PROCESSES USED IN THE FORMULATION OF BEHAVIORAL FREQUENCY REPORTS IN SURVEYS

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ABSTRACT

Previous conceptualizations of the response formulation process for behavioral frequency questions in surveys have presumed that respondents recall and enumerate behavioral episodes and that response errors (for non-threatening questions) primarily result from episode omission and telescoping. The results of three studies indicate that a variety of processes are used to estimate frequency and that the processes used are affected by task conditions. The results suggest that episodic enumeration may rarely be used for high frequency behaviors such as many product purchase or usage behaviors. The relationships between task conditions, response formulation processes, and several measures of response accuracy also are presented.

INTRODUCTION

Information on behavioral frequency is often desired by consumer researchers. Marketers measure the frequency of product purchase or usage and identify demographic, attitudinal, and media usage correlates of frequency. This information is used in making decisions such as target market or advertising media selection. Similarly, a wide variety of social scientists, including psychologists, sociologists, and political scientists, are interested in the measurement of behavioral frequency (e.g., frequency of voting, drug and alcohol consumption, use of public transportation) to guide important policy decisions.

The most common method of measuring behavioral frequency is via survey questions. Because important decisions often depend on the quality of responses to these questions, it is important to understand how survey respondents formulate answers to behavioral frequency questions and how these responses can be made more accurate. This paper presents an overview of three studies which address the following questions:

(1) What cognitive processes are used by respondents in formulating answers to behavioral frequency questions?
(2) Do task manipulations have an effect upon the peocesses used to formulate responses?
(3) How are task manipulations and processes used in response formulation related to the accuracy of response?

BACKGROUND

Survey methodologists interested in measures of behavioral frequency traditionally have assumed that a single response formulation process, episodic recall and enumeration of events, is used. Because the process has been taken as fixed, research has focused on task, respondent, and interviewer variables and their direct relationships with response accuracy. In a review of this literature, Sudman and Bradburn (1974) concluded that task variables have the greatest impact on response accuracy.

Sudman and Bradburn make a distinction between threatening and non-threatening behavioral questions in their discussion of response accuracy. Threatening questions concern anxiety arousing behaviors that are illegal or contranormative (e.g., use of illegal drugs), behaviors generally not discussed without tension (e.g., masturbation), and questions concerning socially desirable behaviors (e.g., voting). Efforts to improve response accuracy for threatening questions have drawn from a social motivational model in which researchers create or strengthen motives toward accuracy and/or remove or reduce motives against accuracy.

Unlike threatening questions (for which respondent motivation has been considered the primary problem), memory errors have been viewed as the greatest threat to accurate reporting for non-threatening behavioral questions. Sudman and Bradburn (1974) identify the two primary sources of memory errors as omission and telescoping. Omission occurs when a respondent fails to recall an event and telescoping involves the misplacement of an event in time. Methods recommended for reducing errors of omission and telescoping include aided recall (Sudman and Bradburn 1974), diaries (Wind and Lerner 1979), the use of records, and bounded recall (Neter and Waksburg 1964).

The focus on errors of omission and telescoping presumes that respondents use episodic memory to recall and enumerate behavioral events. However, this presumption seems unjustified. If you conduct the mental exercise of enumerating how many times you have dined at any type of restaurant in the past month, you will see that this process is likely to be beyond the ability and patience of most survey respondents. One can envision non-enumerative processes that seem more likely to occur in given situations.

This research rejects the presumption that episodic enumeration always is used by survey respondents to estimate behavioral frequency. We accept episodic enumeration as one possible process, but believe there are others. Specific task conditions are viewed as impacting the process used. For example, it is believed that as the frequency of events increases, the task of retrieving and enumerating events becomes much more difficult, and survey respondents will use other processes for providing estimates of frequency.

What other processes may be used by respondents to estimate frequency? Respondents may base responses on a rate of occurrence in which no specific behavioral episodes are recalled. (For instance, to estimate the number of visits to the supermarket in the past month, the respondent may estimate that two trips a week are made, multiply by four weeks, and report an answer of eight without ever recalling a specific episode.) Some cognitive psychologists believe that frequency information is automatically encoded[1] and that direct estimates of frequency may be retrieved without the recall of specific episodes (Hasher and Zacks 1984); such automatic processing may

underlie rate-based estimates or direct estimates of numbers of events. Respondents also may estimate frequency across subcategorizations of the behavior (Rosch 1975). Frequency estimates within subcategories may be based on recall and enumeration, a rate of occurrence, or a direct estimate and then these estimates may be summed to obtain a total frequency estimate. These other processes for estimating frequency are offered as examples of alternative processes, not as an exhaustive list.

This research investigated the effect of several task variables on the response formulation process and response accuracy of behavioral frequency questions. Task conditions studied include: (1) question time frame, (2) natural frequency of the behavior apart from task manipulations, (3) question wording (whether respondents were asked "how many times" or "how often"), (4) time spent by respondents in formulating responses, and (5) question structure (open or closed-ended frequency questions). Also, a variety of behaviors were measured. These task variables were chosen in preference to other task variables on the bases of the anticipated strength of their effects on dependent variables, previous interest of survey researchers in these variables, and the ease with which the variables may be manipulated by researchers in survey settings. Selected variables were judged superior to alternative task variables based on these criteria. Readers interested in the theoretical rationale for the hypothesized relationships between these task variables, response formulation process, and response accuracy may refer to Burton (1986).

METHOD

This research consists of three experimental studies. The first study was designed to examine the effects of two independent variables, question time frame and question wording, on the processes used to formulate responses and on response format (whether answers to open-ended frequency questions were expressed as a number of events or rate of occurrence). Respondents to a telephone interview reported frequencies of six behaviors and the response formulation process was measured for one of these behaviors, dining at restaurants. A 3 x 2 between subjects design was used in which each respondent received one time frame and question wording treatment for all six behaviors. The three time frames used were two weeks, two months, and six months and the two question wording forms were a "how many times" version and a "how often" version. Sample size was 384 or 64 respondents per cell. All respondents were randomly selected from the telephone directory of a large southwestern city.

The second study focused on the relationship between the length of time used for response formulation, response processes, and response accuracy in a laboratory setting with a self-administered questionnaire. Respondents were given 10, 20, 35, 50, or 70 seconds to answer behavioral frequency questions with a sixth group of respondents allowed to answer at an unspecified rate. Frequencies measured in this study were the number of B grades obtained at the university currently attended by respondents and the number of courses completed at this university but outside the student's own college. Respondents were asked to sign release forms which would allow the researcher to access their academic records. Eighty-one percent of the 163 total respondents signed permission forms; an assessment of response accuracy was made for these 132 respondents. All respondents were junior or senior level business students enrolled in a major southwestern university.

The third study employed a telephone interview to examine the effects of time taken by respondents before answering, question structure, and question time frame on processes used in response formulation and response accuracy. Behavioral frequencies measured in this study included the number of checks written on a respondent's primary checking account and the number of times an automatic teller machine (ATM) was used to withdraw cash. For the behavior of check writing, a 2 x 2 x 2 between subjects design was used with manipulations of question structure (open and closed), response time (manipulated and control), and question time frame (one week and six weeks). For ATM withdrawals, a 2 x 2 between subjects design was employed with manipulations of question structure and response time. Response time was manipulated by reading an instruction which asked respondents to spend at least 15 seconds thinking about the question before answering. (The effectiveness of this manipulation was measured by tape recording the interviews and timing the period from when the interviewer finished asking the question until the time when the respondent began stating the answer. Response latency in the manipulated condition was significantly greater than the control condition; 14.0 seconds versus 4.2 seconds, respectively). Respondents in this study were 160 individuals with checking accounts and ATM cards at a southwestern bank, or 20 respondents per cell in the 2 x 2 x 2 design. Bank records for respondents were used as validating information to obtain a measure of response accuracy.

Response formulation processes were measured in these three studies via immediate retrospective protocols. After a respondent provided a behavioral frequency response, s/he was asked to describe the process used in arriving at the answer. In the first and third studies, probes were used by telephone interviewers to clarify process descriptions.

Immediate retrospective protocols have been recommended when the processing episode is brief (Erikson and Simon 1978), and respondents generally respond within seconds to questions in a telephone interview. In use, the retrospective procedure seemed to work well and provide adequately valid data.

Process protocols were coded independently by two coders in the first and third studies. Twelve processes were observed and coded in the first study and fifteen processes were reported in the third study. Rates of intercoder agreement in assigning protocols to the process categories ranged from 84% to 91% across behaviors; for the reduced set of general categories used for testing hypotheses in Study 1, however, intercoder agreement was over 99%. Coding discrepancies were discussed and resolved by the coders.

The three studies were designed to examine the general research topic in various settings that provide different levels of experimental control and task realism, use different behaviors, and use different respondent samples. Such variance in

methods provides robust information for researchers interested in the process used in frequency estimation in survey settings and the relationship between task conditions, response processes, and response accuracy. Also, several of the hypotheses were tested in more than one study, thereby providing an opportunity to replicate results in different research settings and conditions.

RESULTS

Study 1

Contrary to the idea that respondents estimate behavioral frequencies only through the recall and enumeration of episodic events, results for Study 1 showed that estimates can be based on a variety of processes. Table 1 shows that approximately less than one-third of the respondents (28%) relied primarily on episodic enumeration to estimate the frequency of dining at restaurants, while the majority of respondents based their answers directly on a rate of occurrence.

Results in Table 2 show that as reported frequency increased the percentage of respondents who reported recalling and enumerating events decreased rapidly. Episodic enumeration was reported by 84% of the respondents reporting three or fewer events but by no respondents reporting more than ten events. These data suggest that episodic enumeration is a natural process given a small number of events, but the cognitive demands associated with recall and enumeration of individual events in a survey setting presumably grow very rapidly as frequency increases. Telephone survey respondents seem unwilling (or unable) to expend the effort necessary to recall and enumerate events accurately but wish to comply with the role demands of a survey respondent by providing a response. When the frequency is large (ten events or more), the use of non-episodic processes may allow respondents to provide answers while managing the necessary effort.

Table 3 shows the effects of question time frame and of question wording on response formulation processes. As expected, there is a strong negative relationship between question time frame and reports of episodic enumeration; as time frame increases (lengthens), reports of episodic enumeration decrease. This may occur because a longer time frame (1) increases the number of events and (2) introduces more distant events which may be more difficult to recall than recent events. To evaluate the effects of time frame over and above the associated changes in event frequency, and to evaluate the effects of frequency separate from changes in time frame, logistic regressions were run. Response formulation process was coded as a dummy dependent variable and the number of reported events and time frame (measured in number of weeks) were treated as quantitative predictors. The first regression entered number of events first into the model and then obtained the residual contribution of time frame. This contribution was significant ($\chi^2 = 7.1$, $p < .01$), indicating that time frame effects have some basis other than frequency; presumably temporal distance. The second regression entered time frame first and measured residual contribution of frequency. Again this contribution was significant ($\chi^2 = 103.4$, $p < .001$). These results suggest that the bulk of the time frame effect on process was attributable to the associated increase in the number of events, but a significant (if much smaller) part of the time frame effect cannot be attributed to frequency. The multiple r for the model containging both predictors was .722 ($p < .001$) and the fraction of concordant predictions and actual reported processes was .925.

It also was expected that use of a "how many times" question wording would lead to greater use of recall and enumeration processes than a "how often" wording. Table 3 shows that results were in this hypothesized direction, but not statistically significant.

Analyses comparing response formulation process for the dining at restaurants frequency question with the formats in which responses were given (number of events or rate of occurrence) suggested that response format could be used as a weak indicator of response process. Subsequent analyses of response formats used to report restaurant dining and five other behaviors supported the findings given above; question time frame and number of events have strong effects on response format which survive controls for each other, and question wording has weak effects. Overall use of the rate of occurrence format (a good indicator of rate-based process) across the six behaviors was positively related to the mean frequency of the behavior, and also was especially high for the two most temporally regular behaviors, buying gasoline and viewing a favorite weekly television show.

Study 2

The second study examined behaviors for which record data were available, thus allowing the calculation of response accuracy. This study attempted to extend the findings of Study 1 by investigating the effect of another task variable, time spent in response formulation, on response formulation process and response accuracy.

Table 4 shows the effect of response formulation time on three measures of response accuracy: the mean discrepancy between report and record data, the mean absolute discrepancy, and the correlation between report and record data. (To circumvent problems of heteroskedasticity and non-normality, the groups of respondents given 10 or 20 seconds for response and the groups given 35 or 50 seconds have been combined to create groups of approximately equal sizes with n's greater than 30.) The mean discrepancy is the average across respondents of the differences between report and record data and mean absolute discrepancy is the average of the absolute values of the differences between report and record data.

The most commonly used of these measures is the mean response discrepancy. Table 4 shows that the

70 second group had the mean discrepancy closest to zero, but the differences among groups were not statistically significant. Results suggest that increasing response formulation time may not lead to a more accurate estimate of the population mean.

Researchers desiring to identify the correlates of behavioral frequency are more concerned with the accuracy of responses at the individual level, expressed by mean absolute discrepancies and/or the correlations of report and record data. The mean absolute discrepancies declined as response time increased for both behaviors studied (for timed groups only, B grades, $F = 4.9$, $df = (2108)$, $p < .01$; for courses outside Business, $F = 5.0$, $df = (2,103)$, $p < .01$). The mean absolute error was more than two times as high in the shortest than the longest time condition. Table 4 also shows that the treatment group in which time was not specified had results similar to the treatment group given the shortest response time, suggesting that respondents may answer self-administered questionnaires rapidly at a possible cost to accuracy.

The correlations between report and record data shown in the final column of Table 4 offer further support for the hypothesis that greater response formulation time leads to more accurate reporting. The increase from the shortest to the longest condition is statistically significant for both behaviors (for B's, $Z = 1.9$, $p < .05$; for courses outside Business, $Z = 3.1$, $p < .001$). Again, it is of interest to note that the correlations associated with the unspecified time group are most similar to those of the shortest time condition.

Because the treatment groups were not quite equal in their "true" mean frequencies for the two behaviors studied, hierarchial multiple regressions were used to test whether the effect of response time on absolute response accuracy would survive a control for frequency. The effect did survive for both behaviors.

Table 5 shows that the amount of time respondents used to formulate responses also impacted the reported response formulation processes (pooled χ^2 across behaviors = 24.3, $df = 8$, $p < .01$). As expected, respondents given 10 or 20 seconds were less likely to report recalling and enumerating episodes than were respondents given more time. It is interesting to note that more than two-thirds of the respondents in this study (overall) reported episodic enumeration compared to less than one-third in Study 1. Possible causes of this difference are noted in the Discussion section.

Study 3

Study 3 was a telephone interview which examined the effects of question structure, time frame and response time on response formulation processes and response accuracy. This study tested the generalizability of Study 2 results by examining the ability of the researcher to manipulate response time and assessing its impact on response formulation process and response accuracy in an applied telephone interview setting.

The manipulation of response time had a significant effect on response formulation processes for the behaviors examined in this study (pooled χ^2 = 20.2, $df = 6$, $p < .01$). For check writing, 35% of respondents who were asked to take 15 seconds before answering the frequency question reported episodic enumeration and 23% reported rate-based processes compared with 20% and 10%, respectively, in the control condition. Almost two out of three respondents (63%) in the control condition reported direct estimates of frequency in which neither episodic enumeration or rate-based processes were used. For ATM withdrawals, 37% of the respondents in the manipulated condition reported use of recall and enumeration compared to 25% in the control condition. Contrary to the results for check writing, only one out of eleven respondents (9%) in both control and manipulated conditions reported direct estimates of frequency for ATM withdrawals. Overall (across conditions) the percentage of respondents who reported episodic enumeration was 29% and 32% for the behaviors of check writing and ATM withdrawals, respectively. These results are similar to those of the telephone interview in Study 1 (where 28% reported episodic enumeration of dining events), and again indicate that any conceptualization of response error mechanisms that presumes that respondents always use this process to estimate behavioral frequencies appears incomplete.

The question structure manipulation (use of open versus closed-ended behavioral frequency questions) did not have a significant effect on the reported process for either behavior. The question time frame manipulation (1 week versus 6 weeks) was used only for the check-writing behavior. As in Study 1, and as expected, the shorter time frame led to a greater percentage (51%) of respondents reporting episodic enumeration compared with the longer time frame (9%). The result is shown in Table 6.

Table 6 also offers additional support for the hypothesized negative relationship between reported frequency and use of enumeration-based processes. For both check-writing and ATM withdrawals, more than 85% of the respondents reported episodic enumeration when the reported number of events was two or less, while no respondents indicated enumeration when the reported number of checks exceeded twenty or ATM withdrawals exceeded than six. The decline in usage of episodic enumeration was significant at $p < .001$ for both behaviors for the frequency categorizations shown in Table 6 and across several alternative frequency groupings.

Many respondents reported recalling some specific episodes and then adding a general estimate for episodes not recalled. This process allows the respondent to recall and enumerate some events while presumably managing the required cognitive effort. The process involved in estimating these unretrieved events and the accuracy of these estimates are interesting topics for future research.

Table 7 presents the effects of three task manipulations on the accuracy of response. Question structure did not have a significant effect on the mean response error or the mean absolute response error for either of the behaviors measured. Contrary to the results in Study 2, the manipulation of response time did not significantly improve response accuracy.

DISCUSSION

Results from each of the three studies indicated that a variety of processes are used to formulate responses to behavioral frequency questions in survey settings. This is in contrast to the conventional model of response which presumes a fixed process, recall and enumeration of events, and focuses on errors of telescoping and omission.

These results suggest that a model of response error which presumes episodic recall and focuses on errors of omission and telescoping seems appropriate for measures of low frequency phenomena such as durable goods purchases or measures of other purchase behaviors over very short time frames. Similarly, this conceptualization seems reasonable for measurement of vivid, low frequency behaviors such as crime victimization, hospitalization, and automobile accidents. However, it seems probable that respondents will not use episodic recall for high frequency events such as many product or media usage behaviors, or recall purchase episodes for non-durable goods unless the time frame is extremely short. An alternative model seems needed to understand response errors in frequency data for such behaviors.

Results also revealed that task variables may affect the reported processes. One task characteristic which had a strong impact on the response process was the number of events of interest. When the number of events was low (three or less), the majority of respondents reported enumeration of episodes; as the number number of events grew above three, the percentage reporting enumeration diminished rapidly.

Question wording ("how often" versus "how many times") did not have a significant effect on response formulation processes and question structure did not impact processes or the accuracy of the response. If the results concerning the relationship between question structure and accuracy generalize to other behaviors - and this would be consistent with some previous research - then researchers may prefer using open end behavioral frequency questions. The open question spares the researcher the task of initially designing response categories (when often little is known about the true frequency distribution), allows use of a ratio-scaled frequency variable in analyses, or permits construction of approximately equal categories for analyses from the reported frequency data.

An interesting finding in this research was the discrepancy in results concerning the effect of response time manipulations on response accuracy. Significant effects were found in the laboratory study (Study 2) but not in the telephone survey (Study 3). Some of the possible explanations for this discrepancy include the variation in the manipulation of response time, different modes of questionnaire administration, subject pool differences, and possible differences in task involvement. Another interesting possibility concerns the differences in the behaviors in the two studies. Grades of B and courses outside of Business are fairly vivid, salient events which have occurred over several years for most respondents, whereas check writing and ATM withdrawals are probable less vivid but have occurred more recently. For these less vivid events, one wonders if a time manipulation is less effective than for more vivid events. Given the support for the hypothesized positive relationship between response time and response accuracy (Fitts 1966; Pachella 1974), additional research seems warranted.

A point not mentioned in the Results section is that the size of mean absolute errors was consistent with what has been found by other researchers interested in response accuracy (Marquis et al. 1981)); that is, respondents are not very accurate in their estimates of frequency. Analyses suggest that the relatively large individual level errors often result in attenuation of relationships between frequency and demographic and attitudinal variables and thus may negatively affect business strategy or public policy decisions based on these relationships. The size of the errors underscores the advantage of measuring events at the time they occur rather than using retrospective surveys. Panel diaries and mechanical devices, such as checkout scanners, offer possible alternatives to the retrospective survey for measurement of behavioral frequency. However, because these alternatives are not available for many behaviors and settings and are often quite expensive, the large individual-level errors indicate the importance of further research on survey response.

A number of studies appear of theoretical and practical interest. In an effort to pin down the discrepancy in results in Studies 1 and 2, future studies may investigate the effects of modes of administration and the nature of the behaviors of interest (e.g., vividness, regularity, etc.) on response formulation processes and response quality. Questions concerning respondents' awareness of possible response formulation process for various behaviors and their perceptions of the effort and response accuracy associated with any given process seem of interest. This research demonstrated that task conditions may affect response processes; studies of the effect of other task variables (such as question length, interview length, question context, interviewing setting, and distraction effects) viewed as important in previous conceptualizations seem warranted.

Other studies may be of interest to cognitive psychologists. The degree to which respondents automatically encode the frequency of everyday events (Hasher and Zacks 1984), and the accuracy of responses based on automatically encoded information versus those based on more constructive processes is of concern. The relationship between scores on a national memory inventory that measures differences in individuals' abilities to remember (Tulving and Press 1984) and response quality is a project of substantial interest. Schema theory (Croker 1984) offers a basis for research on estimates of frequencies across subcategories of a behavior of interest. A paucity of previous research, the importance of behavioral frequency questions to a variety of disciplines, and recent interest in cognitive aspects of survey methodology (Jabine et al. 1984) combine to make this area rich in possibilities for future research.

Table 1

Processes Reported in Formulating Responses to the Dining Frequency Question

Reported Process	Number of Respondents	% of Respondents
Processing by enumeration of events	**93**	**28%**
Simple episodic enumeration	91	27
Estimates made separately for subdomains and combined; episodic enumeration for all subdomains	2	1
Processing by rate of occurrence	**186**	**56%**
Simple rate-based estimation (reported directly as a rate or converted to an estimate of absolute frequency)	161	48
Subdomains used; rate processing for all subdomains	25	8
Other processing (excluding simple direct estimates)	**53**	**16%**
Rate reported; final answer adjusted up or down to suit respondents' sense that the rate is slightly too high or low	31	9
Rate derived from enumeration for a shorter time frame	5	2
Rate derived from enumeration, then final answer adjusted	3	1
Subdomains used; at least one subdomain estimated by rate and at least one by enumeration	4	1
Subdomains used; at least one estimated by rate and at least one by direct estimate	5	2
Subdomains used; at least one estimated by enumeration and at least one by direct estimate	1	0
Subdomains used; direct estimates used for all subdomains	4	1
Total retained for subsequent analyses	**332**	**100%**
Simple direct estimate of frequency	**17**	
Zero frequency reported, process not measured	**45**	
Total respondents in study	**384**	

Table 4

The Effect of Response Time on the Accuracy of Behavioral Reports

Time Given	n	Mean Reported Frequency	Mean Recorded Frequency	Mean Raw Discrepancy	Mean Absolute Discrepancy[a]	Correlation of Report and Record Data
Behavior: Number of B Grades						
10-20 seconds	38	8.0	8.6	-0.6	3.7	.69
35-50 seconds	38	6.8	7.6	-0.8	2.2	.80
70 seconds	35	6.3	6.2	+0.1	1.7	.86
Unspecified	17	10.8	9.1	+1.7	4.5	.29
Behavior: Number of Courses Completed Outside the College of Business						
10-20 seconds	35	9.9	12.2	-2.3	6.7	.47
35-50 seconds	36	9.2	12.1	-2.9	3.9	.81
70 seconds	35	9.3	11.1	-1.8	3.2	.86
Unspecified	16	10.6	12.6	-2.0	6.0	.51

[a] For timed groups only - for B grades, $F = 4.9$, $df = (2,108)$, $p < .01$; for courses outside Business, $F = 5.0$, $df = (2,103)$, $p < .01$

Table 2

The Effect of Frequency of Dining at Restaurants on the Response Formulation Process

Frequency of[a] Dining at a Restaurant	n	Response Formulation Process: Recall and Enumeration	Rate-Based	Other	Total %
Total sample	332[b]	28%	56	16	100%
1	12	100%	0	0	100%
2	28	68	32	0	100%
3	29	93	7	0	100%
4-5	40	63	35	2	100%
6-10	53	15	59	26	100%
11-25	58	0	66	34	100%
26-100	86	0	77	23	100%
> 100[c]	26	0	100	0	100%

[a] Chi-square = 231, df = 14, $p < .001$; with "Other" processes eliminated from the analysis = 171, df = 7, $p < .001$

[b] Total n = 332; excludes respondents with zero frequency and those unable to report a process

[c] To 9 at 183; 1 at 366

Table 3

The Effects of Question Form and Time Frame on Response Formulation Processes

	n	Response Formulation Process: Enumeration	Rate	Other	Total %
Total sample	332	28%	56	16	100%
Time Frame[a]					
Two weeks	108	56%	36	8	100%
Two months	108	25%	54	21	100%
Six months	116	4%	76	20	100%
Question Form[b]					
"How many times"	169	30%	51	19	100%
"How often"	163	26%	61	13	100%

[a] Chi-square = 76.1, df = 4, $p < .001$; With "Other" processes eliminated Chi-square = 66.2, df = 2, $p < .001$

[b] Chi-square = 3.9, df = 2, $p < .15$; with "Other" processes eliminated Chi-square = 1.62, df = 1, $p < .25$

Table 5

The Effect of Time on the Processes Reported in Response Formulation

Time[a]	n	Response Process Reported: Recall and Enumeration	Rate-Based	Direct Estimate	Total
Behavior: Number of B's					
10-20 Seconds	45	58%	29	13	(100%)
35-50 Seconds	42	81%	12	7	(100%)
70 Seconds	36	75%	22	3	(100%)
Behavior: Courses Outside College of Business					
10-20 Seconds	33	61%	24	15	(100%)
35-50 Seconds	36	78%	22	—	(100%)
70 Seconds	38	92%	8	—	(100%)

[a] Chi-square pooled across behaviors = 24.3, df = 8, $p < .01$.

Table 6

The Effect of Time Frame and Event Frequency on Reported Use of Recall and Enumeration

	n	Response Formulation Process: Recall and enumeration			Other Processes
Question Time Frame (for check writing)[a]		All events	Some events plus estimate	Total	
Overall	151	15%	14	29	71
1 week	71	30%	21	51	49
6 weeks	80	1%	8	9	91
Reported number of checks[b]					
Overall	151	15%	14	29	71
1-2	14	71%	15	86	14
3-5	24	33%	13	46	54
6-10	38	8%	29	37	63
11-20	32	0%	16	16	84
>20	43	0%	0	0	100
Reported Number of ATM Withdrawals[c]					
Overall	148	30%	2	32	68
1-2	25	88%	-	88	12
3-4	56	27%	4	31	69
5-6	39	15%	5	20	80
>7	28	0%	0	0	100

a Chi-square = 32.5, df = 2, p < .001
b Chi-square = 76.0, df = 8, p < .001
c Chi-square = 59.5, df = 6, p < .001

TABLE 7

The Effect of Response Time, Question Structure, and Time Frame on Response Accuracy

Behavior: Number of Checks Written[a]

	n	Mean Number Checks	Raw Response Error[b]	Mean Absolute Error	Correlation Between Report and Record Data
Total Sample	158	5.4	-0.1	3.1	.34
Question Structure					
Open	80	5.6	-0.1	3.2[c]	.40
Closed	78	5.3	-0.1	3.1	.25
Response Time					
Manipulated	78	5.6	-0.3	2.9[d]	.39
Control	80	5.3	0.1	3.3	.31
Time Frame					
One Week	79	5.7	0.3	3.8[e]	.32
Six Weeks	79	5.2	-0.6	2.5	.38

a Number of checks, mean response error, and absolute value of response error have been divided by six to standardize the time frame
b For all manipulations, F < 1.5, p > .2
c F = 0.3, df = 1,154, p < .90
d F = 0.4, df = 1,154, p < .50
e F = 5.2, df = 1,154, p < .025

Table 7, continued

Behavior: Number of ATM Withdrawals

	n	Mean Number Checks	Raw Response Error[a]	Mean Absolute Error[b]	Correlation Between Report and Record Data
Total sample	158	4.2	0.6	1.8	.67
Question structure					
Open	78	4.3	0.8	1.9	.67
Closed	80	4.1	0.3	1.7	.67
Response Time					
Manipulated	78	4.4	0.5	1.9	.70
Control	80	3.9	0.6	1.7	.62

a Question structure; F = 1.3, df = 1,154, p < .26
Response time, F = 0.1, df = 1,154, p < .80
b Question structure, F = 0.2, df = 1,153, p < .68
Response time, F = 0.1, df = 1,153, p < .82

[1] Automatic processes occur without intention or awareness of the individual, drain a minimal amount of limited cognitive capacity, do not benefit from implicit instructions or practice, and exhibit little or no developmental trend.

(References are available upon request)