URBAN PUBLIC TRANSPORTATION RIDERS: SURVEYING A POPULATION ON THE MOVE
Developing a Methodology for AC Transit's 2002 Onboard Riders' Survey

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INTRODUCTION

Intercept surveys present unique challenges in sampling and survey administration. Respondents are often on the move between locations, and the sampling design is more dependent upon the skill of interviewers to target and approach appropriate respondents than is the case in other types of surveys. These challenges are magnified in onboard bus surveys, where passengers are asked to complete a self-administered questionnaire under less than ideal conditions. While response rates tend to be high, item non-response is also high due to a number of factors. These include literacy problems, language and cultural barriers and the short length of time passengers are on the bus. Sampling design must account for time of day, day of week, type of route, ridership volume and direction of travel. Survey administration must both meet the demands of probability sampling, but be practicable on the ground.

In fall of 2002, Alameda Contra-Costa Transit District (ACT) sponsored an onboard survey to gather information on the demographics and travel characteristics of its riders. AC Transit serves a predominantly urban area with a high concentration of minority, immigrant, low-income and disabled riders. San Francisco State University's Public Research Institute was contracted to conduct the study.

AC Transit needed an updated profile of its ridership[1] and a market research study[2] to investigate ways to improve its marketing and outreach and increase its ridership during a time of falling revenues and budget cuts. AC was particularly interested in developing more effective sampling methodologies for its on-board ridership profile and decreasing the amount of item non-response to key questions on the on-board survey. This paper describes the development of survey procedures intended to overcome the challenges described. .

BACKGROUND

On-Board Surveys

On-board ridership surveys are fairly common nationwide, but very little published material is available on survey methodology or findings. Transit surveys are part of a broader typology of survey, the intercept survey, wherein individuals are sampled and surveyed because of their (transient) use of a particular geographic space, usually a public space.

The purpose of on-board studies is (a) to generate a profile of the ridership of particular transit system and sometimes a profile of individual routes within the system, and/or (b) to assess customer satisfaction with the system. The profile of the ridership includes travel behavior related to the trip on which the respondent is surveyed, hence the necessity of immediate response.

Rail system surveys present fewer challenges in that local rail systems have relatively few routes in comparison to bus systems, routes are fixed, passengers tend to take longer trips on rail systems, and rail systems tend to be station-based. Local bus systems are somewhat more challenging to survey because they tend to have numerous routes that vary throughout the day and week, riders on local routes tend to be on-board for short periods of time, and they have numerous stops at which passengers may board and alight. This paper is primarily concerned with surveys on buses rather than light rail, although some of the same conditions apply.

On-board surveys entail sampling of transit trips within routes, and sampling of riders within trips. There are significant variations in choice of other strata dependant upon the objectives of the study. There are also significant variations in survey administration techniques related to conditions in the field that compromise the ability of researchers to implement strictly random sampling plans.

[1] The last ridership profile was completed in 1993.
[2] The last full-scale market research survey was conducted in 1988.

On-board surveys generally entail self-administered survey questionnaires, which are distributed and collected by trained surveyors. Many, but not all, self-administered surveys include a mailback option. Some researchers have conducted in-person interviews with passengers.

Sampling and Weighting

A major challenge for researchers studying ridership has been developing a plan to achieve a truly representative sample. The complexity of surveying passengers on the move across multiple bus routes, times of day, and days of the week has often lead researchers to adopt sampling plans that are a compromise between the need to facilitate surveying and the ideal of scientific sampling. Researchers have also been pulled between conflicting study objectives. Should the survey findings be representative of the individual route at each time of day—which would entail extremely expensive survey administration—or would it be better to develop a sampling methodology that could produce valid findings that adequately represent riders by service-type or system-wide? The latter would require a smaller N and be much less costly (Crain 1979).

Surveyors have generally utilized one of two basic sampling methodologies. One is based upon sampling *trips* stratified by route, direction, and time of day/day of week with the goal of surveying at least one round trip in each sample time for each route. The goal of these surveys is generally accurate representation at the route level as well as at the system level. The other sampling methodology is based upon sampling *passengers* on routes by setting a quota of completes necessary for a pre-determined level of accuracy at the route and system level. While these surveys appear to be concerned with route level accuracy, the goal is often system-level representation. The clustering of survey collection on routes by day and time does not allow for true representation at the route level.

The development of sampling methodologies throughout the course of AC's history of profiling riders is well documented in the consultant and in-house reports on research findings (DKS Associates Nelson\Nygaard 1996/AC Transit 1993; Crain and Associates 1985, 1979; and Wilbur Smith 1980). This development mirrors the range of sampling methodology utilized for other onboard surveys across the country. Until 1993, ACT researchers sampled trips and surveyed all passengers on sampled trips. In 1993, AC conducted its own survey employing a different sampling methodology, which entailed developing a target quota of completes for each route to guarantee a desired level of accuracy for survey results at the route level.

For one of the earliest system-wide ridership surveys, Crain and Associates (Crain 1979) developed a sample of bus trips, operationalizing bus trips as one-way trips from one end of a route to another. The sample included all routes and variations in each of seven time periods (AM peak, mid-day, PM peak, Evening, Owl, Saturday and Sunday) and in each direction of operation. Researchers identified some 1,611 trips for survey, representing about 10% of the 15,524 scheduled trips on a weekday, Saturday or Sunday. They surveyed all passengers 8 years of age and older. In all, 1,553 trips and 43,000 riders were surveyed, resulting in 33,478 responses for a response rate of 78%.

For each trip type, the sample weight was calculated as the number of scheduled trips of that type divided by the number of trips of that type that were surveyed. Crain & Associates conducted a system wide analysis by day of week and by type of service, and a route-by-route analysis of all survey items. While system wide and service-level results were valid within +1%--+2% at the 95% confidence level, they were much less confident about findings at the route level except for results for very high volume routes.

Crain and Associates conducted another onboard survey for ACT in 1985, further improving upon their sampling and weighting methodologies. In their recommendations for update, Crain & Associates noted that resolution of conflicting sampling objectives would greatly enhance the usefulness of the data collected *and* be more cost-effective. For instance, if it were determined that system-level and service-type-level data were sufficient, the sample size could be reduced to one-third or one-fourth (Crain 1985).

AC Transit's last comprehensive survey was conducted in-house in 1993 and the data were analyzed by Nelson/Nygaard Consulting Associates. This survey employed a quota sample of passengers on each route rather than surveying all passengers on sampled trips. The 1993 survey was designed to provide *route level* data. Surveyors attempted to gather one hundred surveys per route[3] in order to achieve adequate detail for route-level analysis at the 90% confidence level with a 5% margin of error. However, results do not indicate how clustering effects were addressed. The survey covered approximately 2,000 bus trips with over 26,000 boardings. Approximately 17,000 riders responded for an overall 64% response rate (AC Transit—Nelson/Nygaard 1993, pg. 1). It is important to note

[3] And/or at least 100 answers per survey question.

the difference in the number of survey completes between 1978 and 1993—from 33,478 in 1978 to 17,000 in 1993.

NuStats, a leader in onboard surveying and sampling methodology, utilized a similar quota-based sample for its 2000 onboard survey for the KYOVA Interstate Planning Commission (West Virginia). This survey was a system-wide portrait of transit provision. Researchers calculated the number of surveys necessary to achieve a 90% confidence level with a margin of error of plus or minus 10%, which was 68 riders per route. They then used an estimate of response rate (30%) to calculate the number of trips and passengers they needed to survey per route, based on average ridership load. Trips were selected on a random basis and sampled in clusters of consecutive trips within a run[4] for surveyor efficiency purposes. Trips were also stratified into four time-of-day periods (AM peak, midday, PM peak, evening.) Each trip within route had an equal chance of being selected, but the sample was balanced to reflect rider loads by time periods (NuStats 2001, pg. 8). Each completed survey was weighted according to route, time of day, and direction. Surveys were weighted with what the researcher called a "boarding factor", which was the result of multiplying two other factors related to percent of trips sampled and percent of passengers surveyed. The "response factor" consisted of the total boardings divided by completed interviews. The "vehicle factor" was calculated as the total number of trips on the route divided by the number of sampled trips (NuStats 2001, pg. 11).

As illustrated by the examples above, researchers have employed different methods of sampling and weighting. It has proven difficult to achieve full randomization that also accommodates a reasonable surveying schedule. Some researchers attempted to address these issues by surveying the population of riders on a set number of sampled trips meant to represent all times of day and week on each route, while others have developed a quota necessary to reach the desired confidence level and then selected the number of trips necessary to achieve this quota. Except in areas with very few routes and relatively small ridership, surveys that need to satisfy the objective of providing route and time-of-day detail within routes are prohibitively expensive and/or produce data that are unreliable. Data at the system or service type level are more reliable as they can be achieved with a relatively small sample size.

[4] A run is different from a trip in that it represents the collection of trips that constitute a driver's schedule on a given day.

Questionnaire Design

Most on-board surveys address basically the same topic areas. These basic areas include:

- Origin and destination of passengers' trips, including the nature of the passenger's starting and end point and the geographic location of those points;
- The nature of the trip including the mode of transportation to and from the bus stop where the passenger boarded the bus, how the passenger paid their fare, how many transfers the passenger needed to make to complete the trip and the purpose of the trip;
- General ridership habits such as frequency of ridership, routes general used, and the availability of alternative modes of transportation;
- Demographics including sex, age, income, ethnicity, and household zip code; and
- More or less extensive customer satisfaction questions.

While on-board surveys tend to be fairly similar in content, the wording, order and design of questionnaires varies considerably, as does the method of administration. Researchers have attempted different methods in order to address the challenges presented by on-board data collection.

Challenges. A number of challenges present themselves in designing questionnaires for use in on-board surveys. Most (although not all) on-board surveys are self-administered. Passengers generally fill out the surveys on the bus or train under conditions that are not conducive to completing a survey. Challenges to data collection resulting from the special conditions of on-board surveying include:

- **Lack of seating for respondents or lack of surface on which to complete the questionnaire.** Passengers may not be able to sit down to fill out the survey due to lack of seating and/or intense crowding.
- **The length of time the respondent is on the vehicle.** The average AC Transit passenger trip length in 1985 was approximately 4 miles (Crain 1985). Passengers may not be on the bus long enough to complete an entire surveys.

Respondent characteristics may also make it difficult for researchers to design a survey that serves all populations:

- **Diversity in respondent language, age and literacy and ability.** Urban areas tend to be extremely culturally diverse as they are

> often the first point of settlement for new immigrants. Translation of the survey instrument into multiple languages may be necessary. Urban transit systems tend to serve large numbers of school children in place of school bus service. Surveys instruments should be simple and easy enough for middle school students to understand. Many persons with disabilities may need to take transit if they cannot drive themselves. Survey design and/or administration may need to accommodate the needs of the blind and mobility impaired.

These challenges, along with error introduced by mistakes in survey design and administration, can result in survey non-response (entire questionnaire), item non-response (some questions are not completed), or error related to respondents' miscomprehension of survey questions.

These challenges result in particular problems for data collection and require specific strategies to address these challenges.

Non-response and Item Non-response.

Respondents frequently do not have time to fill out any or all survey questions in the time that they are on the bus, so non-response and item non-response are significant problems in on-board surveys. The overall response to AC Transit and other local transit surveys seems to have decreased over time. The 1979 survey received a response rate of 78%, the 1985 survey response rate was 73%, and the 1993 response rate was 64%.

Item non-response is also a significant problem. Practitioners report that many respondents return partially completed surveys because they need to deboard prior to survey completion. For instance, origin and destination are particularly important for analysis, but only 21% of the respondents to the 1993 AC Transit On-Board Survey provided useable answers to these questions. In contrast, only 3% of all questionnaires returned to surveyors during the 1998 BART Customer Satisfaction Survey were partially completed and therefore unusable (Corey, Canapary & Galanis 2000)[5], although overall non-response was high (40%).

An important factor in non-response and item non-response may be the length of the questionnaire. The general rule of thumb in survey research is that survey length and response rate are negatively correlated. While some researchers report that survey length generally has no deleterious impact on response rates for self-administered surveys, survey length has important practical implications for respondents who are only in the place where they can be surveyed for a very short period of time. For instant, ACT research consultants (Crain, 1985) believed that the increasing length of ACT questionnaires was partially responsible for the drop in response rate from 78% to 73% between 1979 and 1985.

Item non-response for specific questions is impacted by both the length of time respondents are on the bus and question order. In the 1993 AC Transit on-board survey, questions on the first side of the survey averaged a non-response rate of 11%, while questions on the second side of the questionnaire averaged a non-response rate of 22%.

Non-response and item non-response may also be related to the mode of administration. Respondents may be given questionnaires with a mail-back option. This requires a questionnaire with enough space allocated for a business reply mail-back address and barcode or an additional envelope. The assumption is that such an alternative would enhance response rate and item response for passengers riding short distances or riding on crowded buses.

Many transit surveys have attempted to facilitate survey completion by having questionnaires printed on cardstock, which should be somewhat easier to write on when there is no other surface available (Crain 1979, Crain 1985, Corey, Canapary & Galanis 2000). Surveyors also make "golf" pencils available to riders without writing utensils.

The KYOVA Interstate Planning Commission (NuStats 2001) completely bypassed the issue of mail-back by conducting in-person intercept interviews. While this method reduced item non-response and probably produced better quality data, the overall response rate was only 38%.

Addressing Surveys to Extremely Diverse Populations.

Documenting the opinions, experiences and demographics of diverse riders is particularly important for all transit authorities because of Title VI requirements (1964 Civil Rights Act). Title VI states that:

> "No person in the United States shall, on the ground of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

For transit operators and authorities, implementing Title VI includes not only service

[5] The report does not indicate what threshold of non-response makes a questionnaire a "partial".

equity, but also adequate public involvement in the planning process, and improved data collection on the needs of and potential impacts of any decisions on minority and low-income populations[6].

As noted previously, most local reports offer relatively little detail on survey non-response. Crain & Associates (1979) found that women, people of color, children under the age of 12, and people 65 and older were much less likely to complete any of the questionnaire than other passengers. Achieving a high survey response rate from all groups of riders is important to ensuring that they are adequately counted as riders and that their opinions and concerns are heard. Prior reports offer little guidance as to how to enhance the response rate for the groups mentioned above.

All local on-board studies have made at least some attempts to adapt the survey instrument to address different languages and specific physical disabilities. Most commonly, researchers have provided the questionnaire in English and Spanish and in large print format (Crain & Associates, 1979 & 1985; Wilbur Smith & Associates, 1980; Nelson/Nygaard, 2000). BART surveyors also provided Chinese language surveys along with English and Spanish (BART, 1993). However, there is some evidence that provision in English, Spanish and large print may not be enough in very diverse regions such as the San Francisco Bay Area. In the CCCTA on-board study (Nelson/Nygaard 2000), 5% of potential respondents did not complete the survey because they did not speak either English or Spanish (the two languages in which the survey was offered).

Surveying children is especially important because youth riders make up a large proportion of the ridership in urban transit systems.[7] However, surveying children and youth introduces additional complications to survey administration as many federal regulations concerning research prohibit research on children without written parental consent except in special cases. Children may also have difficulty answering complicated temporal and behavioral questions. In their 1979 report, Crain and Associates note that survey non-response for children 5 and under was 70%, and 16% for those between the ages of 5 and twelve, while 13-17 year olds responded at approximately the same rate as adults. In later studies, researchers determined that children under the age of 13 would not be able to provide reliable information (Nustats, 2001; Nelson/Nygaard 2000.)8 Surveyors counted the number of children below the selected age cutoff point rather than surveying them.

Survey Administration and Management

On-board survey administration is challenging for surveyors and supervisors alike due to the unique demands of scheduling multiple interviewers on multiple trips to compose a single workday, and the difficulty of supervising these individuals as they move across time and space. Researchers have needed to develop a rather complex system of assembling sampled trips into a series of assignments suitable for a day or half-day surveying [9]. In many instances, sampling methodologies employed clustered trips to increase surveying efficiency. Surveyors were given assignment sheets for each shift which included the route number, a trip id number, the start and end times of the sampled trips, start and end locations of sampled trips and date.

Surveyors were not pre-existing staff, but were recruited, hired and trained especially for the on-board survey. Training sessions varied in duration from less than one day (NuStats (KYOVA 2000)) (Nelson/Nygaard (CCTA 2000)) to one-day trainings (Corey, Canapary & Galanis (2000)) (Crain and Associates (1979, 1985)) the day before survey administration. Crain & Associates handed out preliminary materials and first-day assignment sheets at their trainings the day before the start of survey administration. Surveyors were then required to attend a debriefing session at 7pm the evening of the first day of interviewing. Those that returned and had completed satisfactory work were then given a week's worth of assignment schedules and materials.

Surveyors were instructed to distribute the surveys to all persons above a certain age. Many researchers note that they did not distribute surveys to passengers that were sleeping, and one (Crain, 1985) mentions not distributing the survey to "standees" (those who could not find seating on a crowded bus.) While some studies instructed surveyors to collect the surveys directly, several AC studies mention using a questionnaire return box

[6] This section is derived from information on the Department of Transportation's Environmental Justice website: http://www.fhwa.dot.gov/environment/ejustice

[7] Transit has largely replaced chartered school buses in many urban centers as a mode of transportation from and/or to school for children and youth. Nearly 20% of AC Transit's ridership is made up of minors.

[8] The fact that a child of nine may be able to *read* an item does not necessarily mean that the child has the cognitive skills to synthesize and produce an accurate response, especially to behavioral frequency items.

[9] Crain & Associates (1979, 1985) report needing some 300-400 hours to develop work assignments out of the set of sampled trips.

attached to a pole near the back exit of the bus. Some surveys offered respondents the option of mailing the survey back (see discussion above).

An important part of the surveyor's job in many studies was counting boardings and accounting for non-response. Most study reports mention use of a control sheet for each trip which tracked at least the number of boarding passengers and the range of questionnaires distributed, and generally also included the name of the surveyor, the date, the start and end locations and times of the trip, the route number, direction, the range of survey numbers distributed on the trip, unusual circumstance and the number of passengers leaving without completing a survey (NuStats 2001, pg 10 and Attachment C; Corey, Canapary & Galanis 2000, Appendix C, pg 1; Nelson/Nygaard 2000, Appendix C, pg. 2; Hoyt 1990, pg 1-6 through 1-11; Crain 1985, Appendix A, pg. A-6; Smith 1980, Figure2; Crain 1979, Appendix A, pg. A-8). Some researchers were content with simply recording the level of non-response; others required more detailed tracking of the characteristics of non-respondents for the purposes of checking for non-response bias.

Surveyors were assigned different degrees of responsibility for data management, editing and coding. Serial numbers were vitally important in many research designs for tracking response (as noted in the example above) or for linking survey forms to particular trips. NuStats surveyors (KYOVA 2000) were assigned set ranges of questionnaires for each trip with slightly more questionnaires than they anticipated distributing. These serial number ranges were recorded in advance so that research staff could attach the survey forms to a particular trip and interviewer.

The 2002 AC Transit Onboard Survey

The methodology for this study was developed by staff members at Public Research Institute at San Francisco State University in conjunction with AC Transit planners and data collection sub-consultants Wilson Associates. Procedures were derived from the findings of a detailed literature review and interviews with key staff at the Metropolitan Transportation Commission, BART and AC Transit. It was further refined as a result of three pretests. Data collection took place over 2.5 months in fall of 2002, with some follow up in Spring of 2003.

Description of the Population

The population for this study was all AC Transit riders age 13 and above on all AC Transit routes during the survey period. There were three main service types at the time the study took place: local routes (106), transbay routes (37), and school routes (55). AC Transit carries over 250,000 passengers per day on a typical weekday and serves predominantly low-income urban population in two counties, plus transbay service to a third.

Description of the Sample Design

The goal of the sampling plan was to ensure that all members of the study population had an equal (or at least known) probability of being sampled consistent with the available budget and constraints of conducting an-onboard survey. For the final survey, sufficient observations were to be collected to ensure sampling error within ± 5% for a 50% proportion, at 95% confidence for the AC Transit system as a whole and for the principle sub-parts of the system such as trunk and feeder lines and routes within different geographical areas. For each route, the goal was a sampling error within ± 10% for a 50% proportion, at a 95% confidence level.

Within the entire universe of AC Transit riders the study would address a number of dimensions for which representative data was needed:

1. Data would be collected for each local and transbay bus route active during the study period and a sample of school routes.
2. Data would be representative of three sub-categories of routes: (a) Local Service; (b) Transbay service; and (c) School service.
3. Within the above sub-categories, representative data for high, medium, and low volume routes would be collected.
4. For each type of route and volume level, observations should be representative across time of the week (weekend/weekday), and time of day. Including AM Peak (4:00 AM - 9:00AM), midday (9:00 AM – 4:00 PM), PM Peak (4:00 PM – 7:00 PM), evening (7:00 PM-midnight), and owl service (midnight – 4:00 AM)[10].

One of the major precepts of the current study was that the data were to be sufficient to accurately represent AC Transit riders in each time of day and time of week for the overall system and each

[10] Because no routes could be surveyed in less than at least one round trip to reach the desired N, both directions were represented for all trips on routes except for school routes and transbay routes.

service type, and possibly AC planning districts, *but not for each route*[11].

What distinguishes the 2002 ACT Onboard Riders' Survey sampling plan from prior sampling plans has to do with how trips were selected for surveying. While this sampling method utilized minimum quotas of completes per route based on route size and desired level of accuracy, *time periods within routes*, rather than trips within routes, were randomly selected for surveying start. Once the time period within route was selected, research staff determined how many roundtrips within this time period would need to be surveyed in order to achieve the desired number of completes. Survey collection staff could then determine which trips within this time period they wanted to survey. This allowed the field team maximum flexibility to schedule interviewers while adhering to the sampling plan. If a surveyor missed a bus, he or she could simply board the next bus within the sample time period. Surveyors were to ride consecutive trips on a route until they reached the pre-determined quota. The method of stratification is described below.

Using a information about *average daily boardings* for most AC Transit routes, PRI classified local routes in five categories of *extremely high* (over 9,000 average daily boardings), *very high* (5,000 – 9,000 average daily boardings), *high* (2,000 – 5,000 average daily boardings), medium (500-2000 average daily boardings), and low (less than 500 average daily boardings).[12] Basic service accounts for the majority of AC Transit riders, and the majority of riders use the high-volume routes.

The highest-volume routes would require the greatest number of completed questionnaires to offset anticipated clustering effects (collecting a lot of surveys very fast in a condensed time period that may not be representative of the entire route). This study utilized quota sampling to collect 200 completes per route for the extremely high and very high volume routes with over 5,000 average daily boardings, 150 per route in the high (2,000 – 5,000 average daily boarding routes), 100 per route in the medium rider category, and 50 per route for the routes with the lowest number of average daily boardings. Table 2 (below) shows expected completed questionnaires.

Table 1. Quotas and Expected Completes By Route Category (Basic Service)

	Boardings	Count	Quota	# of comp	% of Total comp
Low	< than 500	42	50	2100	18.2
Medium					
500 – 1,999	50	100	5000	43.3	
High	2,000 – 4,999	15	150	2250	19.5
V. High	5,000 – 9,000	5	200	1000	8.7
E.. High	Over 9,000	6	200	1200	10.4
	Total	118		11550	100.

Source: AC Transit 1998 Boarding and Alighting Survey

Questionnaire Design

The development of the survey instrument was informed by two pretests, a literature review and an six month process of revision during which AC Transit staff and staff from the Public Research Institute worked together to develop a final draft.

Several adaptations were adopted from the literature review and prior AC Transit survey experience. Surveys were printed with business reply postage so that passengers who left the bus with the questionnaire in hand could mail the survey back at their convenience. It was hoped that providing the mailback option might address some response bias related to length of time on the bus.

Question order was arranged to maximize item response to those data elements considered most important to AC, which included shifting demographic questions to the beginning of the questionnaire. In the 1990 ACT survey, when demographic questions were placed on the back side of the survey, 14% of respondents did not answer any vital demographic questions. Item non-response on the front page was approximately 10% while non-response on the back page averaged 18% for multiple-choice items.

Surveys were to be translated into English, Spanish and Chinese. Each survey version was to be printed with a different color of ink so that surveyors could easily distinguish between them, and English language surveys had text in the header indicating that surveys were available in other languages.

Vision impaired respondents were to be given Braille cards explaining the study and how to access options for taking the survey or large print versions of the survey instrument, as appropriate.

[11] Except in the case of 6 high volume trunk routes which represent some 30% of ACT's total weekday ridership.

[12] For routes with no weekday ridership, we used the maximum weekend ridership figure.

Survey Administration

Surveyors were to be stationed on selected buses, preferably at the front, to distribute surveys as passengers boarded. This strategy had to be changed slightly as a result of the pretest. This method was found to slow boarding at stops, and passengers became agitated if approached while they were trying to find seats. Surveyors resorted to waiting until the passengers seated and/or situated themselves before approaching them with the questionnaires.

Surveyors were instructed to survey only those over the age of 12. They were to collect surveys directly from passengers, although collection boxes at exits were also provided. They were also to track disposition of survey attempts using a trip control form. They were to tally non-surveyed passengers (including refusals and children) and survey returns for each trip and note the time points and routes during which surveys of specific id ranges were distributed.

Surveyors were also to attempt to survey the passengers by interviewing them if they needed assistance, time permitting. They were to approach *all* passengers, and to attempt proffer surveys in different languages to respondents who appeared to be refusing due to language difficulties. Surveyors were provided badges in Chinese and in Spanish that said "Ask for the survey in (Chinese or Spanish)" in the appropriate language. Recruiting multi-lingual surveyors was a high priority for this study.

Survey Scheduling and Surveyor Deployment

Using detailed data from AC Transit on passengers per revenue hour, trip frequency, and trip length by route, researchers developed detailed estimates of the number of surveys that could be collected on a round trip during the sampled time for each route. From there they were able to estimate the number of round trips necessary to collect the desired N at 58% response rates (considered conservative), and the number of onboard surveying hours anticipated. This information was used to develop overview schedules for each route of the possible trips that could be used for collecting the data for this route.

Example:

On Route #12, time period 4pm-7pm (pm peak) was sampled as the time period in which to begin surveying. Because this is a high volume route (2,616 boardings per weekday), our target was 150 completed surveys. Estimates based on AC Transit boarding counts suggest that surveyors would encounter approximately 62 passengers per round trip on this route. Assuming a conservative response rate of 50%, surveyors could expect to collect about 36 completed questionnaires per round trip, and make approximately 5 round trips at this time period to get 180 questionnaires. This was slightly above the target of 150 completes, but ended up being equally representative of both directions of travel since survey scheduling was based upon the round trip.

Data/Survey Tracking and Management

Unique, sequential identifiers printed on each survey instrument are vital to data management in a survey of this size. Survey coordinators were instructed to use the detailed estimates described above and assign a range of serial id numbers to a route, using a conservative 58% response rate. The ID number for each survey would be tracked in a database with the assigned route listed as one variable. Using this information, coordinators could assign survey instruments to a packet or series of packets for each route. Surveyors would be provided with an individual envelope containing relevant survey materials, including Trip Control Form (TCF), for each one-way trip. Surveyors would record the number range of the surveys distributed for that trip on the TCF, the number of refusals, the number of completes, the number of surveys that were taken off the bus, the number of surveys that were returned blank, and the number of passengers that could not be surveyed. This would be facilitated by the use of sequential id numbers—all refusals would be recorded by writing an "R" on the corresponding survey; completes would be collected, sorted in numeric order, and counted; missing surveys would be evident from gaps in the range, returned blanks would be kept separate from unused blanks and stored with the other returned surveys for that trip in the envelope for that trip; while un-surveyable passengers would be tallied on the TCF. It would be possible to keep a running count of completes, and adjust the number of trips made accordingly. Mailbacks could be easily identified because the survey id could be traced back to the range assigned to that route. Finally, response rate would be very easy to calculate at the route level by checking all dispositions recorded on the TCFs.

Survey coordinators would use the survey-by-survey database described above to track the dispositions of all surveys as survey days were completed. Another, linked database would be used to record the information off of the TCFs, which would include counts of different types of passengers that could not be surveyed. This would allow coordinators to track the response rate by route and overall.

Results and Conclusions

While assessment of the efficacy of individual components of survey sampling and administration are still underway, there are several areas in which the 2002 Alameda-Contra Costa Transit Onboard Survey can be considered a success. The overall response rate for this survey was higher than anticipated (73%--modified AAPOR 3 vs. 66% in 1993). This may be due to effective outreach to non-English speakers and the inclusion of a mail-back option. While only 3% of all completes were returned by mailback, these respondents were significantly different than other respondents in that they were more likely to be seniors and/or disabled. Survey returns from the 2002 survey were higher for Spanish and Chinese speakers than those experienced by the 1992 ACT onboard survey. For the 2002 survey, 3% were in Chinese, vs. 0.3% in 1992. Ten percent (10%) of the 2002 survey returns were in Spanish vs. 1% in the 1992 survey. Finally, while overall item non-response was not significantly different from the 1992 survey, the decision to place the demographic questions on side one in order to enhance response on these questions was validated. Ninety-seven percent (97%) of respondents gave their age, race and ethnicity compared to only 80-84% of respondents in the 1992 onboard survey. These factors indicate that the overall goal of enhancing survey representativeness was well served by developments in survey design and administration. The impacts of design effects on the data and productivity are still being assessed.

References

AC Transit. 1998. *South County Demographic Study*. (Oakland: AC Transit).

AC Transit Planning and Research Department. 1993. *On-Board Survey Preliminary Assessment.* (Oakland: AC Transit).

Beroldo, Steve. RIDES for Bay Area Commuters, Inc. 2001 *Commute Profile 2001 – A Survey of SF Bay Area Commute Patterns*. (Oakland: Metropolitan Transportation Commission).

Cambridge Systematics. 1996. *Travel Survey Manual*. A report prepared for the US Department of Transportation and US Environmental Protection Agency. http://ntl.bts.gov/data/1392.pdf

Center for Urban Transportation Research. 1998. *Public Transit in America: Findings from the 1995 Nationwide Personal Transportation Survey* / Polzin, S.E., J.R. Rey, and X. Chu (Washington: US DOT).

Center for Urban Transportation Research. 1993. *MDTA On-Board Survey Design and Sampling Plan: Final Report.* (Florida: Metropolitan Dade County).
---. 1993. *Metropolitan Dade County General Travel Survey Design and Sampling Plan: Final Report.* (Florida: Metropolitan Dade County).

Corey, Canapary & Galanis Research and SF BART. 2000. *2000 BART Customer Satisfaction Study: Final Report.* (Oakland: BART).

Crain and Associates. 1979. *AC Transit On-Board Survey.* (Menlo Park: Crain and Associates).
---. 1985. *AC Transit On-Board Survey: Final Report. (*Menlo Park: Crain and Associates).
---. 1988. *AC Transit Market Research Survey Final Report.* (Menlo Park: Crain and Associates).

DKS Associates, Nelson/Nygaard Consulting Associates. 1996. *On-Board Rider Survey Results Weighted by Route: AC Transit Strategic Plan Analysis.* (An analysis of the data collected by AC Transit in 1993.) (Oakland: AC Transit).

George Hoyt & Associates, Inc. *Final Report: On-Board Bus and Rail Survey.* 1990. (Atlanta: Metropolitan Atlanta Rapid Transit Authority--MARTA).

Hufstedler, G.D. and P. Johnson. 2000. *DART Light Rail Rider - Projected and Actual.* (Washington DC: Transportation Research Board).

JHK & Associates in Association with Transo Associates. 1985. *Sonoma County Transit Survey Update.* (Santa Rosa: Sonoma County Transit).

Korve Engineering, Inc. and Associated Subconsultants. 1991. *San Francisco Bay Crossing Study – Final Report.* (Oakland: Metropolitan Transportation Commission).

Nelson\Nygaard Consulting Associates. 2000. *On Board Passenger Survey: Final Report.* (Central Contra Costa County Transit Authority).

NuStats. 2001. *On-Board Ridership Survey: Tri-State Transit Authority, Huntington, WV, Final Report.* (West Virginia: KYOVA Interstate Planning Commission).

Purvis, C.L. 1994. *San Francisco Bay Area 1990 Regional Travel Characteristics.* (Oakland: Metropolitan Transportation Commission).
---. 1993. *Sample Weighting and Expansion*. (Oakland: Metropolitan Transportation Commission).

RESCUE MUNI. 1998. *MUNI Riders' Survey Results.* (San Francisco: MUNI).

San Francisco Bay Area Rapid Transit District (BART) Office of External Affairs. 1999. *Final Report: BART Station Profile Study.* (Oakland: BART).

San Francisco Bay Area Rapid Transit District (BART) Planning Department: Office of Strategic Research. 1993. *BART 1992 Passenger Profile Survey Summary Report*. (Oakland: BART).

Systan, Inc. in Association with The Roanoke Company, Nelson/Nygaard and ATD, Inc. 1995. *Surveys of Park-and-Ride Lot Users in the San Francisco Bay Area.* Submitted to CalTrans District Four (Sacramento: CALTRANS).

Wilbur Smith and Associates. 1979. *AC Transit District II 1980 On-Board Survey* (Oakland: AC Transit).