Analysis of Call Patterns in a Large Random-Digit Dialing Survey

The National Immunization Survey

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Some Background on the NIS

Design of the NIS

- 78 Geographic Areas (50 States, 28 Metropolitan Areas)
- About 1.9 Million Fielded RDD Phone Lines Per Year
- Over 10 million call attempts per year
- About 1 million resolved HH's per year
- 35,500 RDD Interviews per Year
- Provider Record Check Study

Flowchart of RDD Process

(next slide)

```
┌─────────────────┐        ┌─────────────────────┐
│ Field Sampled   │        │      Resolve        │
│ Telephone       │───────▶│  Telephone Nos.     │
│ Numbers to CATI │        │  as Residential/    │
│                 │        │  Non-Residential/   │
│                 │        │  Non-working        │
└─────────────────┘        └─────────────────────┘
                                      │
                                      ▼
                                  ╱───────╲
                                 ╱ Household?╲───No──▶  ( Case Finalized )
                                 ╲         ╱
                                  ╲───────╱
                                      │
                                     Yes
                                      │
                                      ▼
                              ┌─────────────────┐
                              │   Screen for    │
                              │ Eligibility: 19-│
                              │ 35-month-old    │
                              │   child in HH   │
                              └─────────────────┘
                                      │
                                      ▼
                                  ╱───────╲
                                 ╱ Eligible ╲
                                 ╱   for     ╲──No──▶  ( Case Finalized )
                                 ╲ Interview? ╱
                                  ╲───────╱
                                      │
                                     Yes
                                      │
                                      ▼
                              ┌─────────────────┐
                              │   Administer    │
                              │  Immunization   │
                              │   Interview     │
                              └─────────────────┘
```
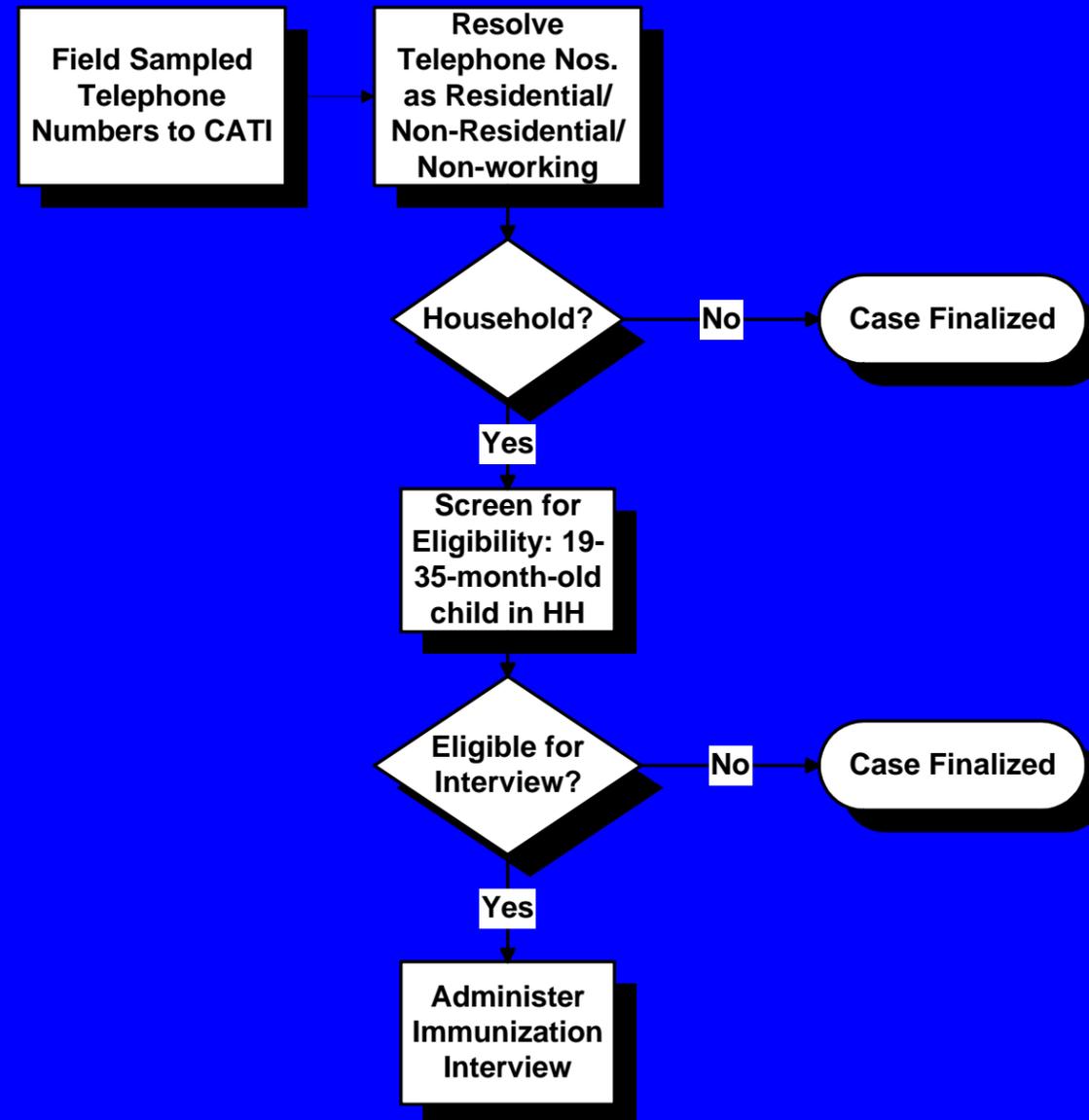
Note on Distribution of RDD Call Attempts

- Mean number of call attempts:
  - 4.95 calls per fielded case
  - 3.1 calls to contact a household
  - 3.4 calls to complete an eligibility screen
  - 5.6 calls to obtain an interview
- By the 5th call attempt, 69% of interviews are completed; by 10th attempt, 86%; by 25th, 97.6% of interviews are completed.

Source: NIS Q4/1996-Q3/1997 data.

Call Pattern Concepts

Subject of the Inquiry

- Call patterning involves scheduling call attempts according to a predetermined sequence (which may be disrupted by the setting of appointments, by refusals, etc.)

  Example of call patterning: Four of the first five call attempts scheduled for Monday-Thursday evenings; one of the first five for Monday-Thursday afternoons.

- Call patterns may also be conditioned on demographic information at the level of the telephone exchange.

What Is Optimal Call Patterning?

- The definition may depend on what is being optimized. Examples:
    - Optimize on household contact rate by Y call call attempts
    - Optimize on overall (CASRO) response rate (e.g., for low-eligibility-rate studies) by Y call attempts

Definition of Optimal Call Pattern

A call pattern that results in the highest response rate against the number of call attempts, given resource constraints and response-rate goals.

Other things being constant, it's optimal to use call patterns that result in the best response rates and the lowest costs.

Approach to Optimization

Examination of:

- First-dial household contact and response rates
- Three-dial call patterns maximizing resolution rate
- Three-dial call patterns maximizing household contact rate
- First-dial rates by Metropolitan status and median household income of the telephone exchange

Previous Research on Optimal Call Patterns

- Massey (1996): His research on NIS call patterns led to present NIS CATI scheduler and observed call patterns in data

- Kulka and Weeks (1988): 190K RDD sampled phone numbers, conditional probability approach, weekday evenings had best contact rates on first call and second call attempts, except when first call is also made during weekday evenings

Definitions: First-Dial Resolution and Contact Rates

- Resolution Rate =

$$\frac{\text{Number of Cases Resolved as Households, Business or Non-working}}{\text{Number of Cases Fielded}}$$

- Household Contact Rate =

$$\frac{\text{Number of Cases Resolved As Households by Speaking with Adult HH member}}{\text{Number of Cases Fielded}}$$

Three-Dial Resolution Rate Calculation

Call 1 at Day/Time A

Call 2 at Day/Time B (of those numbers not resolved at call 1, called here)

Call 3 at Day/Time C (of those numbers not resolved at call 2, called here)

Number of Cases resolved=

- actual number resolved at Call 1

- plus projected number resolved at Call 2 (product of resolution rate at call 2 and number of unresolved cases after call 1)

- plus projected number resolved at Call 3 (product of resolution rate at call 3 and number of unresolved cases after call 2)

Recent NIS Research on Optimal Call Patterns

Data Sources

- Electronic record of calls (for all call attempts) for Q4/1996-Q3/1997 NIS

- Updated 1990 Census data mapped to the telephone exchange of sampled telephone numbers

Sample Sizes for the Analyses

- 1.7 million fielded phone numbers

- 9.5 million call records

- 44,000 sampled telephone exchanges

- 104 3-dial call patterns with at least 1,000 unresolved cases after the third call attempt (mean unresolved=2,529; range 1,000-16,390)

- 122 3-dial call patterns with at least 1,000 uncontacted cases after the third call attempt

Results on Time and Day First-Dial Attempt Rates

RESPONDENT LOCAL TIME	SUN	MON	TUE	WED	THU	FRI	SAT
9AM-NOON							
NOON-4PM							
4PM-6PM							
6PM-9PM							

Excluded because of small sample size are 9am-12 noon, Friday noon-6pm, and Sunday 4pm-6pm. Dialing occurred 9am-9pm respondent local time, seven days a week (except for major holidays).

First-Dial Rates for Resolution, HH Contact, and CASRO Response

Note: The results are based on 18 time/day cells. Excluded because of small sample size are 9am-12 noon, Friday noon-6pm, and Sunday 4pm-6pm.

First-Dial HH Contact Rate

	🟨	🟥	🟥	🟥	🟥		🟥
		🟨	🟨	🟨	🟨		🟨
	🟩	🟩	🟩	🟩	🟩	🟨	🟨

LOW	🟥	19.7%-23.9%
MEDIUM	🟨	25.0%-26.8%
HIGH	🟩	27.2%-30.0%
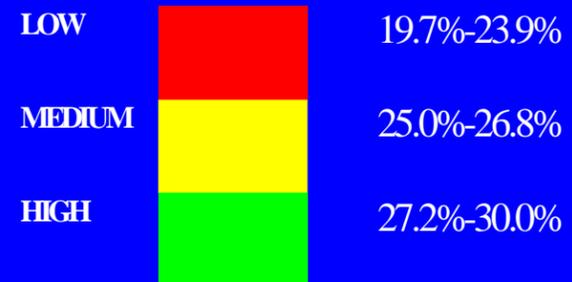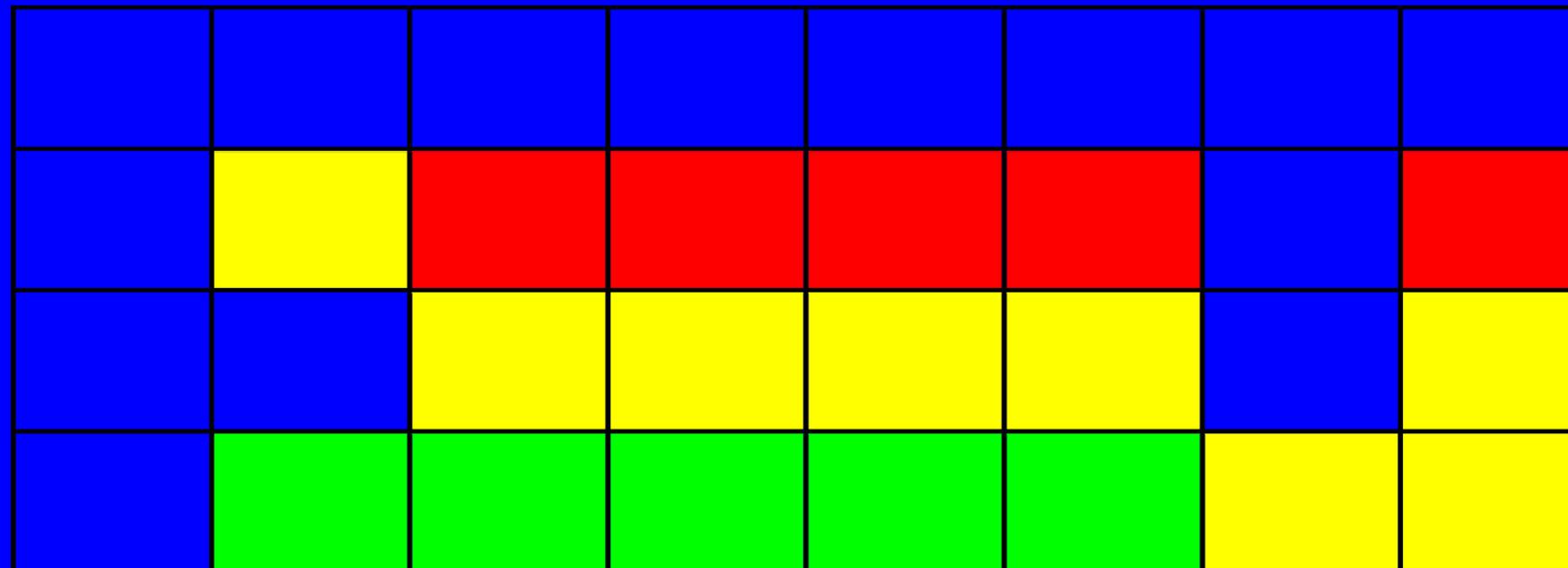
HH Contact Rate = Percent of sample where adult household member is contacted (no answering machines)

First-Dial CASRO Response Rate

LOW		20.6%-24.8%
MEDIUM		25.2%-26.1%
HIGH		26.3%-27.6%

CASRO Response Rate = resolution rate x screener completion rate x interview completion rate

A Call Pattern That Is Good for HH Contact May Not be Good for the Response Rate (and Vice Versa)

- Tuesday late afternoon

- Friday night

- Saturday afternoon

(See next slide for contrast)

First-Dial Contact and CASRO Differences

	HH Contact Rate (%) Mean=25.0	CASRO Rate (%) Mean=25.1
Tuesday 4-6pm	25.1 (rank 11)	26.5 (rank 5)
Friday 6-9pm	26.8 (rank 8)	24.3 (rank 13)
Saturday 4pm - 6pm	25.4 (rank 9)	20.6 (rank 18)

Note: There are 18 time/day cells. Excluded because of small sample size are 9am-12 noon, Friday noon-6pm, and Sunday 4pm-6pm.

Results on Resolution Rate:
3-Dial Call Patterns

Resolving Cases as Household / Non-Residential / Non-Working

Resolution Rate and Number of Dial Attempts: 104 3-Dial Call Patterns

Statistic	Resolution Rate By 3rd Dial Attempt (%)	Mean Number of Dial Attempts in Call Pattern [1]
Mean	66.6	1.61
Std. Dev.	2	0.04
Range	62 - 70	1.52 - 1.71

[1] Number of dial attempts on unresolved sample for calls 1-3 divided by number of cases at call 1.
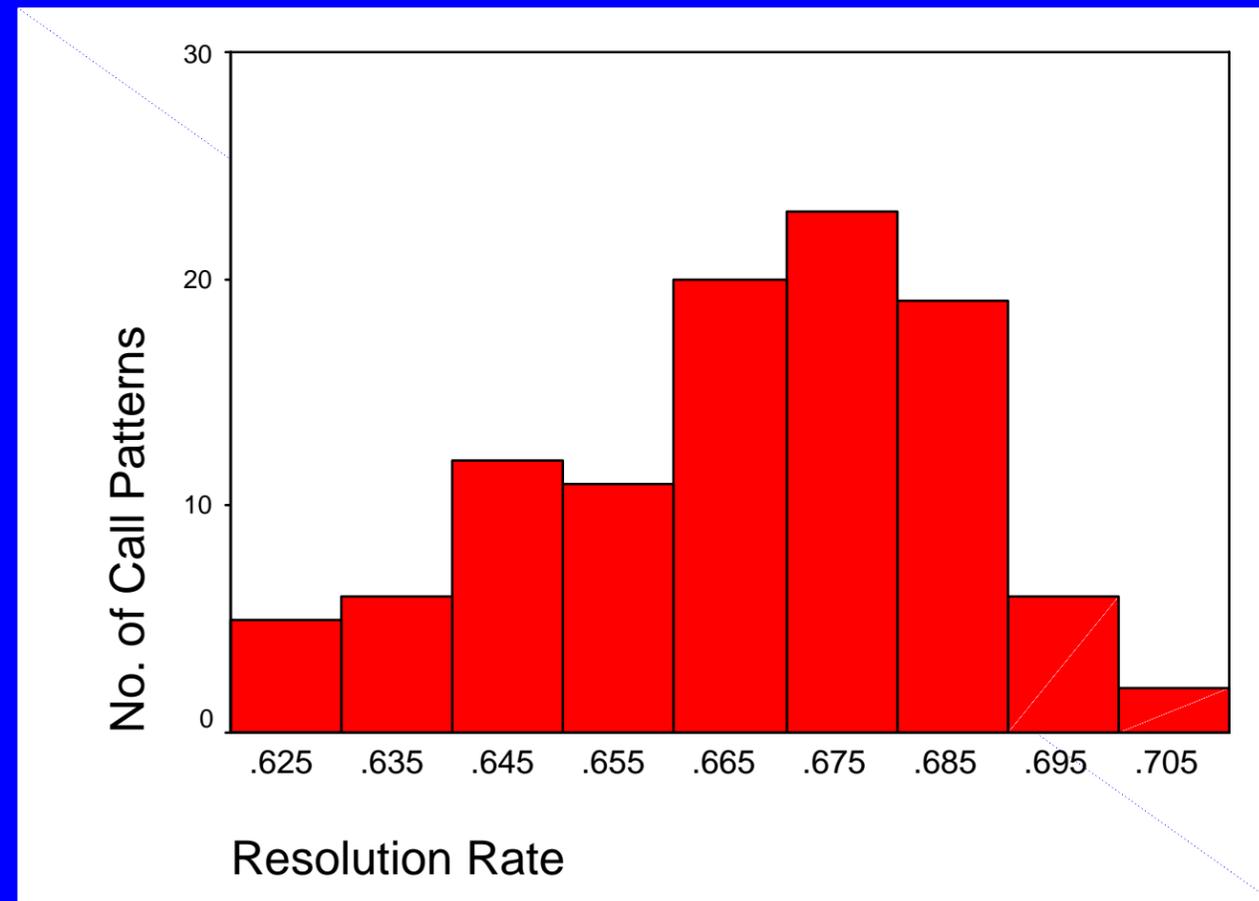
3-Dial Resolution Rates by Average Number of Dial Attempts
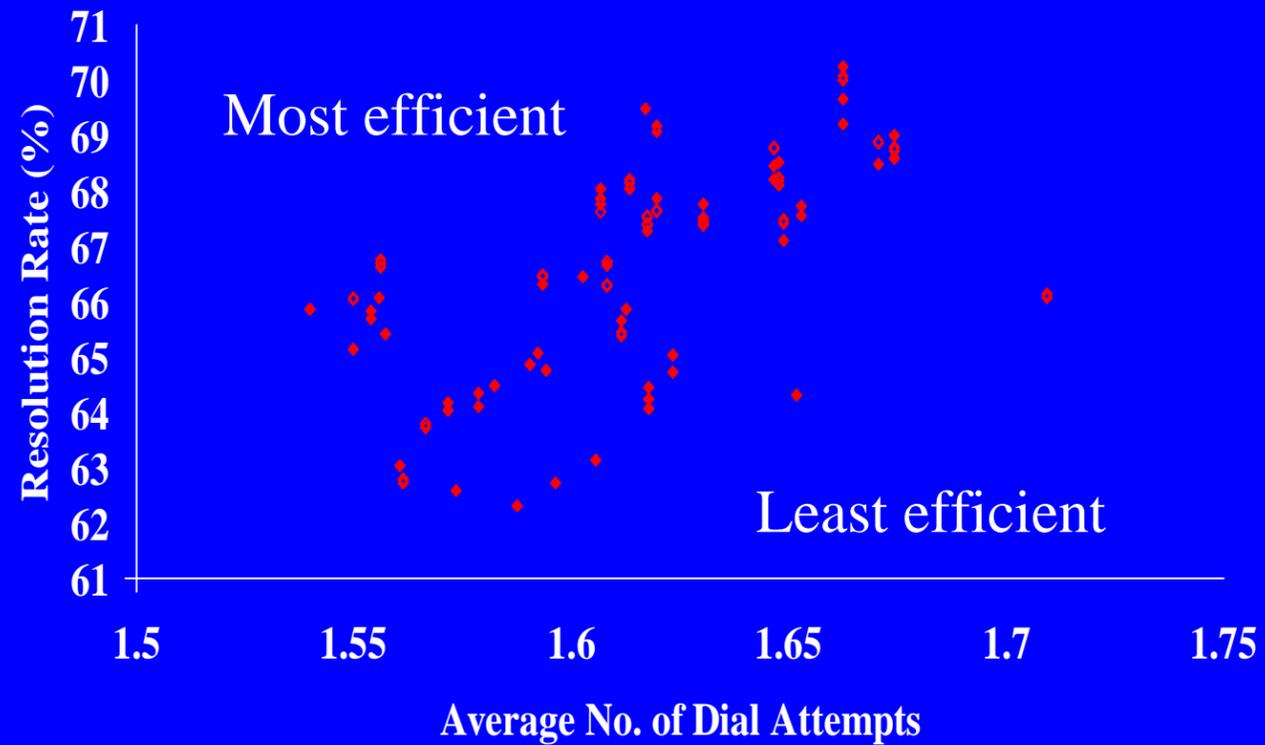
Results on Household Contact Rate

Household Contact Rates and Number of Dial Attempts: 122 3-Dial Call Patterns

[1] Number of dial attempts on uncontacted sample for calls 1-3 divided by number of cases at call 1.

Top 5 3-Dial Call Patterns: Ranked by HH Contact Yield

[1]Yield is 100 times the household contact rate by the third call attempt divided by the mean number of call attempts made to uncontacted sample on call attempts 1-3.

Monday-Thursday First-Dial Household Contact Rates by Metropolitan Status
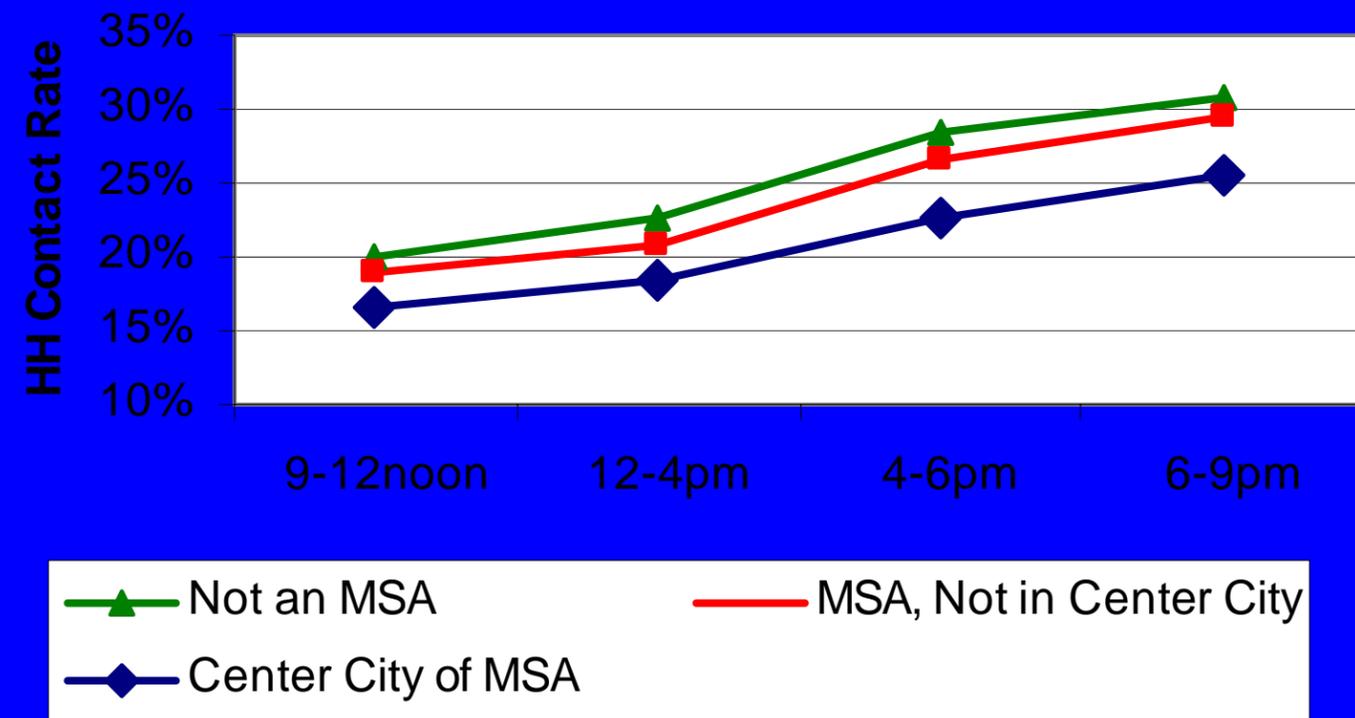
Saturday-Sunday First-Dial Household Contact Rates by Metropolitan Status
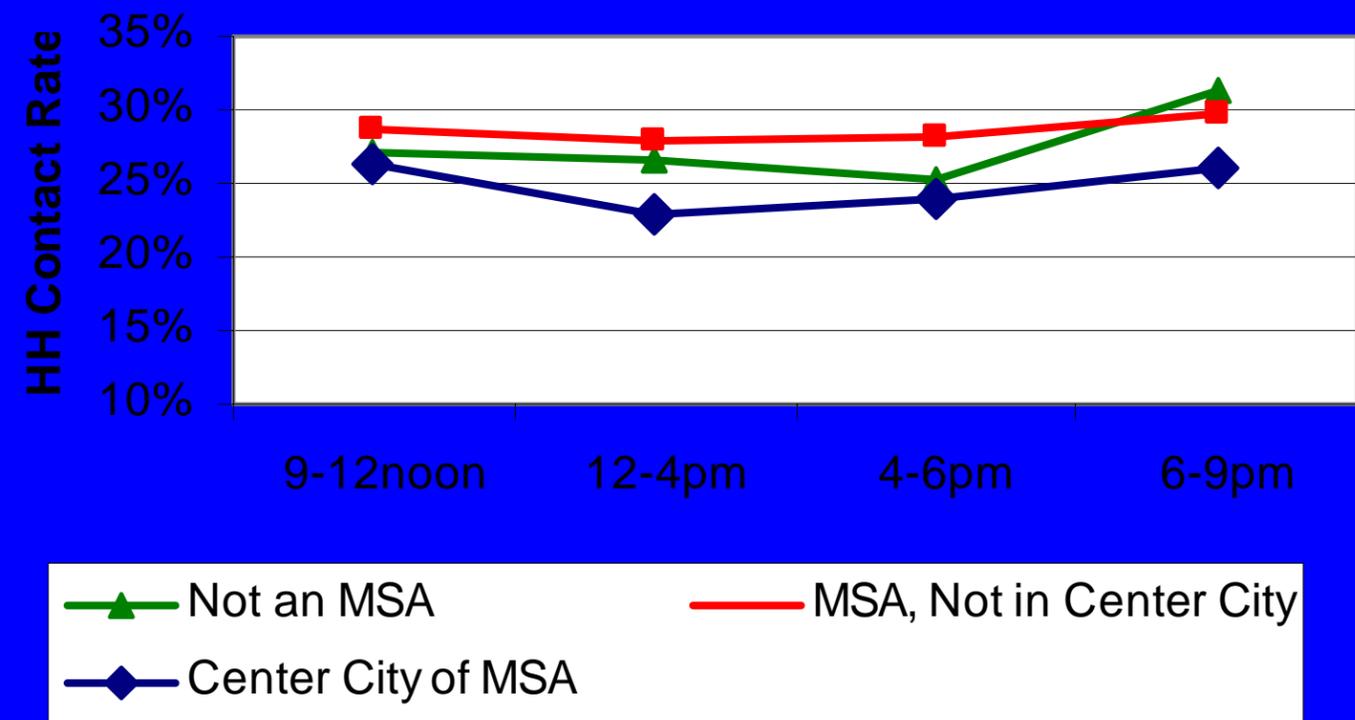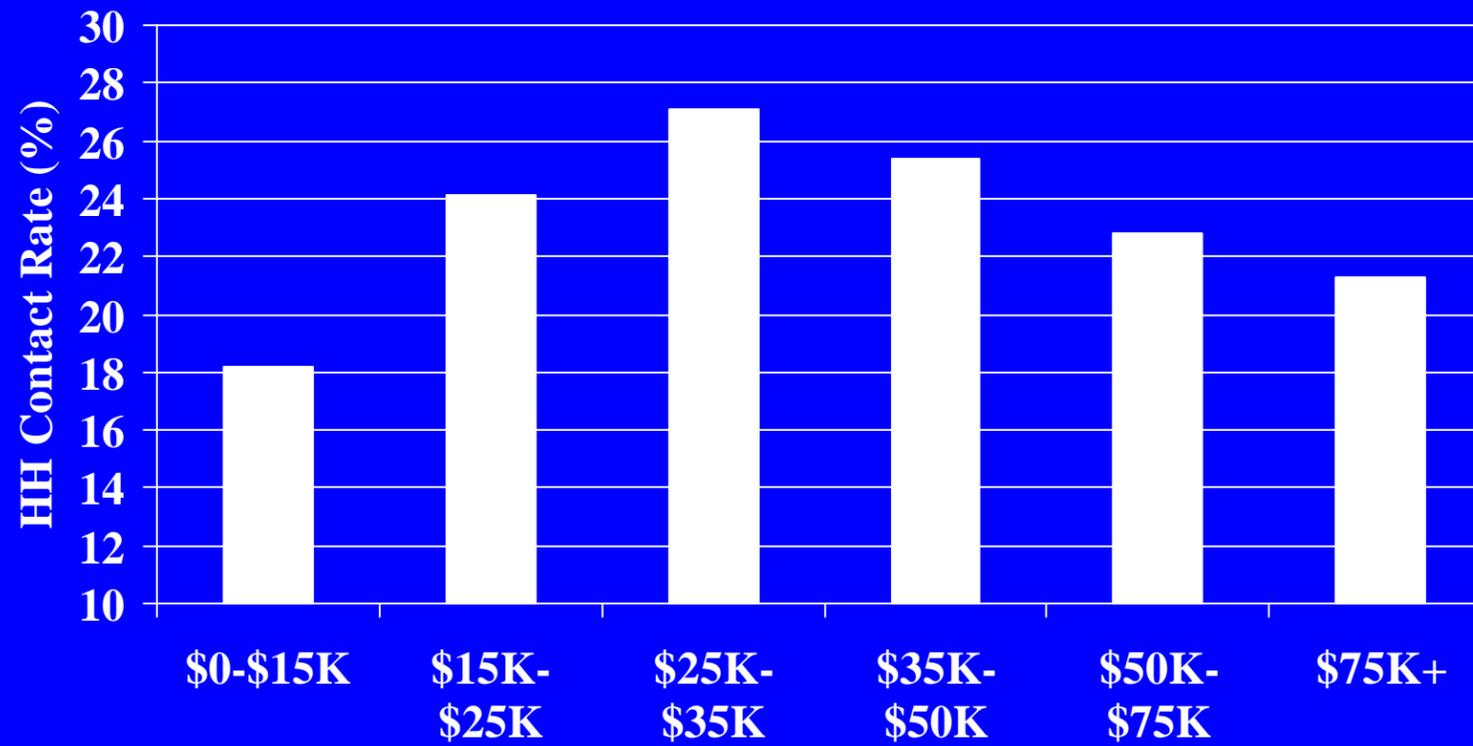
Monday-Thursday First-Dial Household Contact Rates by Selected Median Income Ranges
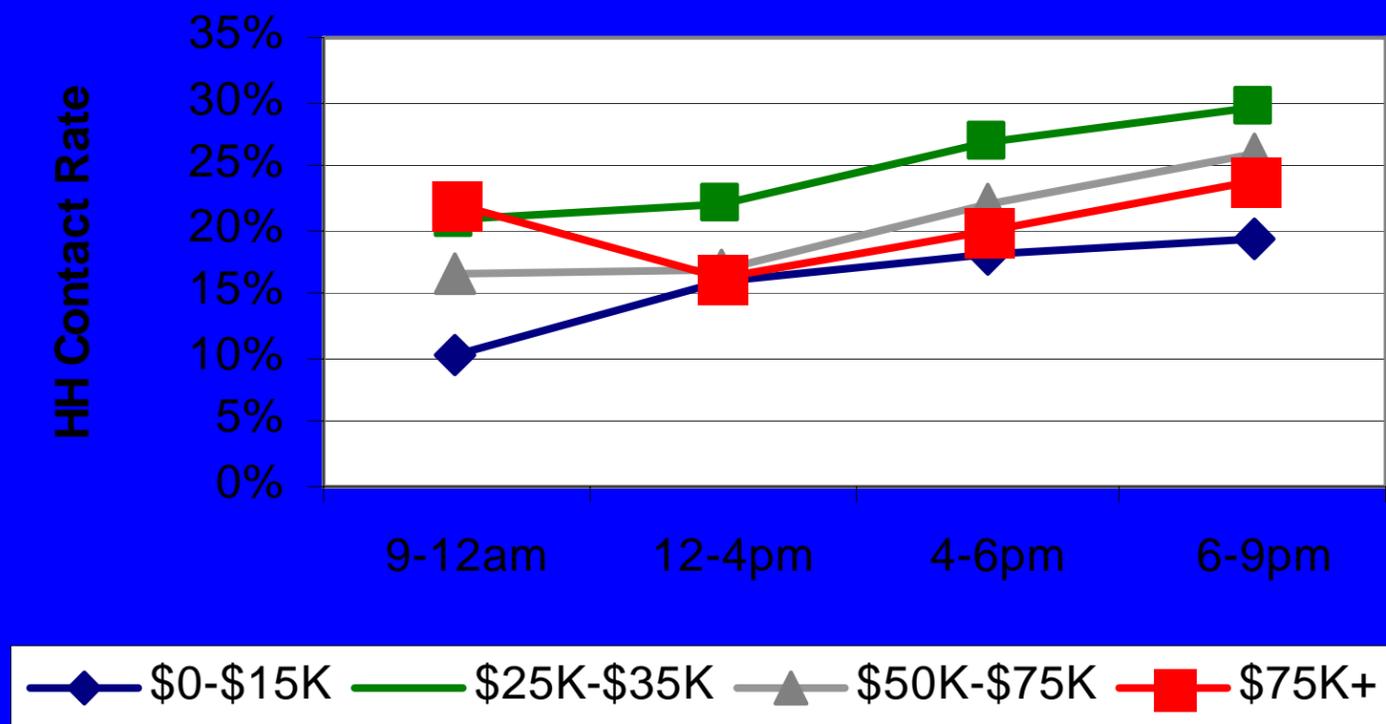
Summary of Major Results

3-Dial Calling Patterns Optimal for Resolution and HH Contact Rates

- Call attempt 1 on Sunday-Thursday evening (6pm-9pm)
- Call attempt 2 on the late afternoon (4pm-6pm) of the following day
- Call attempt 3 the evening of the second call attempt (6pm-9pm)

Counterintuitive?

Making two or three call attempts on consecutive weekday evenings did worse than making the second or third attempt on an afternoon or a late afternoon.

Demographically Speaking

- Urban/Rural: Highest contact rates on the first dial attempt were in nonMSA areas, with the lowest contact rate belonging to the Central Cities of MSAs.

- Income: Exchanges with a median annual income of less than $15,000 have the lowest single-dial contact rate at 18.2%, compared to a high of 27.1% for areas in the range of $25,000-$35,000.

Conclusion

A CATI call scheduler based on analyses of calling patterns has the potential to reduce the costs of an RDD survey while maintaining a high response rate.