M.P. (2000), "Experiments with Incentives in Telephone Surveys", *Public Opinion Quarterly*, Vol.64, No. 2, pp171-188.

Beerten, R., Lynn, P., Laiho, J., and Martin, J. (2000) "*Response Rates as a Measure of Survey Quality*", accessed on 17/03/04, from

<http://webfarm.jrc.cec.eu.int/ETK-NTTS/Papers/final-papers/61pdf>.

Lynn, P., Beerten, R., Roeland, L., Jean, J., and Jean, M. (2001), "*Recommended Standard Final Outcome Categories and Standard Definitions of Response Rates for Social Surveys*", Working Papers of the Institute for Social and Economic Research, paper 2001-23. Colchester: University of Essex, accessed on 5/03/04, retrieved from

<http://iser.essex.ac.uk/pubs/workpaps/pdf/2001-23.pdf>

Dillman, D.A.. and Carley-Baxter, L.R. (2000), “*Structural Determinants of Mail Survey Response Rates Over a 12 Year Period, 1988-1999*”, Accessed on 5/11/02 and retrieved from; <http://survey.sesrc.wsu.edu/dillman/papers.htm>.

Dillman, D.A., Phelps, G., Tortora, R., Swift, K., Koherll, J., and Berck, J. (2001), “*Response Rate and Measurement Differences in Mixed Mode Surveys: Using Mail, Telephone, Interactive Voice Response and the Internet*”, Draft Paper, Accessed on 5/11/02 and retrieved from; <http://survey.sesrc.wsu.edu/dillman/papers.htm>

Kalfs, N. and van Evert, H. (2003), “Non-Response and Travel Surveys” in *Transport Survey Quality and Innovation*, (eds) Stopher, P.R. and P.M. Jones.

Brick, J. M., Montaquila, J. and Scheuren, F. (2002), “Estimating Residency Rates for Undetermined Telephone Numbers”, *Public Opinion Quarterly*, Vol. 66, pp 18-39.

Keeter, S., Miller, C., Kohut, A., Groves, R.M. and Presser, S. (2000), “Consequences of reducing non-response in a national telephone survey”, *Public Opinion Quarterly*, Vol. 64, No. 2, pp 125-148.

National Center for Education Statistics (2002), “*NCES Statistical Standards*”, accessed on 5/03/04, retrieved from <http://nces.ed.gov/statprog/2002/stdl3.asp>

Groves, R.M. and Couper, M.P. (1998), *Nonresponse in Household Interview Surveys*, John Wiley and Sons.

Ellis, J.M. (2000), “*Estimating the Number of Eligible Respondents for a Telephone Survey of Low-Incidence Households*”, Presented at the Annual Meeting of the American Association for Public Opinion Research, May 21, 2000.