Call Scheduling: Theory and Practice

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Abstract: Utilizing optimal call scheduling is one way to minimize non-response. In order to optimize call scheduling, it is important to have both a flexible call scheduler that can utilize multiple parameters for prioritizing and delivering cases, as well as sufficient data to illustrate when sample members are at home and can be contacted. This paper builds on prior discussions of call schedulers by detailing key features of call schedulers and linking these features to call outcomes. In addition, this paper expands prior discussions of optimal call scheduling which have typically limited their review to one study by presenting an analysis of both successful call attempts and refusal conversion for different types of samples (list versus RDD), waves of data collection (baseline versus follow-up), and populations (e.g., youth, adults over 18, and workers).

Introduction

Nonresponse in telephone surveys remains an important issue for survey researchers. Error from nonresponse can result in biased estimates for critical study variables. Two ways to minimize nonresponse are to target calls to households during times that have been shown to be most productive in terms of contacting households and completing interviews and to minimize calls during less productive times including times when more refusals occur. Optimal call scheduling has the added benefit of conserving project resources by focusing labor on times and days that are most productive. In order to optimize call scheduling, it is important to have both a flexible call scheduler that can utilize multiple parameters for prioritizing and delivering cases, as well as sufficient data to illustrate when sample members are at home and can be contacted.

Prior studies investigating optimal call scheduling have typically limited their review to one study. This paper expands prior work by discussing key features of call schedulers and presenting an analysis of both successful call attempts and refusal conversions for different types of samples (list versus RDD), wave of data collection (baseline versus follow-up), and population (for example, youth, adults over 18, workers, etc.). Specific topics to be investigated include:

- Timing of successful first contact,
- Timing of all successful contacts,
- Timing of completed interviews,
- Timing of successful refusal conversions, and
- Success of calling cases in follow-up waves at the same day/time of completed interview during baseline wave.

In this paper we describe key features of call scheduling and case delivery systems, as well as present a literature review of call scheduling including a discussion of call schedulers, factors that influence call scheduling, optimal times for contacting sample members, and the impact of demographic variables and survey type on telephone contacts. We then attempt to link specific call scheduler features to contact outcomes and present results on best times to contact populations of three sample types (RDD, list, and longitudinal). Finally, we present data on the

percent of cases that were completed during similar time/day in follow-up waves compared to baseline wave completions.

Overview of Call Scheduling Systems

Weeks (1988) was one of the first to detail the importance of automated call scheduler programs. His and subsequent research has focused on ways to optimize times to contact sample members as a means to both improve survey response as well as make the most efficient use of project resources. The outcomes detailed in these analyses are dependent on features of automated call schedulers. For example, if a call scheduler does not have the capability to restrict the timing of the first few attempts then the information obtained from the research on best times to make initial attempts for certain populations cannot be put into practice. In this section, we detail key features of call scheduler systems. Many of these features impact call outcomes; some of which can be measured more clearly than others.

Call scheduling systems are one component of larger case management systems, and there are two other case management system components that impact call scheduling: case delivery systems and computer-assisted telephone interviewing (CATI) front end systems. Each of these three systems plays an important role in the overall call scheduling for individual cases, and case management systems for outbound calling depend heavily on these three systems to manage the scheduling of cases which ultimately drives and regulates the workload of interviewing staff.

The call scheduler identifies, groups and prioritizes calls to be made, whereas the case delivery system allocates those cases to waiting interviewers by predetermined rules and the CATI front end system records key information about actions taken on cases. The call scheduler, case delivery, and CATI front end systems jointly manage the flow of cases in a complementary fashion. The three systems communicate and interact by reading from and writing to a collection of stored information provided and coordinated by the overall case management system.

The call scheduler runs as a background process using current case status, call counters, priority rules, delay parameters and other information to prioritize cases so that the best case can be quickly identified for the selection criteria specified by the case delivery system. The case delivery system runs in response to an action by the interviewer, selecting a case based on the access level of the interviewer (for example, only specially trained interviewers may be allowed to work refusal cases). Case information, including preloaded information, contact data, status and call history, if any, is drawn by the case delivery system from the case management database and presented on screen for interviewing. Cases are then delivered to an interviewer and electronically handed off from the case delivery system to the CATI front end system. Upon completion of a call, whether productive or not, the status and call counters are updated by the CATI front end system for use when the call scheduler runs again. The following sections provide more detailed information about each of these three systems that are important for the overall call scheduling of cases.

Call Schedulers. Call scheduling systems can either be separate from or part of computer-assisted interviewing (CAI) software (such as Blaise or CASES). Call scheduling software

ranges from a simple listing of available cases to complex algorithms designed to maximize productivity. There is no overall evaluation criteria that can be used to determine whether a given call scheduler system is adequate; rather the evaluation depends on the needs of the organization seeking to use the system and is influenced by the type of survey(s) being conducted, sample size, number of telephone interviewers required, among other factors. There are, however, features that have proven to be more useful than others and that are common among multiple call scheduling systems.

Call scheduler features fall into two main categories: survey case management and computing performance. Survey case management features allow flexibility and control of call scheduling operations by survey managers within the context of a particular study, whereas computing performance features affect the routine operation of the system, which in turn impacts the usability of the system for interviewers.

Survey case management features can be further categorized into three separate groups: time features, scheduling features, and management features.

- Time features ensure cases are available for delivery to interviewers at appropriate times of day. These features include items such as time zone and daylight savings time which are used to automatically adjust for the respondent's time zone and daylight savings time.

- Scheduling features are rules that are programmed into the scheduler that help organize the cases so they are available for appropriate delivery to interviewers. For example, the call scheduler can give priority to certain types of cases (such as hard call backs), implement an automatic delay to refusal cases (to allow for potential respondents to cool off before being re-contacted), or allow the interviewer to schedule appointments only during the field data collection period and during call center hours.

- Management features allow the user (usually supervisors) to manually override the rules that have been programmed into the scheduler. The user can put cases on hold, or lock them out of production so they are not delivered to interviewers. Also, the user can generate specific reports about cases using the call scheduler, allowing the user to better manage the case flow.

Table 1 details some of the survey case management features by overall feature (time, scheduling, or management) along with their value to surveys.

Table 2 presents various computing performance features which are used to enhance the usability of the scheduler system and minimize the human effort involved to manage the cases. Desirable features include the ability to schedule cases for multiple independent projects, running as a scheduled operation, and updating reports and case-lists without the need of human interaction. When the software is designed to perform as an always-on process, it can automatically log users' access to cases and any system or user errors that occur. Designing the software for continuous high performance maximizes the usefulness of the scheduler and delivery system and minimizes the human effort to manage cases.

Table 1. **Call scheduler features for survey case management, for outbound calling.**

Feature	Description
Time Features	
Time Slots	Schedule cases according to different rules for weekdays, weeknights, weekends or other defined time slots.
Restricted calling hours	Case specific restrictions as to when calls can be made in order to improve the chances of contacting the respondent. For example, the first two calls should be on nights and weekends.
Time Zones	Use stored time zone information when queuing cases to make the case available only during appropriate hours in the respondent's time zone.
Daylight Savings Time	Apply stored daylight savings time adjustments when queuing cases.
Midnight Effects	Schedule cases during reasonable hours based on respondents' time even if it means the call center time is after midnight
Holidays and Working Hours	Allow appointments only for times the call center or study is in operation.
Scheduling features	
Appointments	Recognize appointment information and schedule accordingly.
Appointment Windows	Allow appointments which have a specified window of time in which they are valid.
Multiple Queues	Manage cases in independent queues, such as new cases, Spanish language, refusals, etc.
Case Prioritization	Sort cases within a queue by predefined rules and priority values.
Automatic Delays	Set minimum callback times for cases with specific call outcomes, such as answering machines, busy signals, etc.
Release Dates	Omit cases which have not yet passed a case-specific and/or project-specific release date.
Expiration Dates	Omit cases which have passed a case-specific and/or project-specific final date.
Quotas (for RDD)	Use case-specific information to eliminate cases from scheduling after quotas have been reached.
Call Counters	Use data from call counters which may be available from the case management system, for limiting calls, sorting order or assignment to queues.
Management features	
Case Locking	Lock cases during scheduling to prevent status change by another system or user.
Case Protection	Omit or defer scheduling of cases locked by another system or user.
Hold Flags	Temporarily remove a case from scheduling.
Scheduler Reports	Periodic (at least hourly) reports that provide adequate information to the call center managers for staffing and other purposes.

Table 2. **Call scheduler features for computing performance, for outbound calling.**

Feature	Description
Multiple Projects	Produce independent schedules for multiple projects within a single run.
Multiple Databases	Access and update data stored in multiple databases or on multiple servers.
Rapid Computation	Minimize the time in which cases are locked and unavailable for work.
Automated Logging	Record actions performed, exceptions and error conditions.
Scheduled Operation	Run unattended, at scheduled intervals, without the need for human control, frequently enough to keep the case lists up to date for the case delivery system.
Error Tolerance and Recovery	Identify and log error conditions, resuming activity at the next appropriate step.

Case Delivery. Case delivery systems are the second system used for call scheduling, and interact both with call scheduling systems and users. The case delivery system utilizes information from the call scheduling system to determine which cases, and the order of these cases, are ready to be delivered to interviews. Then, when interviewers are ready to make outbound calls, they indicate to the system that it should deliver a case to them (either by clicking a button, choosing from a menu, or otherwise signaling readiness). The case delivery system will take into account the access level of the interviewer, as well as the case delivery request. Interviewers can request either specific cases (for example, by entering in a case ID) or request any cases from a particular queue (or group of cases, such as new cases, refusals, etc). In each situation, the case delivery system identifies the case to be worked next, retrieves and displays the case to the interviewer and electronically hands control of the case to the CATI front end system for the interviewing session.

CATI Front End. The CATI front end classifies or categorizes cases in a way to make scheduling efficient, and this information is then used by the call scheduling system. The CATI front end includes all of the screens (contacting, recruiting, screening, informed consent, etc) that are not a part of the substantive questionnaire but which are administered by the interviewer, as well as the logic which links the questionnaire to the management tools and infrastructure of the call scheduling program. This system (or module) also determines the status of the case, the best number to call the next time the case is invoked (for list samples), the best time to call, the scheduler queue the case should be assigned to, delay dates if any, and maintains flags and counters to help categorize/classify the case into the appropriate scheduler queues. Based on the information derived by the CATI front end, the scheduler does its job of scheduling the cases.

Literature Review

Since the development of call scheduling systems, researchers have been investigating the impacts of these systems on survey outcomes – especially in terms of usefulness of various call scheduling features and optimal times to contact sample members. Below we present a review of the four main aspects of this research: call schedulers, factors that influence call scheduling,

optimal times for contacting sample members, and the impact of demographic variables and survey type on telephone contacts.

Call Schedulers. With the development of computer-assisted telephone interviewing (CATI) call scheduler systems in the 1970s, researchers began to organize, examine, and modify those systems in order to optimize the chances of contacting sample members by eliminating the manual process of interviewers scheduling calls and instead utilizing more sophisticated calling algorithms. Since the 1970s, many researchers have analyzed the most effective ways to adjust the timing of calls to increase the probability of contacting households and completing interviews. The early literature centered on the timing of calls to households and the impact of other variables such as season of year, day of week, and time of day on call outcomes (Falthzik, 1972; Weeks, Jones, Folsom, and Benrud, 1980; Vigderhous, 1981).

In one of the first in-depth analyses of computerized call scheduler systems Weeks (1988) conducted a survey of key survey research organizations and presented the advantages of using an electronic call scheduler over a manual scheduling system. He found that use of an automated call scheduler led to a reduction in human error, reduced labor to manage calls, and enhanced ability to program complex calling protocols.

In an expansion of this research, Edwards, Suresh, and Weeks (1998) conducted a more detailed analysis of features available in call scheduling software and how different organizations (both research and commercial) used the existing software. They asked survey organizations to rate the importance of call scheduling software features, and found that most organizations rated features such as the ability to specify time slot for the next call, built-in reports on interviewer productivity, and the availability of daily and on-demand status reports more highly than other features. The majority of features were ranked highly by all organizations, however the authors noted small variations in the ratings.

Although the literature on key features of call scheduling systems is very detailed (Weeks, 1988; Edwards et al, 1998), more research is needed in this area to keep pace with the changes in call scheduling technology. For instance, it would be beneficial to conduct another survey of research and commercial organizations to assess the existing and new key features of call scheduling software.

Factors that Influence Call Scheduling. When trying to determine the optimal calling schedule for a study, a number of factors should be taken into consideration. Many of these factors are study specific, such as the population and sample members' availability. In addition, many call scheduling problems can be avoided by carefully considering the data collection time period, sample population, and study aims. While there are numerous factors to consider, we focus on three of the factors that seem to have the most influence on call scheduling: 1) the population of interest for the study; 2) the availability of the sample members; and 3) availability of multiple telephone numbers.

It is important to understand the characteristics of the study population before data collection begins because population characteristics may impact the best time to call. For example, a study of youths conducted during the school year would be well advised to limit the number of calls

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made during weekday mornings and early afternoon hours since most teens are in school at that time. However, it may be beneficial to make some calls during this time period in an attempt to first obtain parental permission to interview the selected youth. As discussed above, there is some research on the impact of demographic characteristics on optimal calling times (cf., Mecklenburg, Murphy, and Shin, 2004), however more research is needed in this area. By being familiar with the characteristics of the population of the study, assumptions can be made about optimal times to make calls. These assumptions can lead to data collection procedures that help minimize the number of callbacks to respondents, which in turn reduces costs.

A main goal of call scheduling is to contact sample members at times when they would be willing to do an interview to minimize the number of calls that need to be made to the household, and knowing the sample population can help in understanding their potential availability and creating an optimal calling schedule. Part of understanding the characteristics of a given population is having an idea of when sample members may be available to participate in the survey. As participation in surveys continues to decline, understanding sample members' availability is increasingly important as a means to increase response by targeting time periods that are most effective for contacting sample members. For example, research shows that some sample members would benefit from targeting calls to evenings and weekends (Weeks, Kulka, and Pierson, 1987), whereas a study of workers may benefit from targeting calls during working hours. More research is needed to determine sample members availability within various populations so that this information can be used in the most effective way possible to obtain survey goals.

Finally, the availability of multiple telephone numbers for individual cases can also impact optimal call scheduling times. Some list studies may benefit from having alternative phone numbers, such as work numbers, for sample members. Caution must be taken however, to not overly rely on work telephone numbers for studies that are not related to the sample member's job. In addition, cell phone numbers may provide another avenue with which to reach sample members in list studies.

Optimal Times for Telephone Contacts. Optimal calling strategies were first studied in the late 1980s and early 1990s. Many of these earlier studies focused only on RDD samples and the optimal time to schedule the first few call attempts for cases where no contact had been made. The main purpose of this research was to improve response rates by completing more interviews while removing business numbers and other ineligibles from the sample. Several key articles in the late 1980s and early 1990s focused on the best days and times to contact households. This research has shown that the best times for contacting a household and completing an interview are evenings and weekends versus the less productive weekday daytime hours (Weeks et al, 1987; Kulka and Weeks, 1988; Greenberg and Stokes, 1990).

Kulka and Weeks (1988) were among the first to expand earlier work by applying a probability based approach for scheduling calls which utilizes information from prior calls to predict the probability of a particular call outcome on a subsequent call. They found that calling during weeknights or weekends was the optimal time to reach sample members on the first contact, as well as on second and third calls providing that no contact was made on the prior calls. Massey, Wolter, Wan, and Liu (1996) expanded the work of Kulka and Weeks by analyzing call pattern

data from the National Immunization Survey (NIS), and found that evening and weekend calls were the best combination of calls to contact households and complete interviews; however, this combination also slightly increased the chance of obtaining a refusal over weekday attempts. They also recommend one weekday call be made within the first three attempts to help screen out businesses. It would be useful to revisit this discussion of using a priority score or contact probability approach for scheduling calls.

Telephone Contacts by Demographics and Type of Survey. Recent literature on call scheduling has focused less on optimal calling times and more on ways to minimize the increased effort needed to contact households and keep response rates from declining further. For instance, current research shows that most cases finalized as completed interviews, ineligibles, or refusals usually occur by around the sixth call attempt, with markedly reduced success after that point (Brick, Martin, Warren, and Wivagg, 2003; Sangster and Meekins, 2003; Sangster and Meekins, 2004).

In order to improve contact rates and increase response rates, researchers now have to focus their resources on mailing advance lead letters, mailing refusal conversion letters, increasing the number of call attempts, extending data collection periods, calling initial refusals multiple times, and offering incentives. Researchers have also had to focus attention on applying new sample management techniques to increase the likelihood of contact. For instance, more research is being done on ways to target call attempts based on demographic data. This focus on altering call scheduling parameters based on demographics is still a relatively new area. However, research has shown that households on the high and low ends of the income spectrum tend to be harder to contact (Mecklenburg et al, 2004; Dennis, Saulsberry, Battaglia, Roden, Hoaglin, and Frankel, 1999; Keeter, Miller, Kohut, Groves, and Presser, 2000). Also, sample members who are better educated and younger are more difficult to contact (Keeter et al, 2000).

Most of the literature on optimizing telephone contacts and reducing non-response tends to focus on analyzing data from only one RDD study at a time; and less emphasis has been placed on list and longitudinal samples. One exception is Meekins and Sangster (2004) who analyzed wave non-response in a longitudinal study and found that prior wave data quality does not affect wave non-response; rather call history variables better predict wave non-response. They found that being hard to reach during the previous wave substantially increased the probability of being hard to reach on subsequent waves, but that it had no impact on refusals in the future waves; and being a reluctant respondent in the first wave substantially increased the chance of refusals on all waves.

Methods

We focused our analysis on three different sample types (RDD, list, and longitudinal) in an attempt to document whether weekdays or weekends and which times of day work best for garnering completed interviews for a wide variety of populations. We selected two studies each for the three sample types.

The two RDD studies chosen for inclusion were both fielded in a northeastern state. One focused on adults 18 and over, and the other focused on youths aged 13 to 17. The adult study was conducted over multiple quarters, and we report results for three of those quarters in this paper. Both RDD studies only included one telephone number for the household.

The two list studies were both conducted nationwide; one focused on college faculty and the other on college students. The faculty study utilized both home and work telephone numbers for sample members, as well as updated contact information provided either through tracing or from informants. Similarly, multiple telephone numbers were available from the start of data collection for the college student study; these numbers could have included current place of residence or parent's residence among other telephone numbers.

One of the longitudinal studies was conducted in east coast states and focused on workers, while the other longitudinal study was conducted in a northeastern state and focused on adults 18 and over. For the study of workers, we had both work and home telephone numbers and first attempts were made to home telephone numbers. The adult longitudinal study was conducted in quarters corresponding to the initial quarter of data collection for the respondents. Adult longitudinal respondents were initially respondents to an RDD study.

Table 3 presents key information on each of the studies by sample type and includes geographic location of the sample, timing of data collection, starting sample size, and number of completed interviews.

Table 3. Key information about included studies.

Population	Geographic Location	Field Dates	Starting Sample Size	Number of Completed Interviews[1]
RDD				
Adults 18+	Northeast state	Sep 2003 – Mar 2004	29,506	3,977
Youth 13-17	Northeast state	Mar 2005 – Sep 2005	15,160	1,424
List				
College Faculty	National	Feb 2004 – Sep 2004	35,646	26,108
College Students	National	Jan 2004 – Oct 2004	109,213	61,827
Longitudinal				
Workers	East Coast	Jan 2001 – Apr 2004	21,315	14,405
Adults 18+	Northeast state	Sep 2004 – Mar 2005	1,437	654

Our analysis focused on the process of getting a completed interview starting with the timing of successful first contact, the timing of all successful contacts, followed by the timing of completed interviews, and the timing of refusal conversions. Our analysis presents all of these types of contact for all six studies, and attempts to link these outcomes back to relevant call scheduler features.

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[1] The number of completed interviews includes full and partial completes.

We divided the timing of successful contacts/calls into weekday versus weekend and time of day (day shift, night shift, late night shift). Day shift calls were completed up until 4:59pm[2], night shift calls were completed from 5:00pm to 8:59pm, and late night calls were completed from 9:00pm and later. For projects where sample members were located in multiple time zones, we adjusted the time of the call (which was recorded in the local time of the call center) to represent the time in the sample member's time zone.

Further, in the longitudinal studies we were interested to see if the prevailing wisdom that calling a case back for a follow-up interview at the same time of day and day of the week as the baseline interview was completed was more successful than calling at other times. We looked at the time and day of completion for the interview and compared the follow-up interview time and day of completion to determine where the most matches occurred. For this analysis we looked at both exact day of the week and weekday versus weekend, and we used time of day (day, night, late night) as a proxy for time of complete since matching on exact time of complete may be considered too exacting of a standard.

Results

We present results for timing of first contacts, all contacts, completed interviews, and successful refusal conversions for three sample types: RDD, list, and longitudinal. Our target populations include the general adult public (RDD adult, longitudinal adult), youth (13-17), college students, college faculty, and workers who may be more like the general US population than other groups in this analysis. We also present results on how closely time/day of complete for follow-up interviews in two longitudinal studies match time/day of completion from the baseline survey[3].

First Contacts.   Since the first step in obtaining a completed interview is contacting a sample member, we first looked at the time and day of successful first contacts for all of the populations. The timing of first contacts can be regulated by multiple call scheduler features including restricted calling hours and time slots to ensure that the first few call attempts are made at specific times.

Exhibit 1 shows that the most successful time, by far, for a first contact for adults in a general population survey is weekday nights (between 5pm and 9pm) with 65 percent of first contacts occurring during this time period. Interestingly, weekday days (before 5pm) and weekend days (before 5pm) are nearly tied for the next most successful time to contact adults with approximately 15 percent of first contacts coming during each of those time periods. Late nights on both weekday (1 percent) and weekends (less than 1 percent), as well as weekend nights (4 percent) receive the lowest percentage of successful first contacts for adults.

The timing of successful first contacts for teenagers does not show such striking differences. Just over 36 percent of successful first contacts for teens occurred during weekday days, while

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[2] Calls coded as day shift began at 4:00am, and calls coded as late night occurred up until 3:59am. Calls recorded during these early morning hours are likely from errors with the time stamp on the individual computer used to conduct the interview.

[3] Tables for all of the results are presented in Appendix A.

29 percent occurred during weekday nights. We were surprised to see such a high contact rate for weekday days but this may be due to the need to obtain parental permission before we can interview the selected youth; further this may be related to the fact that data collection for the youth study was collected at least partially during the summer when youths were out of school and may have been more available for weekday day contacts. Weekend days (16 percent) were the next most successful time period for contacting teens, followed by just under 10 percent each for weekday late nights and weekend nights. Weekend late nights (2 percent) were least successful for achieving a successful first contact for teens.

Exhibit 1. Successful first contacts for RDD studies.
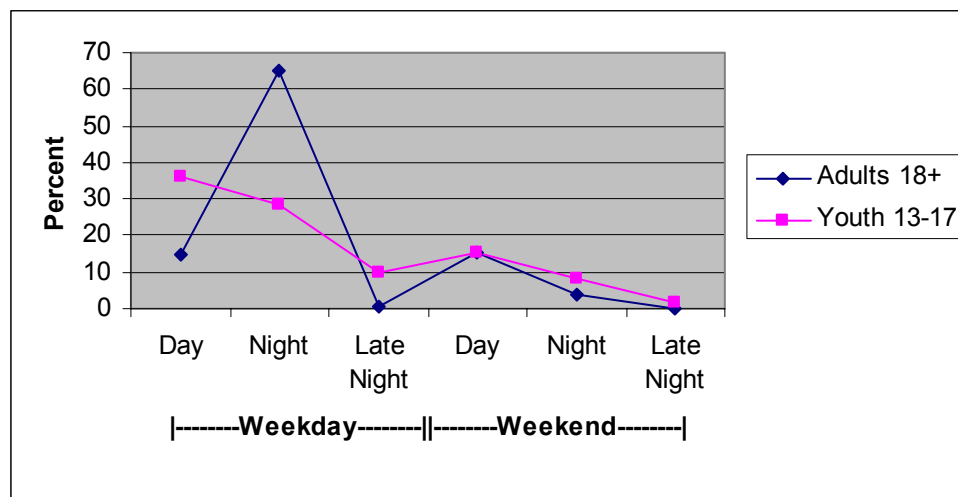
As expected, a noticeably different pattern emerges for the two types of list studies analyzed. We would expect that the most successful times to contact college faculty would differ from those most successful for contacting college students, and while this is true in terms of distribution across time periods, the top two time periods are the same for both groups (Exhibit 2). Successful first contacts for college faculty are much more likely to occur during weekday days (65 percent), followed by weekday nights (21 percent), and weekend days (10 percent). Weekday late nights (5 percent), weekend nights (2 percent), and weekend late nights (less than 1 percent) are the least successful times for achieving a first contact with a faculty member. It is not surprising that the best time to reach college faculty is during weekday days, especially given that we had both work and home telephone numbers for calling. If faculty are not in the office during the traditional work week, then they are likely to be working at home so having both numbers may increase our chances of contacting this population during weekday days.

The pattern is somewhat different for college students. The most successful first contacts for students also occurred during weekday days (45 percent), followed by weekday nights (24 percent) and weekend days (21 percent). The least successful times for first contacts with college students was weekday late nights (6 percent), weekend nights (4 percent), and weekend late nights (less than 1 percent). We were surprised to see that weekday late nights were not a good time for initial contacts of college students.

Exhibit 2. Successful first contacts for list studies.
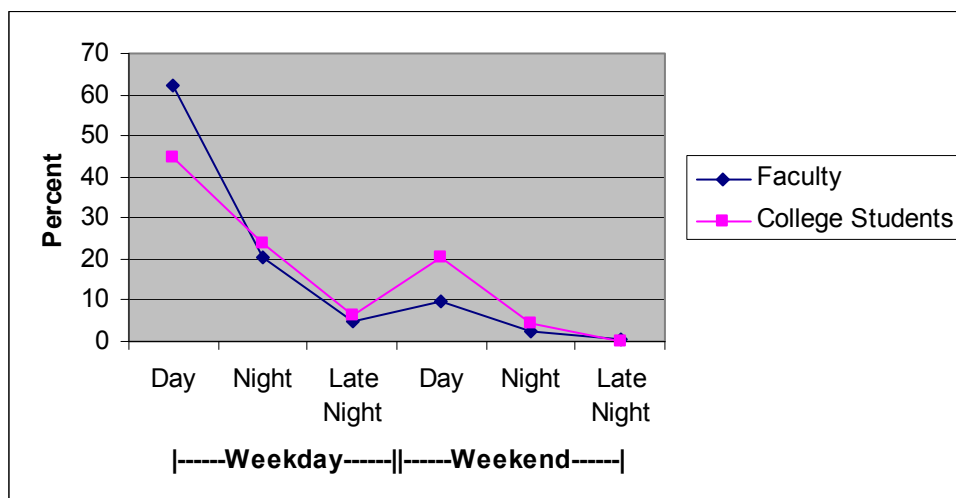
Successful first contacts with adult workers were most often achieved during weekday days (48 percent), with an additional 35 percent occurring during weekday nights (see Exhibit 3). This finding is interesting, and somewhat perplexing, given that the initial telephone number called for these cases was the home telephone number and one would expect these workers to be on the job during weekday days. Weekend days contributed another 11 percent to successful first contacts for this group, while weekday late nights (4 percent) and weekend nights (2 percent) were less successful. No first contacts were made with this group during weekend late nights.

**Exhibit 3. Successful first contacts for longitudinal studies.**
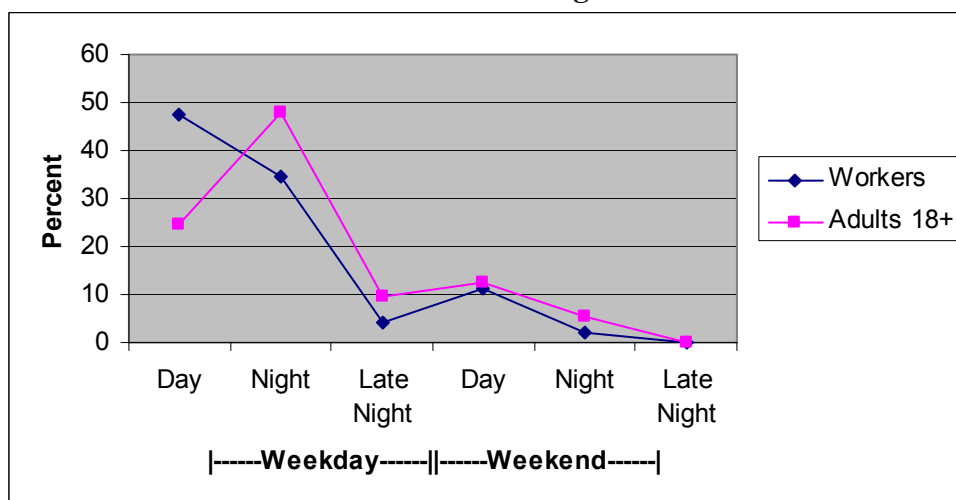
The pattern for contacting adults in a longitudinal study differs somewhat from the results for the adult RDD study. While weekday nights (48 percent) are still the most successful time period for first contacts, a higher percentage (25 percent compared to 15 percent for RDD adults) of first contacts occurred during weekday days. Similar trends were observed for percentage of successful contacts for weekend nights (12 percent versus 15 percent for RDD adults), weekend late nights (5 percent versus 4 percent), and late night (no contacts versus less than 1 percent).

Interestingly, adult participants in the longitudinal study were more likely to be successfully first contacted during weekday late nights (10 percent) than were general RDD adults (1 percent).

While overall some differences appear in the best times for successful first contacts for the varying populations, Exhibit 4 shows that there are some times of the day and days of the week that are better for contacting all populations in this analysis. Weekday days and nights are clearly the best time to contact all populations, followed by weekend days. Weekday late night calls are somewhat more successful than weekend late night calls, but both have less than 10 percent of successful first contacts for all populations analyzed. Weekend nights are also not as successful for first contacts as other time periods. These results provide support for utilizing call scheduler features such as restricted calling hours and time slots to only allow initial calls to be made during weekday nights, with at least one attempt to be made during weekday days and weekend days.

Exhibit 4. Successful first contacts for all studies.
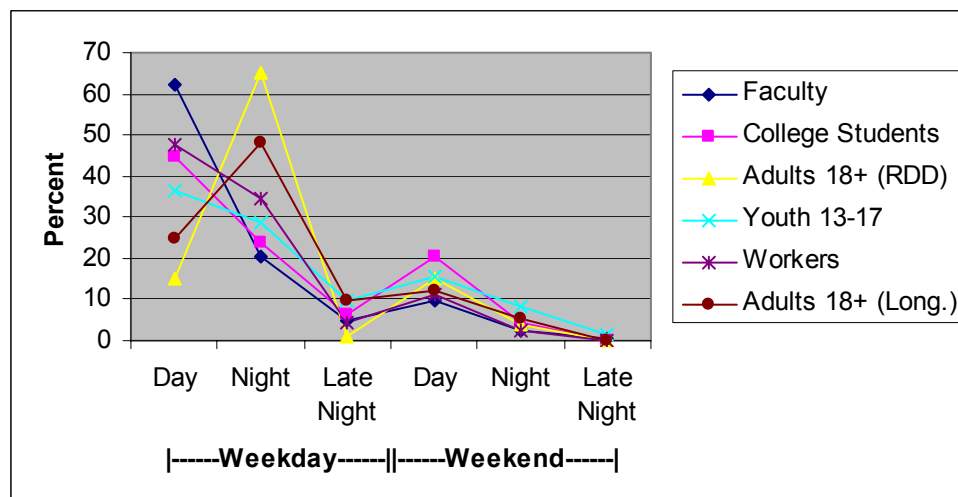

All Contacts. The same call scheduler features that impact timing of first attempt are also important for regulation of additional attempts. Just as restrictions can be placed for initial call attempts, the restrictions will need to be released and other adjustments made to the call scheduler for later attempts. For example, the call scheduler will need to be able to make sure that cases receive attempts in all of the various time slots in order to minimize potential non-response bias (which could result from not attempting to contact sample members at all times of day and days of the week). Similarly, call counters are important to limit the number of calls made to a particular case according to study procedures. By not allowing cases to be called past the maximum call count set by the project, project or call center staff can review those cases to determine the best course of action.

For both adult and youth RDD studies, the best time for all contacts was weekday nights with 52 percent of all adult contacts and 44 percent of all youth contacts happening during this period (see Exhibit 5). However, an additional 21 percent of adult RDD contacts were made during weekday days followed by 19 percent on weekend days. The least successful times for all contacts for adult RDD respondents was weekend nights (6 percent), weekday late nights (1

percent), and weekend late nights (less than 1 percent). As with adults, weekday days (18 percent) and weekend days (15 percent) were the second and third most productive times for contacts of RDD youths, followed by weekday late nights (13 percent). The least successful times for all contacts of RDD youth were weekend nights (9 percent), and weekend late nights (2 percent).

Exhibit 5. All successful contacts for RDD studies.
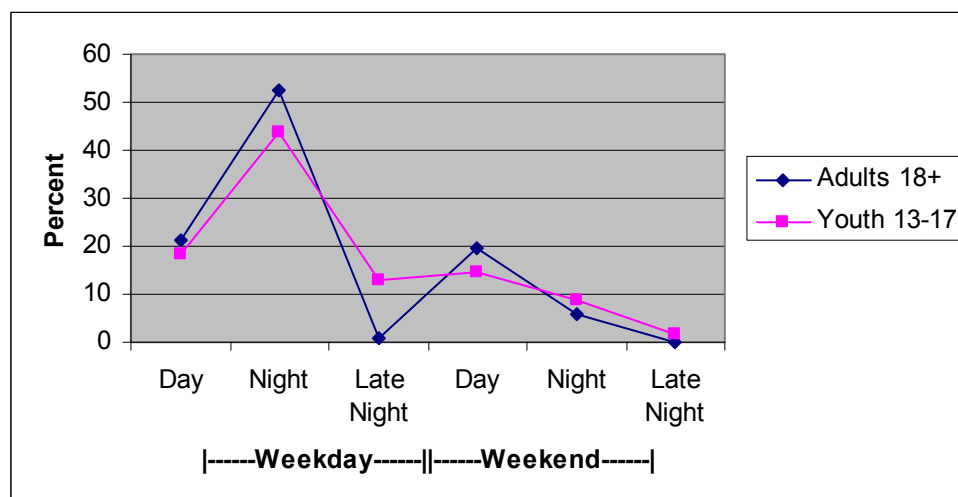
All successful contacts closely mirrored first contacts for faculty with weekday days (60 percent) being the best time to contact them, with weekday nights (25 percents) a distant second (see Exhibit 6). All other time periods combined only accounted for 15 percent of all contacts with weekend nights achieving 7 percent of all contacts, weekday late nights 5 percent, weekend nights 2 percent, and weekend late nights less than 1 percent. For students, the order of the success of the time periods remained the same for all contacts as for first contact, however the distribution among the top three time slots changed. Weekday days accounted for 36 percent of all contacts (compared to 45 percent of first contacts), followed by 33 percent in the weekday night time slot (compared to 24 percent of first contacts), and 15 percent in the weekend day slot (compared to 20 percent of first contacts). While weekday late nights did account for 11 percent of all contacts, we expected this percentage to be higher for this population. As expected, weekend nights (4 percent) and weekend late nights (less than 1 percent) were the least successful times for contacting college students.

Exhibit 7 shows that for both longitudinal studies, the most successful time slots for first contacts were the same for all contacts. For workers, weekday days (46 percent) was the best time for all contacts, followed by weekday nights (33 percent) and weekend days (15 percent). Less than 7 percent of all contacts were made in the remaining three timeslots: weekend nights (5 percent), weekday late nights (2 percent) and weekend late nights (less than 1 percent).

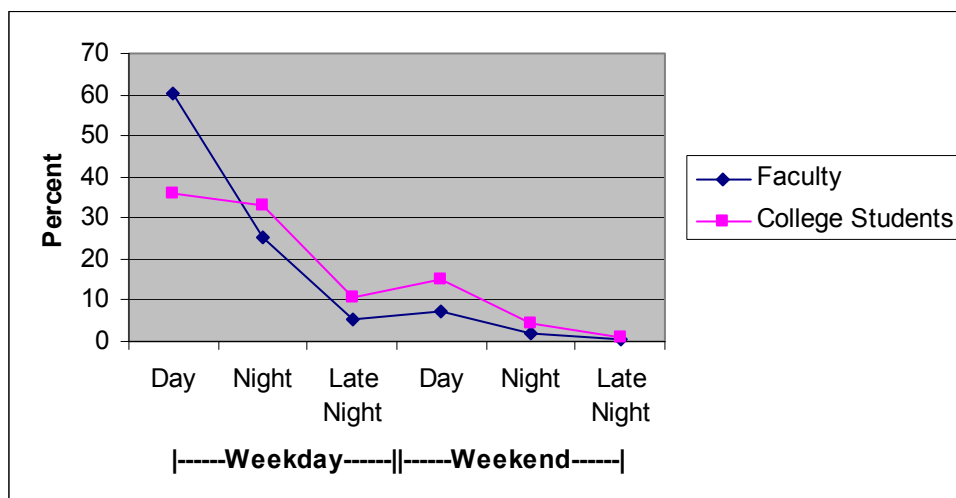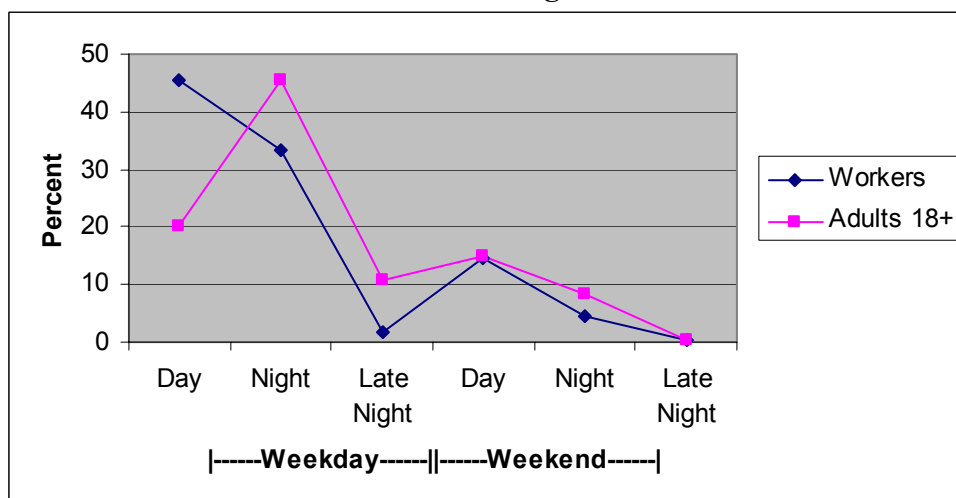**Exhibit 6. All successful contacts for list studies.**

**Exhibit 7. All successful contacts for longitudinal studies.**

Timing for all successful contacts for adults in a longitudinal survey were very similar to timing for first contacts. Weekday nights (45 percent) were the most successful time to contact adults in a longitudinal survey, followed by weekday days (20 percent), weekend days (15 percent), weekday late nights (11 percent), and weekend nights (8 percent), with weekend late nights being the least successful time for contacts (less than 1 percent).

Exhibit 8 shows the timing of all contacts for all studies. For all populations, the two best times for all successful contacts are weekday days and weekday nights. Only for the adult RDD and adult longitudinal populations are weekday night better than weekday days. Similarly, weekend days are the third most successful time period for all populations analyzed. Weekday late nights, weekend nights, and weekend late nights are the least successful times for all contacts for all populations presented here. The ability to deactivate restrictions for initial call attempts, as well as use of time slots are important features for maximizing all contacts. As data collection proceeds and new information is available, these features can be further regulated to optimize

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time rules for attempting to contact sample members and make the most efficient use of project resources.

Exhibit 8. All successful contacts for all studies.
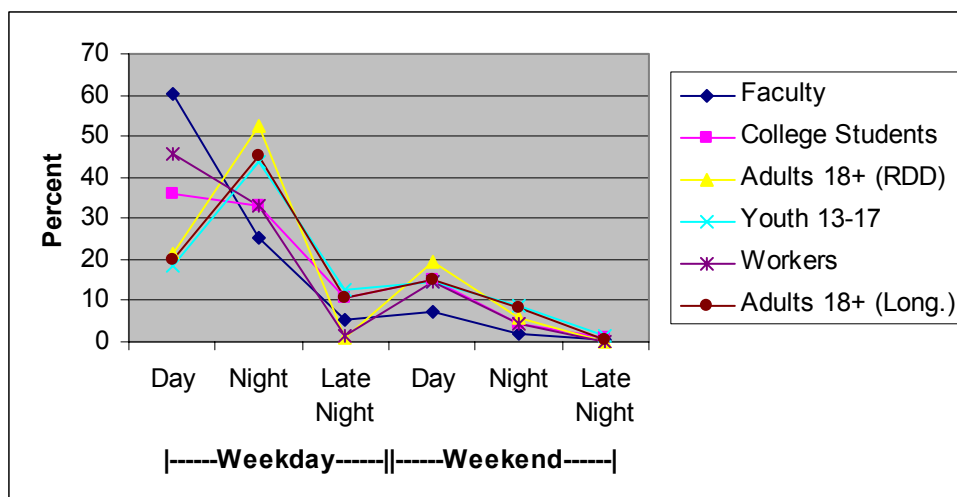
Completed Interviews. All of the call scheduler features that are important for all contacts are also important for completed interviews. Particularly, utilizing priority scores that allow for more attempts or sooner attempts for cases where contact has been made with a household increase the likelihood of a completed interview.

Exhibit 9 shows that the timing of completed interviews for adults in an RDD survey remains similar to that for first contacts and all contacts with weekday nights (52 percent) clearly being the best time to reach adults. However, just under 20 percent of interviews were completed in each of two other time periods: weekday days (18 percent) and weekend days (18 percent). Weekend nights (6 percent), weekday late nights (5 percent), and weekend late nights (less than 1 percent) were times when the fewest interviews were completed.

For youths, the timing of completed interviews differed somewhat from the timing of successful first contacts and all contacts. This may be due to the fact that parent permission must be obtained before a youth can be interviewed, so once that permission is obtained the timing for completed interviews depends more on the schedule of the youth than the parent, hence the shift in timing between contacts and completed interviews. While weekday nights (42 percent) was the best time to obtain completed interviews, an additional 24 percent of interviews were completed during weekday late nights. Approximately 12 percent of youth interviews were completed during weekend days, 10 percent during weekday days, 10 percent during weekend nights, and 2 percent during weekend late nights.

The distribution of completed interviews for faculty differed somewhat from the timing of successful contacts, although the top two time periods for both contacts and completed interviews remain the same: weekday days (57 percent) and weekday nights (26 percent) (see Exhibit 10). All remaining time periods account for 17 percent of completed interviews: 8

percent were weekday late nights, 6 percent were weekend days, 2 percent were weekend nights, and less than 1 percent were weekend late nights.

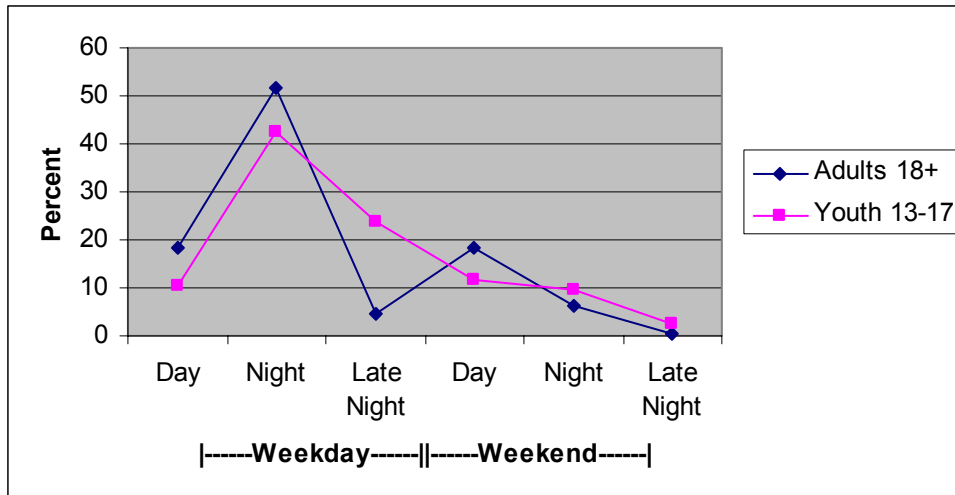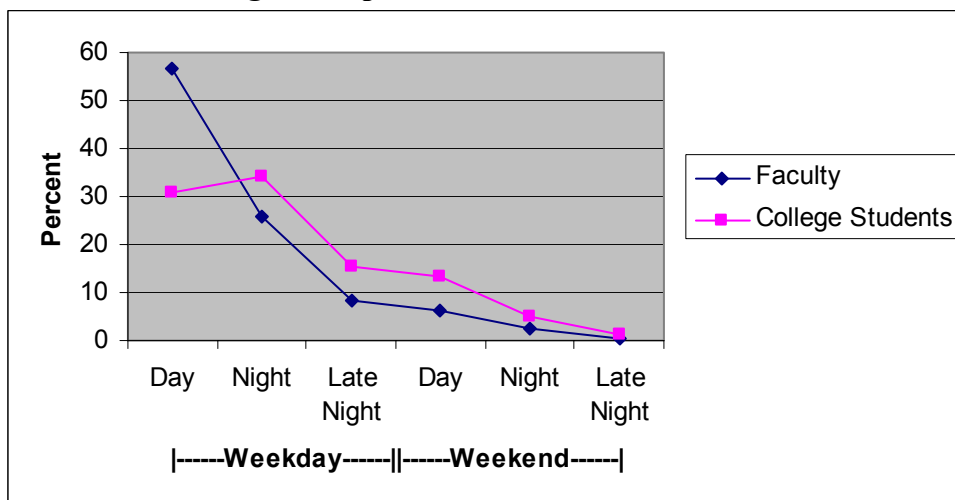**Exhibit 9. Timing of completed interviews for RDD studies.**

**Exhibit 10. Timing of completed interviews for list studies.**

While the top two best times for contacting students were also useful for completes, the order changed with weekday nights (34 percent) becoming the best time to complete interviews followed closely by weekday days (31 percent). Weekday late nights accounted for 15 percent of all completed interviews, while weekend days accounted for 13 percent. Weekend nights (5 percent) and weekend late nights (1 percent) were the least successful times to complete interviews with college students.

Exhibit 11 shows that nearly 39 percent of completed interviews with workers in the longitudinal study occurred during weekday days, followed by 26 percent during weekday nights. Interestingly, weekend nights (16 percent) were more successful than weekend days (6 percent), weekday late nights (2 percent), and weekend late nights (less than 1 percent). For adults in the longitudinal study, weekday nights (39 percent) was clearly the best time to complete interviews,
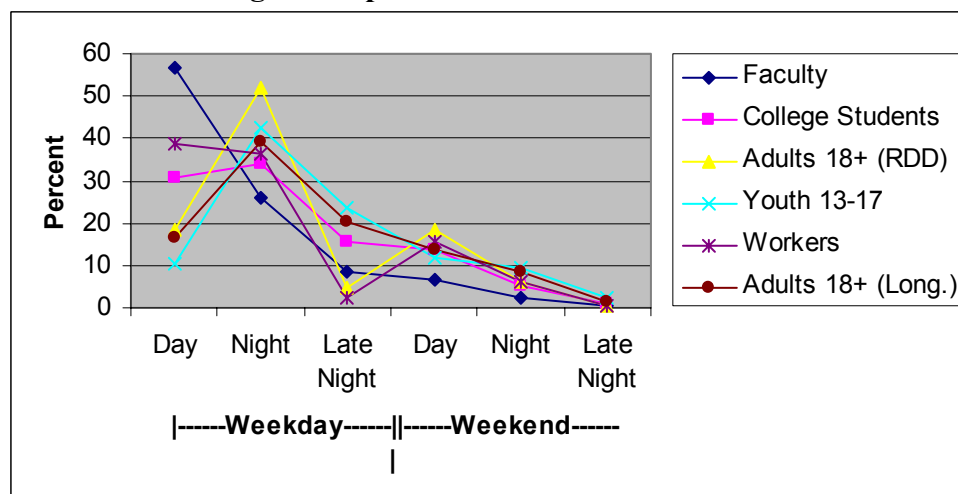
followed by 21 percent during weekday late nights, 17 percent during weekday days, and 14 percent during weekend days. Weekend nights (8 percent) and weekend late nights (1 percent) were the least successful times for completing interviews with adults.

Exhibit 11. Timing of completed interviews for longitudinal studies.
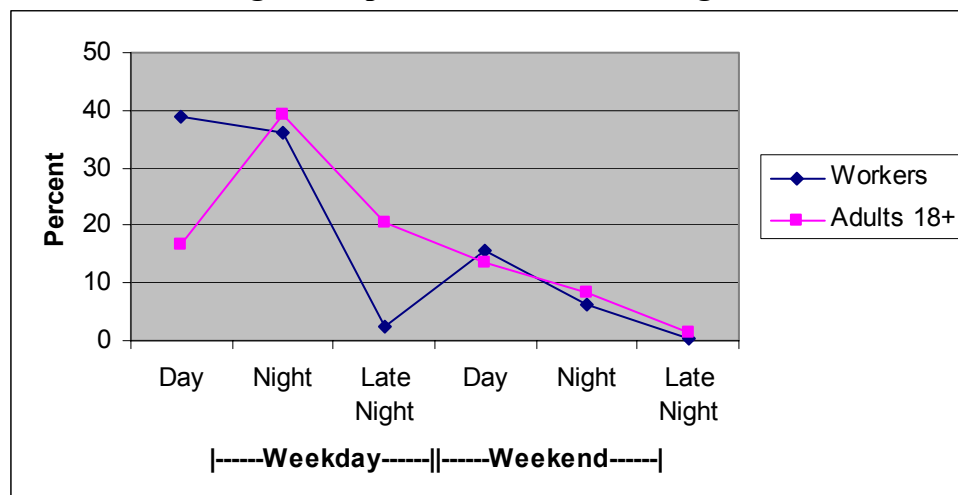
For all populations analyzed, weekday nights and weekday days are the two most successful times for completing interviews (see Exhibit 12). Only faculty members complete more interviews during weekday days than weekend nights. Weekday late nights and weekend days are the next most successful time periods for completing interviews; however the success of these time periods varies by population. The ability to prioritize contacted cases for calling by interviewers is an important call scheduler feature that contributes directly to obtaining completed interviews by focusing resources (calls) on cases where a contact has been made.
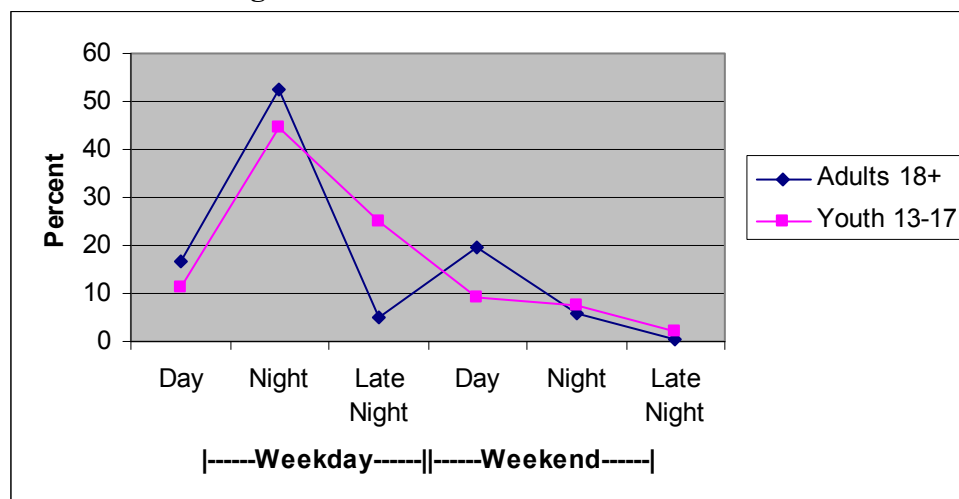
Exhibit 12. Timing of completed interviews for all studies.

Refusal Conversions. The ability to delay a case based on a status code is the most important call scheduler feature for refusal cases, however timing of cases is also important for completing refusal conversions.

Timing for successful refusal conversions for adult and youth RDD respondents closely mirrors the timing of completed interviews. The best time for completing refusal conversions for adult RDD respondents was weekday nights (53 percent), followed by weekend days (20 percent), and weekday days (17 percent) (see Exhibit 13). Nearly 6 percent of all refusal conversions were completed during weekend nights, 5 percent during weekday late nights, and less than 1 percent during weekend late nights. For youths, weekday nights (45 percent) are the best time for refusal conversions, followed by weekday late nights (25 percent), weekday days (11 percent), weekend days (9 percent), weekend nights (8 percent), and weekend late nights (2 percent).

Exhibit 13. Timing of successful refusal conversions for RDD studies.

Timing for successful refusal conversions for college faculty and students closely mirrors timing of completed interviews for each group. Exhibit 14 shows that weekday days (65 percent) were clearly the best time for faculty refusal conversions, followed by weekday nights (20 percent), weekday late nights (8 percent), weekend days (6 percent), and weekend nights (1 percent). Weekday nights (36 percent) and weekday days (32 percent) were the best time for student refusal conversions followed by weekday late nights (14 percent), weekend days (12 percent), weekend nights 5 percent) and weekend late nights (1 percent).

For the longitudinal studies, successful refusal conversions for workers mirrored timing for completed interviews, while the pattern for adults changed somewhat from the timing of completed interviews (see Exhibit 15). Just over 42 percent of refusal conversions for workers occurred during weekday days, followed by 32 percent during weekday nights, 15 percent during weekend days, 7 percent during weekend nights, 4 percent during weekday late nights, and less than 1 percent during weekend late nights. Weekday nights (33 percent) was the most successful time for refusal conversions for adults in the longitudinal study, followed by weekday late nights (26 percent), weekday days (23 percent), weekend nights (9 percent), weekend days (7 percent), and weekend late nights (2 percent).

Exhibit 14. Timing of successful refusal conversions for list studies.
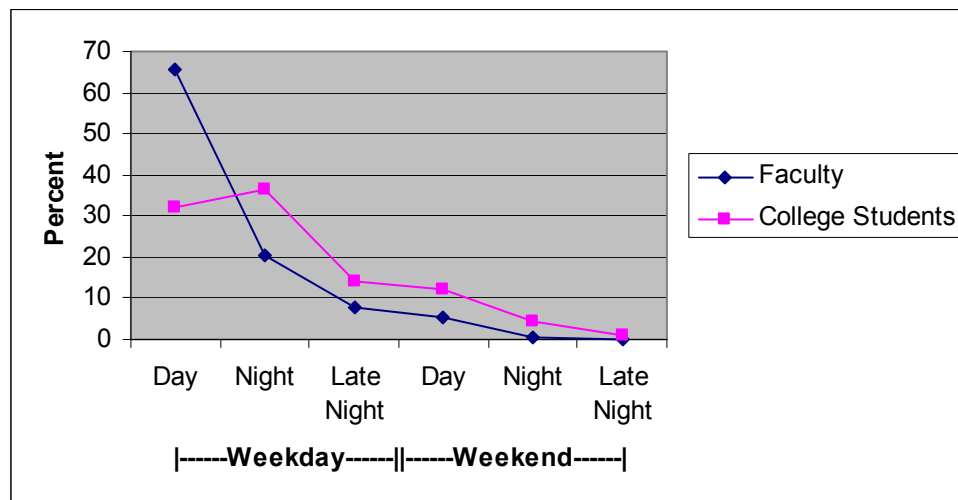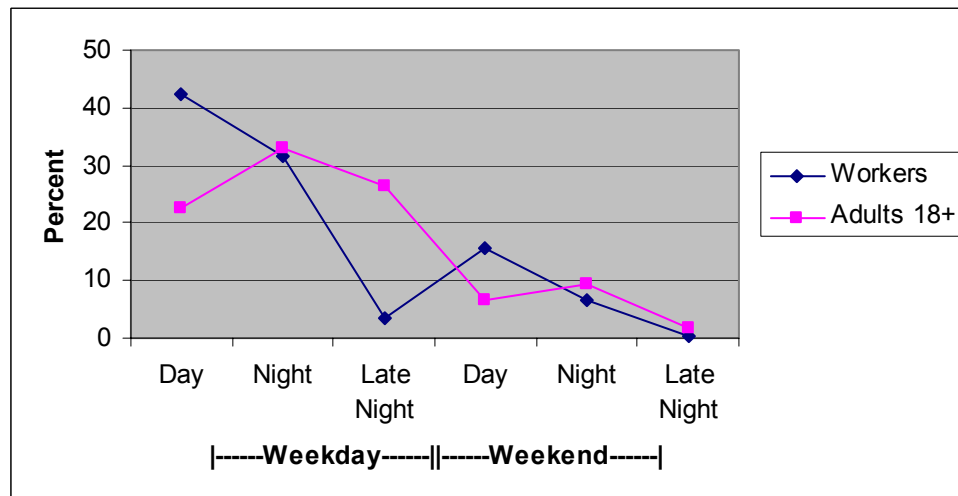

Exhibit 15. Timing of successful refusal conversions for longitudinal studies.

Overall, the two most successful time periods for refusal conversions are weekday nights and weekday days (see Exhibit 16). Faculty and worker samples both had more successful refusal conversions during weekday days while all other populations have more successful refusal conversions during weekday nights. Weekday late nights and weekend days are successful time periods for refusal conversions at differing levels for different populations, however these are the third and fourth next most successful time periods for refusal conversions. The ability to change the delays on initial refusal cases throughout data collection is important for ongoing sample management. In addition, being able to auto-deliver a case during a different day and time period than the initial refusal can be very beneficial to studies. The impact of changing refusal delays needs further investigation in the survey research literature.

Exhibit 16. Timing of successful refusal conversions for all studies.
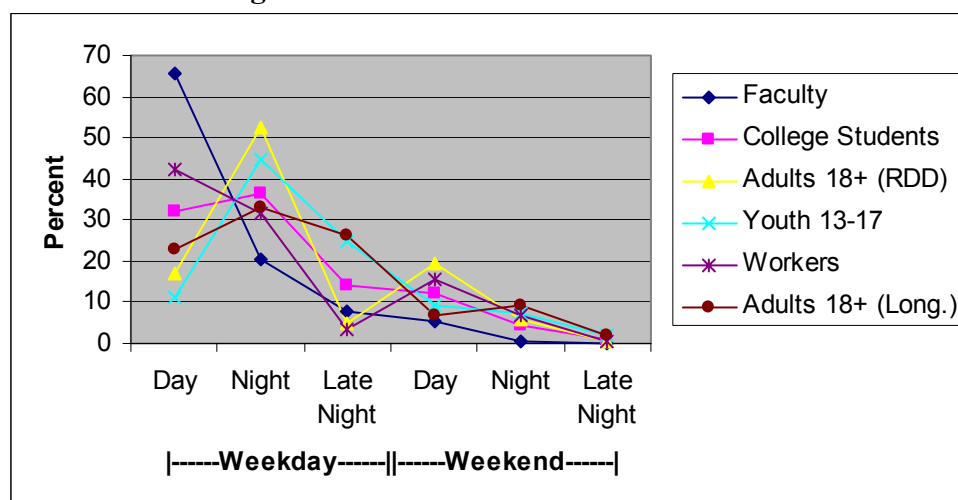
Matches. We compared the time/day of baseline completion to time/day of completion for follow-up waves for two longitudinal studies. We believed that more follow-up completions would be made during the same time/day as baseline interviews. We report results in terms of percent of completions that matched time/day between baseline and follow-up for three different time periods: match time of week, match exact day of week, and match interviewer shift.

The timing of first contacts for longitudinal cases can be regulated by multiple call scheduler features including restricted calling hours and time slots to ensure that the first few call attempts are made at specific times. It is important to utilize the information about day and time of complete for baseline interview in follow-up data collection efforts.

Over 70 percent of interviews at 12 months and 24 months were completed during the same time of week (weekday versus weekend) compared to the time of week of the original interview for workers (see Exhibit 17). However, only 19 percent (each) of interviews at 12 months and 24 months were completed on the same day of the week as the original interview. Just over 60 percent of completed interviews at 12 months and 55 percent of completed interviews at 24 months were completed during the same interviewing shift as the original interview.

For adults, over three calendar quarters of data collection between 60 and 69 percent of follow-up interviews were completed during the same weekday versus weekend time period as the original interview (see Exhibit 18). Similar to workers, specific day of the week matches were much lower (in the range of 15 to 21 percent). Between 43 and 46 percent of follow-up interviews in all three quarters were completed during the same time shift as were the original interviews.

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Exhibit 17. Time/date matching of completed interviews from baseline to follow-up interviews for workers.
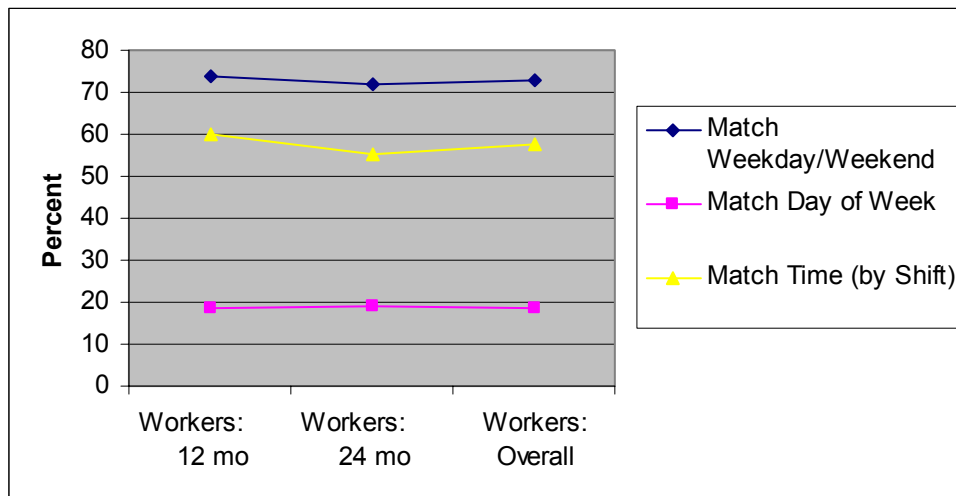
Exhibit 18. Time/date matching of completed interviews from baseline to follow-up interviews for adults.
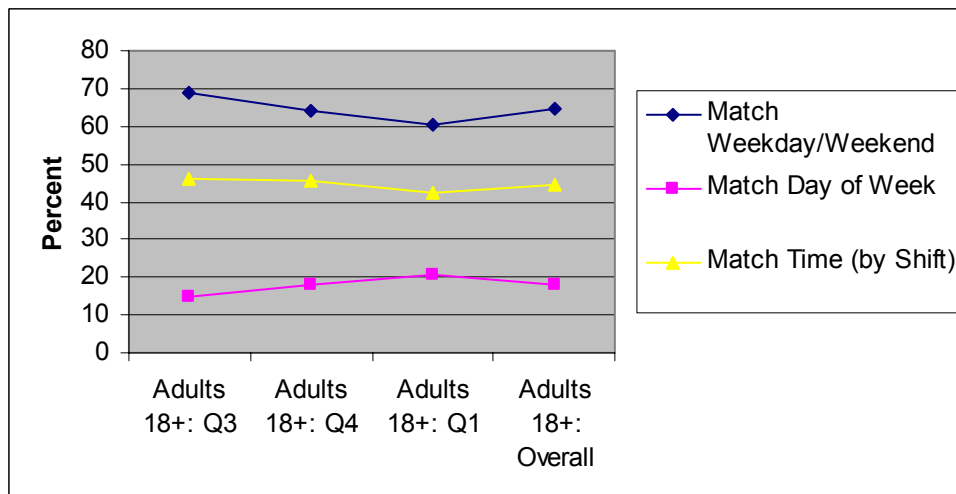
Clearly, for both populations it is advisable to make attempts for follow-up studies during the same time of the week (weekday versus weekends) and same time of day (day, night, late night) as the original completed interviews. At least 60 percent of all follow-up interviews were completed during the same time of the week and at least 40 percent of all follow-up interviews were completed during the same shift as the baseline interview. Matching follow-up calls for the exact day of week is much less effective than focusing on time of week. This data provides support for the idea that it is advisable to utilize the call scheduler to restrict initial attempts on follow-up studies to the time/day of baseline completed interviews.

Discussion

Much of the past research on best times to contact sample members has focused on RDD studies with little attention paid to optimal contact times for other populations. Our analysis reported on best times for first contact, all contacts, completing interviews, and successful refusal conversion for three sample types: RDD, list, and longitudinal. We found that for all types of contacts (first, all contacts, completed interviews, and refusal conversions) the best time periods for contacting all populations were weekday nights and weekday days.

Weekend days were the third most successful time period for first and all contacts; whereas for some populations, weekday late nights were also important. For example, studies of college students will benefit from attempts during weekday late nights since a reasonable percentage of all completed interviews occur during this time period. Also, staffing patterns for studies of youths need to focus more on weekday days at first (to gain parent permission), then shift to weekday nights and weekday late nights when attempting to complete interviews and refusal conversions with the youth themselves.

While there are time periods that are clearly more productive than others, we cannot discount the impact of the remaining time periods. These other time periods contribute between 4 and 23 percent of all contacts, completed interviews, and refusal conversions. For example, for youth completed interviews, youth all contacts, and adult longitudinal completed interviews, we would miss up to 23 percent of the contacts if we only focused on the three most productive time periods for contacting sample members.

It is imperative that survey practitioners pay attention to the timing of contacts, completions, and refusal conversions throughout the data collection period in order to adjust staffing levels and interview schedules as necessary. It is also important for researchers to be aware of the features available on the all scheduler their organization is using and to know how changes to the features can impact call outcomes, and hence the success of their study.

We also investigated whether the timing of calls for follow-up studies would benefit from being made at the same time as the initial interview was completed. We found that for both workers and adults it is efficient to make follow-up calls during the same time of the week (weekday versus weekend) and shift (day versus night). In order to make the most effective use of survey resources, it is important to make the first few attempts for follow-up studies during the same time of week and shift as the initial completed interview.

We plan to extend our work to include exact day of contact, as well as hour of contact and impact of staffing levels on call outcomes. The field would benefit from future research focusing on targeted sub-populations rather than just RDD populations, as well as more experiments. More attention should be paid to the potential difference in contact times/days for different demographic groups, as well as the best time to contact different populations (a la Weeks). Finally, a more in-depth discussion of key or essential features of call scheduler systems and how these features can be modified or adjusted for various populations would be useful.

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Appendix A

Table A1. First contacts by time of day /day of week for all sample types.

First Contact	Faculty		College Students		Adults 18+		Youth 13-17		Workers		Adults 18+	
	n	%	n	%	n	%	n	%	n	%	n	%
Weekday Day	5,277	62.43	12,582	44.62	2,171	14.9	1,084	36.34	2,254	47.64	286	24.74
Weekday Night	1,740	20.58	6,779	24.04	9,484	65.09	856	28.7	1,862	34.73	555	48.01
Weekday Late Night	393	4.65	1,826	6.48	106	0.73	286	9.59	225	4.2	110	9.52
Weekend Day	812	9.61	5,744	20.37	2,219	15.23	463	15.52	597	11.14	143	12.37
Weekend Night	207	2.45	1,200	4.26	582	3.99	247	8.28	123	2.29	62	5.36
Weekend Late Night	24	0.28	67	0.24	8	0.05	47	1.58	-	0	-	0
Total	8,453	100	28,198	100.01	14,570	99.99	2,983	100.01	5,061	100	1,156	100

Table A2. All contacts by time of day /day of week for all sample types.

All Contacts	Faculty		College Students		Adults 18+		Youth 13-17		Workers		Adults 18+	
	n	%	n	%	n	%	n	%	n	%	n	%
Weekday Day	41,499	60.07	150,052	35.94	25,551	21.36	3,039	18.46	37,246	45.65	2,263	20.09
Weekday Night	17,313	25.06	137,851	33.02	62,659	52.38	7,210	43.79	27,164	33.29	5,109	45.36
Weekday Late Night	3,532	5.11	45,085	10.8	1,209	1.01	2,111	12.82	1,277	1.57	1,223	10.86
Weekend Day	5,072	7.34	63,518	15.21	23,251	19.44	2,397	14.56	12,026	14.74	1,681	14.92
Weekend Night	1,459	2.11	17,913	4.29	6,900	5.77	1,450	8.81	3,695	4.53	937	8.32
Weekend Late Night	204	0.3	3,110	0.74	44	0.04	258	1.57	180	0.22	50	0.44
Total	69,079	99.99	417,529	100	119,614	100	16,465	100.01	81,588	100	11,263	99.99

Table A3. Completed interviews by time of day /day of week for all sample types.

Completed Interviews	Faculty		College Students		Adults 18+		Youth 13-17		Workers		Adults 18+	
	n	%	n	%	n	%	n	%	n	%	n	%
Weekday Day	3,555	56.52	9,896	30.71	1,128	18.39	145	10.27	5,601	38.91	190	16.71
Weekday Night	1,622	25.79	11,026	34.22	3,180	51.85	598	42.35	5,215	36.23	447	39.31
Weekday Late Night	530	8.43	4,992	15.49	291	4.74	334	23.65	357	2.48	233	20.49
Weekend Day	405	6.44	4,339	13.47	1,132	18.46	165	11.69	2,268	15.76	155	13.63
Weekend Night	147	2.34	1,611	5	383	6.24	135	9.56	900	6.25	96	8.44
Weekend Late Night	31	0.49	360	1.12	19	0.31	35	2.48	54	0.38	16	1.41
Total	6,290	100.01	32,224	100.01	6,133	99.99	1,412	100	14,395	100.01	1,137	99.99

Table A4. Refusal conversions by time of day /day of week for all sample types.

Refusal Conversions	Faculty		College Students		Adults 18+		Youth 13-17		Workers		Adults 18+	
	n	%	n	%	n	%	n	%	n	%	n	%
Weekday Day	106	65.43	1,451	32.11	274	16.85	38	11.41	396	42.26	24	22.64
Weekday Night	33	20.37	1,643	36.36	854	52.52	149	44.74	297	31.7	35	33.02
Weekday Late Night	13	8.02	639	14.14	79	4.86	83	24.93	33	3.52	28	26.42
Weekend Day	9	5.56	539	11.93	318	19.56	31	9.31	145	15.47	7	6.6
Weekend Night	1	0.62	202	4.47	95	5.84	25	7.51	63	6.72	10	9.43
Weekend Late Night	-	0	45	1	6	0.37	7	2.1	3	0.32	2	1.8
Total	162	100	4,519	100.01	1,626	100	333	100	937	99.99	106	99.91

Table A5. Time of day/day of week matches for workers.

	Workers: 12 mo fu		Workers: 24 mo fu	
Match Weekday/Weekend	3113	73.98	2452	71.89
Match Day of Week	779	18.57	649	19.03
Match Time (by Shift)	2532	60.17	1889	55.38

Table A6. Time of day/day of week matches for adults 18 and over.

	Adults 18+: Q3		Adults 18+: Q4		Adults 18+: Q1		Adults 18+: Overall	
Match Weekday/Weekend	134	68.72	154	64.17	123	60.29	411	50.74
Match Day of Week	29	14.87	43	17.92	42	20.59	114	14.07
Match Time (by Shift)	90	46.15	109	45.42	86	42.46	285	35.19

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