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Debiasing Using Decomposition: The Case of Memory-Based Credit Card Expense Estimates

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This article develops a conceptual framework to examine how consumers incorporate memory-based and context-based cues in estimating past and future credit card expenses. Focusing on memory-based information, in this framework we suggest that past credit card expenses may be recalled as holistic totals or episodic individual expenses depending on the accessibility of each form of expense. We tested the conceptual framework with 3 studies. Study 1 showed that the recency of past expenses and frequency of credit card usage moderated the extent to which past expenses were used in estimating future expenses. Study 1 also showed that self-awareness of estimation bias affected consumers' estimates of future expenses. Study 2 showed that a *decomposition strategy* (unbundling a total into subcategories), which serves to make episodic individual expenses more accessible, was effective in reducing sampling-based bias. Study 3 provided a validity check and showed that decomposition cues reduced estimation errors and affected estimates of future expense. In this article, we demonstrate the manner in which memory-based information is used to make estimates, and we also demonstrate the effectiveness of decomposition as a debiasing technique for past and future estimates.

Since the introduction of credit cards nearly half a century ago, the credit card industry has grown worldwide to over $2 trillion by the turn of the century. However, consumers appear to be increasingly concerned about the excessive use of credit cards because they cannot pay the entire balance at the end of the billing period. Slom (1991) reported that 21% of credit card-owning households claimed they had recently eliminated or soon would eliminate one or more of their credit cards to reduce their debt. Despite self-imposed regulatory mechanisms, many consumers are unable to break their pattern of credit card spending. Home equity loans and lines of credit rose from $182.9 to $697 billion from 1986 to 1997, representing over half of all consumer borrowing (Lazarony, 1999). People who consolidated credit card debt did not seem to change their spending habits. About 4 million U.S. households converted $26 billion of credit card debt into home equity loans or lines of credit from 1996 to 1998. However, two thirds of those surveyed charged their cards back up again in less than a year (Lazarony, 1999).

The fact that many consumers cannot break their pattern of credit card spending is particularly surprising given that previous research suggests that past expenses (or spending) affects future expenses (or spending) in an adverse manner. For example, Heath and Soll (1996) suggested a budgeting model where, based on the available resources, consumers set a budget for different categories (e.g., food or clothing) and then track expenses against the budgets. The likelihood of future spending then depends on the funds available in the budget after accounting for past expenses. In other words, as expenses are incurred that serve to deplete the budget, the likelihood of future spending decreases. To the extent that past spending has an aversive affect on future spending, consumers who predominantly use credit cards should be able to control their credit card spending.

A fundamental assumption underlying the notion that past spending affects future spending in an aversive manner is that

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consumers can recall past expenses accurately. This article argues that people do not fully experience the aversive impact of past expenses because their recall of past credit card expenses is prone to systematic biases. Note that for cash payments, there is an immediate "pain" of paying that provides a natural check for those in danger of overspending (Prelec & Loewenstein, 1998). For credit card expenses, the pain is held at bay until the end of the month, and the temptation to spend may go unchecked. The time lag is also responsible for the systematic biases in recall of past expenses. The biases in recall occur because consumers' recall of past credit card expenses is a function of their accessibility. In these studies, we developed and tested a conceptual framework that allows an assessment of how accessibility of past expenses affects estimates of future expenses in the context of credit cards. In particular, the conceptual framework explicitly accounts for how recency of past expenses, frequency of use of credit cards, and the accessibility of individual (vs. total) expenses in memory affect consumers' estimates of future credit card expenses. Importantly, from a consumer welfare perspective, the theoretical framework suggests that the systematic biases in recalling past expenses due to differential accessibility may be reduced with the use of a decomposition strategy (subdividing a total into its subparts; Menon, 1997). Despite the ubiquity of credit cards in the marketplace and their impact on the economy, previous research on the psychology of consumers' credit card spending is sparse. The few studies that exist suggest that credit cards are a convenient payment mechanism that allow people to defer and spread out payments (cf. Tokunaga, 1993). Further, some studies suggest that there is a difference in how consumers treat credit card and cash purchases (e.g., Feinberg, 1986; Hirschman, 1979).

In this article, we report three studies to demonstrate the manner in which memory-based information is used in estimating future credit card expenses. Further, the effectiveness of decomposition as a debiasing technique for both past and future estimates is also demonstrated. From a consumer welfare perspective, our results suggest a prescriptive remedy for consumers who underestimate their credit card bills and find themselves in debt. The general argument is that past credit card expenses are differentially accessible as a function of their level of aggregation: holistic totals versus episodic individual expenses. Individual, often small, expenses are easily forgotten, leading consumers to sample from the population of such incurred expenses rather than comprehensively recall them all. Building on the work of Menon, Raghubir, and Schwarz (1997), the conceptual framework suggests that consumers' estimates of future credit card expenses may be based on a recall of past credit card expenses. These expenses may be differentially accessible as holistic totals or individual expenses that need to be aggregated. Specifically, Study 1 showed that the recency of past expenses and frequency of credit card usage moderated the extent to which holistic totals of past expenses were used to extrapolate to future expenses. Study 1 also demonstrated that self-awareness of estimation bias affected whether a *sampling- and aggregation-based projection* method (believing comprehensive recall) or a *anchor and adjust* method (accepting that recall was based on a sample of all expenses) was used in estimating future expenses. The former leads to underestimation, whereas the latter leads to overestimation. Study 2 presented the decomposition strategy as a debiasing tool to reduce sampling-based biases. *Decomposition* is unbundling a total into subcategories, a strategy that should increase the accessibility of individual expenses and lead to greater accuracy in recall when behaviors are frequently performed but at irregular intervals (Menon, 1997). Study 3 extended the findings of Study 2 by providing an external objective criterion against which to compare estimates. We found that decomposition cues were effective at reducing the errors associated with estimates of past credit card expenses and number of charges. We also show that decomposition reduced estimates of future credit card expenses.

CONCEPTUAL FRAMEWORK

How do people decide how much to spend? How do they estimate how much they will spend? Previous research suggests that consumers commonly rely on memory-based information, context-based information, or both to make such judgments (Menon et al., 1997). A consistent theme underlying extant memory models is that past information is recalled as a function of its *accessibility,* or the ease with which information can be brought to mind (Feldman & Lynch, 1988). In general, frequent behaviors, such as purchases, are not easily accessible in episodic memory (Menon, 1993; Schwarz, 1990). When estimating the number of times one engaged in a frequent behavior, respondents rarely "recall-and-count" (Blair & Burton, 1987) but instead rely on estimation strategies (Bradburn, Rips, & Shevell, 1987). In the latter, the effort involved in recalling each instance and then aggregating the recalled instances is less effortful (Blair & Burton, 1987; Menon, 1993). In some cases, the estimates are relatively accurate and robust, particularly where rates of occurrence associated with frequent behaviors performed with a fixed periodicity can be used to make estimates (Burton & Blair, 1991; Menon, 1993; Menon, Raghubir, & Schwarz, 1995). However, when such estimation heuristics are not available, consumers may attempt to recall each individual instance to formulate an estimate. In such cases, all individual instances may not be equally accessible, which leads to systematic biases in estimates due to sampling errors, particularly if the behavior is performed with high frequency.

Our framework is based on the memory-based model of how people estimate future expenses developed by Menon et al. (1997). In a market research context, Menon et al. argued that respondents' estimates of future expenses are based on information stored in memory and on information provided by the context (i.e., response situation). Further,

their model suggests that estimates of future expenses may be based on recalled past expenses and on the recall of frequencies related to behaviors associated with the expense category (e.g., shampoo expenses are related to the frequency of hair washing). The focus of the Menon et al. study was to examine how the range of response categories used in eliciting behavioral frequency judgments could skew estimated future expenses for irregularly performed behavior. Building on Menon et al.'s model, we propose that consumers have access to two sources of information to make a judgment: memory-based information about past expenses and context-based information. In this article, we focus on the use of memory-based information in estimating future expenses.

To the extent that past expenses are stored in memory, this information will be recalled and used in making estimates of future expenses. However, despite being stored in memory, it may not be easily accessible and is likely to be recalled and applied with error. There are at least two levels of aggregation at which memory-based past expenses may be available. Consumers may either recall past credit card expenses holistically (e.g., as a monthly total) or episodically (as individual instances of expenses incurred per transaction). The relative accessibility of these two sources of memory-based information is likely to determine their relative use in the estimation task. Relative accessibility is itself contingent on time, behavior patterns (e.g., frequency of credit card usage behavior), and the estimation process (which can be contextually manipulated). The memory-based model is displayed in Figure 1.

Holistic Recall of Past Expenses

The simplest strategy that consumers could use to estimate future credit card expenses is to merely extrapolate from recalling total past expenses, making adjustments for any unusual differences between past periods and the future period. The use of credit cards is particularly amenable to such a strategy because the pain associated with each individual credit card transaction is likely to be appreciably lower relative to an equivalent cash transaction. Further, the pain is felt at the end of a billing cycle in the form of a monthly total (Prelec & Loewenstein, 1998).

Estimates of future credit card expenses are thus likely to be based on holistic recall of past expenses. However, past expenses may be differentially accessible. Accessibility is a direct function of the recency of activation of information in memory (Higgins, 1989). The more accessible the information, the easier and faster it comes to mind. Thus, more recent expenses are likely to be more accessible and more likely to be used in estimating future credit card expenses (i.e., more

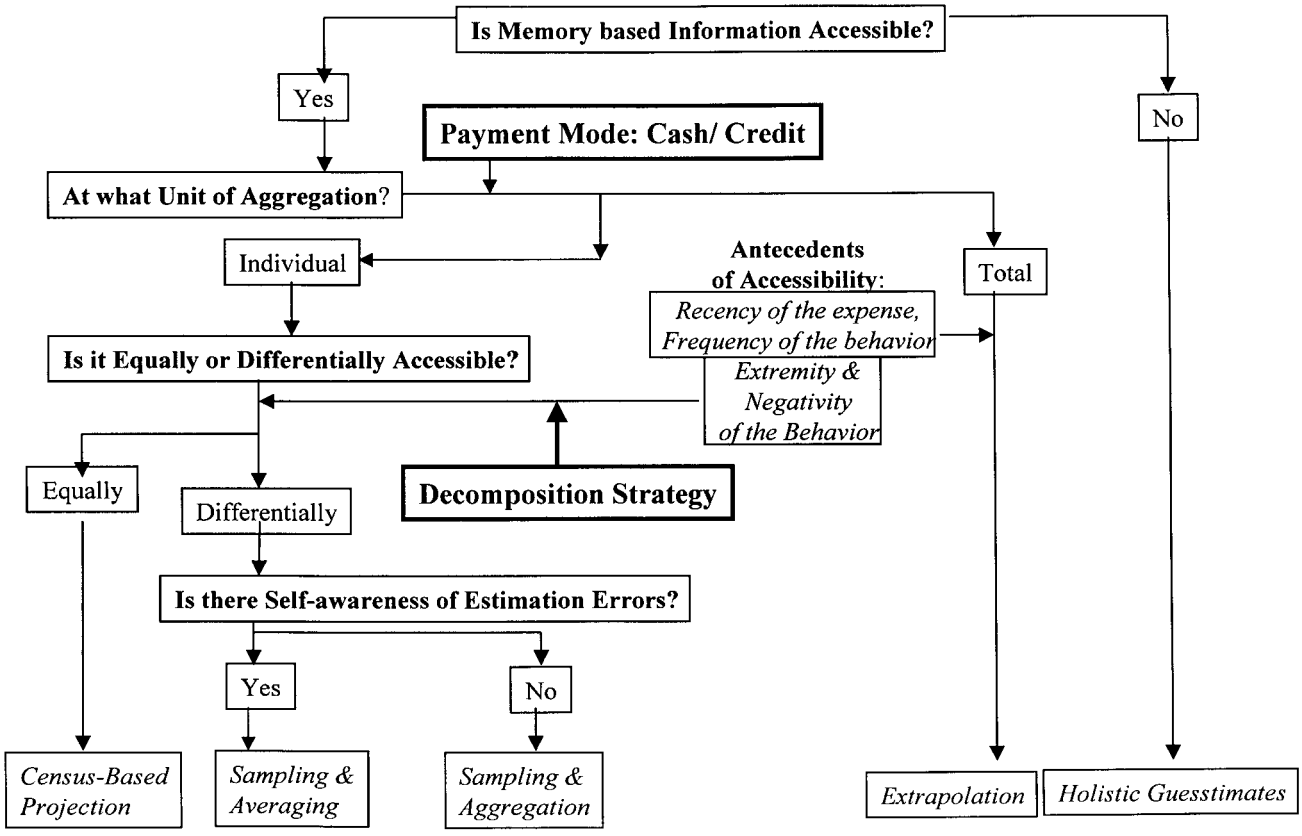

FIGURE 1 Conceptual framework.

likely to be a better predictor of future credit card expenses; H = hypothesis):

H1: The more recent a credit card expense, the greater the likelihood that it will be used in the estimation of a future credit card expense.

Episodic Recall of Past Expenses

A second way in which people can estimate their future credit card expense is to recall individual expenses and then aggregate them. Because individual instances, in most cases, are likely to be more numerous than a single summary holistic total, the task is cognitively demanding. To the extent that past expenses are not recalled with confidence or that there are situational differences between the past and the future, consumers may incur the effort involved to make this judgment.

However, because of the differential accessibility of individual expenses, episodic recall of past expenses may be biased, leading to sampling errors. Accessibility of individual expenses in memory differ as a function of their recency and frequency (Higgins, 1989), negativity (Taylor, 1991), and extremity (Fiske, 1980; Taylor, 1991). To the extent that the sample of individual expenses recalled systematically differs from expenses not recalled, a sample-based strategy may lead to actual past expenses differing from estimated past expenses.

There is no reason to expect the average dollar amount of individual expenses to systematically differ based on their recency or frequency. However, recall of expenses that are negative and extreme is likely to lead to an oversampling of large expenses and an undersampling of small expenses. To the extent that small credit card expenses are less accessible, consumers are likely to underestimate past expenses as they go through the process of aggregating sample expenses and projecting this to total expenses. We label this process *sampling- and aggregation-based projection.*

To the extent that consumers are aware that their recall is based only on a sample from a larger population of expenses, they may use sample information as a starting anchor and adjust this to include nonsampled expenses. Anchoring and adjustment models of judgments have been shown to be empirically robust across situations typified by multiple, complex inputs, including behavioral frequency reports (Davis, Hoch, & Ragsdale, 1986; Menon, Bickart, Sudman, & Blair, 1995). Empirical findings on the anchor–adjust process suggest that people tend to adjust insufficiently, which results in the final estimate being skewed in the direction of the starting anchor (see Kahneman, 1992). If consumers use a sampling strategy with subsequent projection based on sample means, this should lead to an overestimation of past expenses. We label this process *sampling and averaging:*

H2: Awareness of estimation biases will moderate the direction of bias in estimating future expenses, such that estimates of consumers who are aware will be higher than of those who are unaware.

Moderators of the Use of Holistic Versus Episodic Memory-Based Information

Frequency of use. The extent to which consumers recall past expenses holistically versus episodically depends on the accessibility of the form of past expenses stored in memory. Frequent credit card users are more likely to recall past expenses in a holistic manner than infrequent credit card users. The rationale is that for frequent users, the total amount charged (or paid) is more accessible relative to individual expenses. In contrast, for infrequent users, recall of past expenses would be more difficult but few individual expenses may be easier to recall and aggregate:

H3: Frequency of the use of credit cards will moderate the relative use of individual versus total expenses in estimating future credit card expenses, such that frequent users will use total expenses to a greater extent than infrequent users.

H1 through H3 were examined in Study 1. Although infrequent usage may make individual expenses easily accessible, we next argue that contextual cues can serve the same purpose, thereby increasing the accessibility of episodic individual expenses.

Debiasing episodic recall of past expenses. To the extent that episodic recall of past expenses is systematically biased due to differences in accessibility of the individual instances, it may be possible to reduce or even eliminate this bias by making the individual expenses more accessible. One method that may reduce the systematic bias in the episodic recall of past expenses is a decomposition strategy. A decomposition strategy involves providing cues that make the process of recall easier by increasing the accessibility of individual instances. The rationale is that enhancing the encoding context of a specific instance stored in memory leads to faster and more accurate retrieval of the event.

The decomposition strategy has been successfully tested by providing subcategories in a behavioral frequency recall task (Means, Swan, Jobe, & Esposito, 1994). Menon (1997) showed that the decomposition strategy is only effective for frequent behaviors that are irregular, and it works through reducing the effort required in recalling individual instances. Given that the effectiveness of the decomposition strategy depends on the quality of the cues provided, Menon suggested that it may backfire for regular behaviors. The reasoning is that unless the list of cues is comprehensive, a decomposition strategy may reduce the accessibility of instances that are not cued because of part-list cuing effects (Alba & Chattopadhyay, 1985).

Because individual credit card expenses are typically irregular (although monthly expenses follow a regular pattern), a decomposition strategy where cues are provided to enhance the accessibility of individual expenses may reduce the bias in the episodic recall of past expenses. The decomposition strategy is likely to counteract the effects of negativity and extremity because the cues provided make individual expenses accessible in memory, besides the ones that are already salient. A decomposition strategy should thus reduce the systematic bias in the episodic recall of past expenses.

Given our argument that future expenses are based on estimates of past expenses, decomposition cues should affect future expenses in the same direction that they affect past expenses:

H4: Decomposition cues moderate the extent to which estimates are biased (H2), such that expense estimates following decomposition are likely to be less biased.

Studies 2 and 3 examined H4.

STUDY 1: MEMORY-BASED ESTIMATES

Study 1 used a survey-based methodology to test the conceptual framework. The framework suggests that the use of past expenses in estimating future expenses is contingent on the accessibility of the past expense, which in turn, is a function of its recency and the frequency of using credit cards. Further, the framework suggests that self-awareness of estimation bias affects whether expenses will be overestimated or underestimated.

Study 1 was designed to test H1 through H3. In particular, this study demonstrated that (a) consumers use past credit card expenses to estimate future expenses; (b) the more recent the past expenses are, the stronger the relation between the estimate of future expenses and recalled past expenses will be; (c) the differential use of holistic versus episodic expenses in estimating future expenses is a function of their relative accessibility, which is determined by the frequency of credit card usage; (d) the recall of past expenses episodically is prone to sampling errors, which leads to systematic biases in recall and subsequent extrapolation to future expenses; and (e) the direction of the bias is contingent on consumers' self-awareness of estimation biases; those who are unaware are more likely to underestimate their overall credit card bill.

Method

Participants and procedure. Fifty-nine undergraduate participants in an introductory marketing class participated in the study for partial course credit. Five students were eliminated from the sample because they did not own credit cards, which left a usable sample of 54. The mean age of the sample was 21.5 years, and 39% were male.

Participants were asked to participate in a questionnaire survey and were instructed to respond to the questions to the best of their ability. Participants were asked to recall their last 2 monthly credit card bills and to provide an estimate of their next monthly credit card bill. Specifically, the instructions read "Please estimate your credit card bill for each of the last 2 months (If you use more than one credit card regularly, then please answer with respect to the *primary* card you use)." As a manipulation check to assess the differential accessibility of the two bills, they were asked "How confident are you about these estimates?" elicited on a 7-point scale ranging from 1 (*not at all confident*) to 7 (*very confident*). They were then asked to estimate their next monthly credit card bill.

We also collected data on frequency of use of credit cards by asking participants (a) the number of separate charges per month of the primary credit card (1–5, 6–10, 11–15, 16–20, and 21 or more) and (b) the frequency of credit card usage (> 10 times a week, 5–10 times a week, less than once a week, a few times a month, and less than once a month). Participants were then asked the extent to which they agreed with the statement "I underestimate the total expense of a shopping trip when I use a credit card" (1 = *strongly disagree,* 7 = *strongly agree*) to measure awareness of estimation bias. We also collected data on standard demographics and credit card ownership (i.e., total number of credit cards possessed).

Results

Summary description. The average credit card bill recalled was $423.38 for the past month ($405.46 for 2 months before). Credit cards were frequently used by the participant population, as 59% reported more than six separate charges per month, and the remainder reported one to five charges a month. On average, participants reported owning 2.6 cards, with about two thirds owning 2 or more cards. The modal card use reported was between 5 and 10 times a week.

H1. H1 predicted that because recent past expenses are more accessible, the most recent monthly bill is used to a greater extent in estimating next monthly bill relative to the bill of 2 months before (Higgins, 1989). A proxy variable was used to check that the last monthly bill was more accessible than the bill of 2 months before. Participants rated how confident they were for each of the two estimates. A within-subjects analysis of variance (ANOVA) on the two confidence measures showed that participants were more confident about their estimate of the last monthly bill relative to the bill of 2 months before (Ms = 6.02 and 5.43), $F(1, 55) = 21.58$, $p < .001$.

Regression analysis was used to test H1. Separate regressions were run for each of the last monthly bills as predictor variables and the next monthly bill as the dependent variable.

A regression on the next monthly bill with the last monthly bill as the predictor variable, along with number of cards owned, the average number of charges per month, and the reported frequency of card usage per month was significant (R^2 = .61), $F(4, 51) = 22.68$, $p < .001$. The effect of the last monthly bill was significant ($\beta = 0.41$; $t = 4.26$, $p < .001$). In addition, other significant variables were number of charges per month ($\beta = 0.44$; $t = 4.38$, $p < .001$) and the number of cards owned ($\beta = 0.21$; $t = 2.34$, $p < .05$).

A similar analysis using the bill of 2 months before as the predictor variable was also significant ($R^2 = .53$), $F(4, 51) = 16.63$, $p < .001$. The effect number of charges remained significant ($\beta = 0.49$; $t = 4.34$, $p < .001$). The effect of the bill of 2 months before was also significant ($\beta = 0.27$; $t = 2.52$, $p < .01$), but its effect was weaker than that of the last monthly bill in the previous analysis.

Taken together, the data appear to support the idea that past credit card expenses are used in estimating future expenses and that the use of past expenses is greater the more recent the expense.

H2. According to the conceptual framework, the use of episodic recall of past expenses in estimating future expenses may be biased because of differential accessibility of the individual instances. For example, negative and extreme expenses are more likely to be accessible, leading to an oversampling of large expenses and undersampling of small expenses. Consumers are thus likely to underestimate past expenses as they aggregate sample expenses and project this total to future expenses. However, to the extent consumers are aware that they are prone to sampling biases, they may use the sample average as a starting anchor and adjust this amount. As the starting anchor is likely to be a biased sample of higher expenses, this strategy leads to overestimation. Note that although the survey does not include objective measures of accuracy, the operational implication stated in H2 is that estimates of future expenses should be higher for consumers who are aware (vs. unaware) of estimation biases.

To test the hypothesis, we first divided the sample into two groups ($Mdn = 3$): those who disagreed with the awareness statement, the unaware group ($n = 25$), and those who agreed with the statement, the aware group ($n = 31$). We conducted two types of analyses: ANOVAs on the overall estimates with the awareness split as an independent variable and regression analyses for the two groups examining the relative use of alternate inputs into the future expense estimate.

An omnibus ANOVA on the next monthly bill, the last monthly bill, and the bill of 2 months before with the median split on awareness as the independent variable showed that those who were aware had higher expense estimates for all three measures (next month = \$242.80 and \$344.35; last month = \$306.00 and \$518.03; 2 months before = \$280.48 and \$506.26), overall averaged $F(3, 162) = 4.06$, $p < .01$. Estimates were between 40 to 80% higher for the aware group. These data support the idea that unaware consumers will aggregate individual expenses based on incomplete recall, leading to underestimation. In contrast, aware consumers will anchor on the expenses recalled and adjust these to incorporate forgotten expenses. However, as the starting anchor is skewed toward the larger expenses that are more accessible, this will lead to overestimation.

To examine whether these effects of recall percolated through to future expense estimates as argued by H1, we conducted a mediation analysis. The follow-up analysis on the next monthly bill, incorporating the last monthly bill as a covariate, showed that the effect of awareness was not significant ($p > .75$), whereas all the variance was explained by the last monthly bill, $F(1, 53) = 33.63$, $p < .001$. This suggests that the episodic recall of the past expenses is affected by whether people are aware that they are prone to estimation biases, which in turn, affects estimates of future expenses.

We then conducted regression analyses on the future expense estimate separately for each of the two groups. The regressions included the holistic estimates of past expenses and variables capturing the episodic expenses (number of charges).

For unaware users, a regression of the next monthly bill as a function of the last monthly bill, the number of cards, and the number of charges was significant ($R^2 = .72$), $F(3, 21) = 21.10$, $p < .001$. All coefficients were significant: the last monthly bill ($\beta = 0.28$; $t = 2.10$, $p < .05$) and the number of charges and the number of cards (βs = 0.45 and 0.39; ts = 3.45 and 3.41, ps < .005).

A similar analysis for those who were aware was also significant ($R^2 = .57$), $F(3, 27) = 14.38$, $p < .001$, but showed a larger effect of the last monthly bill ($\beta = 0.49$; $t = 4.02$, $p < .001$). The coefficient of number of charges was significant ($\beta = 0.47$; $t = 3.73$, $p < .001$), whereas the coefficient of number of cards was not ($p > .20$).

A test of the coefficients of the last monthly bill in the two subsamples showed that the effect was greater for those who were aware ($t = 1.69$, $p < .05$; see Cohen & Cohen, 1983, p. 111). The pattern was consistent with the conceptual framework, which suggests that the aware group was likely to anchor and adjust, whereas the unaware group was likely to sample and aggregate. The results suggest that aware consumers appear to rely more on the last monthly bill, which is the logical input available for adjustment.

H3. The conceptual framework suggests that past credit card expenses may be recalled holistically or episodically to estimate future expenses. The use of these alternate forms of information stored in memory is contingent on their relative accessibility or ease of use. H3 argued that for frequent credit card users, it is likely that past expenses are easier to recall in holistic form rather than in episodic form. However, for infrequent credit card users, it is relatively easy to recall past expenses episodically because of fewer occasions of card use,

and therefore, infrequent users would be more likely than frequent users to use these to estimate future expenses.

To test this, we divided the sample into frequent users (usage > 5 times per week; $n = 22$) and infrequent users ($n = 30$). Three students were dropped from the analysis reported here because they did not respond to the frequency question. Separate regressions were conducted for each group. For frequent users, a regression on the estimate of the next monthly bill as a function of the last monthly bill, number of cards owned, and number of charges was significant ($R^2 = .47$), $F(3, 19) = 7.48$, $p < .001$. The coefficient of the last monthly bill was significant ($\beta = 0.55$; $t = 3.28$, $p < .005$), as was the coefficient of number of cards owned ($\beta = 0.42$; $t = 2.56$, $p < .01$), but the coefficient of number of charges was not significant ($p > .75$). The data support the idea that for frequent users, it is easier to recall and use past expenses holistically rather than to recall individual charges to make judgments about future expenses.

A similar analysis for the infrequent users showed a different pattern of results ($R^2 = .57$), $F(3, 26) = 13.97$, $p < .001$. Whereas the coefficients of the last monthly bill ($\beta = 0.41$; $t = 2.94$, $p < .01$) and the number of charges ($\beta = 0.51$; $t = 3.69$, $p < .001$) were significant, the coefficient of number of cards owned was not significant ($p > .80$).

Although the coefficients for the last monthly bill in the two subsamples were not significantly different, the data were directionally consistent with the hypothesis that the effect of the last monthly bill is likely to be greater for frequent users. Further, the effect of the number of charges was significant for infrequent users but not significant for frequent users. These data support our contention that the recall of past expenses holistically or episodically is contingent on the relative accessibility of the two forms of information, which in turn, is dependent on the frequency of credit card use.

Discussion

Study 1 provided support for the conceptual framework. The results demonstrate that people use past credit card expenses to estimate future expenses as a function of its accessibility, operationalized as recency of past expenses. The results also demonstrate that recall of past expenses may be holistic or episodic, depending on the relative accessibility of the two forms of information, operationalized as frequency of credit card usage. We found that when past expenses are accessible at the individual level (e.g., infrequent usage), people are less likely to rely on holistic totals in estimating future credit card expenses. Finally, in recalling past expenses episodically, people are prone to systematic biases in their estimates. In particular, people who are unaware that they are using a sample of individual instances (chosen due to their higher accessibility) have relatively low expense estimates, presumably because they make no adjustments for having incompletely recalled all expenses. In contrast, aware people have higher expense estimates presumably because they anchor on an upwardly biased sample estimate and then adjust for out-of-sample expenses.

The main implication of Study 1 is that the recall of holistic versus individual expenses in estimating future expenses is contingent on the accessibility of each form of information. Given that individual credit card expenses are typically numerous and less accessible, the effort involved in recalling and aggregating leads people to either bypass the entire process and use holistic totals to estimate future expenses or to merely use a sample of individual expenses rather than enumerating all of them. To the extent that the underlying reason for this process is the (relative) inaccessibility of smaller expenses, we argue that contextual manipulations that enhance accessibility should lead to a reduction in estimation biases.

The next study introduced the decomposition strategy as a way to reduce or eliminate the systematic biases due to sampling that are manifested in the underestimation or overestimation of expenses as a function of consumers' awareness.

STUDY 2: DEBIASING MEMORY-BASED ESTIMATES

The main objective of Study 2 was to examine whether making individual expenses more salient by cuing expense categories would affect the episodic recall of credit card expenses. The decomposition strategy works through making less accessible expenses more accessible by cuing them directly. This strategy should be particularly effective for enumeration of credit card expenses, as it has been shown to be particularly effective for frequent and irregular behaviors (Menon, 1997).

The paradigmatic use of decomposition involves taking a large total (e.g., the number of times you dined out last month), and making the estimation task simpler by providing subcategories that may cue behaviors that may have been forgotten (e.g., with your family, with your colleagues, with your friends; Italian, Mexican, ethnic). The respondent answers questions pertaining to each of the subcategories. These are then aggregated to form the final judgment. One of the disadvantages associated with this technique is that it is associated with higher cognitive effort. There is a possibility that the additional effort could backfire, with decomposition leading to worse judgments than the use of a simpler heuristic relying on holistic estimates, particularly for regular behaviors where people have access to robust rates of occurrence (Menon, 1997).

In this study, rather than asking respondents to separately estimate the expenses for each subcategory of expense, we used a variation of the decomposition task. Because the goal was to simply increase the accessibility of individual expenses that might otherwise have been forgotten, we asked a simple behavioral frequency question (using semantic scale anchors) intended to cue less accessible expenses.

Method

Participants and procedure. Eighty-six undergraduate students from an introductory marketing class participated in the experiment for partial course credit. The procedure was similar to that of Study 1, with one important difference. The elicitation of the past bills was manipulated at two levels. In the decomposition strategy condition, participants were asked "On average, how frequently do you use a credit card to pay for" a variety of expense categories (travel, hotel, restaurants, entertainment, personal expenses, groceries, household items, gas, catalog and Internet purchases, bills, and other) before they were asked to estimate their bill. Responses were elicited on a semantic behavioral frequency scale (1 = *never,* 2 = *rarely,* 3 = *sometimes,* 4 = *often,* and 5 = *always*). In the control condition, this question succeeded the estimation question.

Results

Sample description. About 57% of the participants were male. The average bill amount was $458.47 for the past month ($471.16 for 2 months before). As in Study 1, usage of cards was common in the participant population. Only 30 participants reported 5 or fewer charges a month ($n = 23$ each reported 6–10 and 11–15 charges a month, respectively, with 9 reporting 16 or more charges). The mean number of cards owned was 2.70 and ranged from 1 to 9, with the mean number of cards used on an active basis reported to be 1.45 (ranging from 1 to 2). Participants reported a mean motivation level of 5.12 on a 7-point scale in responding to the questionnaire.

H4. As the estimates of the two bills (the last month and 2 months before) were highly correlated, we pooled them together ($r = .83$).[1] We wished to examine whether the effect hypothesized in H2 and demonstrated in Study 1, would replicate and be moderated by the decomposition strategy. As in Study 1, the sample was divided with a median split ($Mdn = 4$) into those who were aware ($n = 34$) and those who were unaware ($n = 46$). The analysis pattern was ANOVAs, followed by individual regressions for the two groups.

We conducted a 2 (Decomposition Strategy: present vs. absent) × 2 (Awareness: unaware vs. aware) ANOVA on the pooled past expense measure. The analysis yielded a significant interaction effect, $F(1, 76) = 2.71$, $p < .06$. In the condition where there was no decomposition, aware participants reported higher bill amounts than those reported by the unaware participants ($1384.71 and $660.01), $F(1, 38) = 5.34$, $p < .05$. These results corroborate Study 1 findings and provide additional support for the theoretical framework. Interestingly, in the decomposition condition the effect was not significant ($919.48 vs. $910), $F < 1$. The data suggest that when past expenses are differentially accessible, cuing individual expense categories can lead to a better sample (or census) leading to a reduction in estimation errors.

Analysis of the confidence measure provides additional support for this process. An ANOVA on the confidence with which the estimates were made as a function of estimation condition was significant, Fs(1, 83) = 5.21 and 3.59, $p < .05$ and .10, for the two confidence measures and reflected that respondents were less confident about their estimates when individual expense categories had been cued (i.e., in the decomposition condition) versus when their estimates preceded their behavioral frequency responses (Ms = 5.83 and 5.09 and 5.19 and 4.53, respectively). Cuing of the individual expense categories may have led to a greater awareness that some individual expenses have been forgotten.

With regression analysis, we examined the route through which the cuing works to provide more evidence for the proposed process. A regression analysis of estimated past expenses as a function of the number of charges per month, number of cards owned, and number of cards used on an active basis was estimated. The fourth variable was the extent to which a card was used in the 10 expense categories listed. We expected that when a card was used frequently, the relation between frequency of usage and past expenses should be greater when individual category usage was cued. Individual regressions in both estimation conditions supported this hypothesis.

When estimates preceded response to usage frequency (i.e., no decomposition), the regression was not significant, but when respondents first answered questions about their usage frequency in the 10 expense categories, the frequency of usage was a significant predictor ($\beta = 0.37$; $t = 2.21$, $p < .05$) in the overall regression ($R^2 = .15$), $F(4, 35) = 2.78$, $p < .05$. No other variables were significant in either regression.

These results provide support for the process by which the decomposition cues work. The findings show that when individual categories are not cued, people appear to base their estimates of past expenses on some holistic extrapolation. In contrast, when the expense categories are cued, the estimates are directly related to usage frequency.

Discussion

We found that a strategy intended to increase the accessibility of individual expenses was effective at debiasing estimates of past expenses. Using a variant of the decomposition strategy, in one condition we asked respondents to estimate the frequency with which they used credit cards in 10 expense categories, as well as their past credit card bills. In the other condition, we elicited responses in

[1]An analysis of the confidence with which these two were recalled replicated Study 1 results. Respondents were more confident with their estimates of the last monthly bill relative to the bill of 2 months before (Ms = 5.46 and 4.86), $F(1, 84) = 28.43$, $p < .001$.

the reverse order. We found that when past expenses were estimated first, respondents who were unaware that they were prone to estimation biases estimated lower bill amounts when using credit cards as compared to those who were aware that their estimates were biased. However, the effect disappeared when estimation followed a response of behavioral frequency. Regression analyses showed that expense estimates were related to usage frequency only in the condition when usage frequency was elicited prior to expense estimates.

STUDY 3: EXTENSION TO VALIDITY

A major limitation of Studies 1 and 2 was that there was no external objective criterion on the basis of which accuracy of recall was assessed. Study 3 was designed to address this limitation.

Method

Participants and procedure. Participants were 55 students from two undergraduate business courses who participated for partial course credit. They were randomly assigned to one of four cells of a 2 (Decomposition: before vs. after total estimate) × 2 (Cue Type: category-based vs. calendar-based decomposition) between-subject factorial design.

Participants were presented with a fictitious diary account of a visiting exchange student who recorded her activities in a daily journal (see Appendix for complete details). Three aspects of her diary were notable: (a) She wished to put as many of her expenses as possible on her credit card so that she could earn frequent flyer miles; (b) she kept a daily record of all her expenses, cash and credit, as she was on a limited budget; and (c) on the last day of the detailed diary record, she identified a set of tourist options that she needed to make a decision on during the course of her visit.

Participants were asked to read her daily journal and then complete a thought-listing task. The objective of this thought listing was to clear short-term memory. Subsequent to this, we asked them to estimate "How much Chris charged to her credit card in her first week at Berkeley" using an open-ended response format. This question either preceded or followed a decomposition task. This was used to create our primary dependent measure: absolute errror in estimates (actual = $1,260.95).

In the calendar-based decomposition, they were asked to estimate credit card expenses separately for each of the 7 days. In the category-based decomposition, they were asked to estimate credit card expenses for "Transport," "Restaurant and Bar," "Entertainment," "Clothing and Accessories," "Books and Music," "Groceries," and "Housing." Seven categories were chosen such that they were (a) collectively exhaustive of the exchange student's credit card expenses and (b) comparable to the calendar-based category cues. An "Other" category was also provided for the sake of completion.

Subsequent to estimating total expense, all participants were asked how confident they were in their expense estimate (1 = *not at all confident,* 7 = *very confident*). They were also asked to estimate the number of charges made to the credit card (actual = 11). This was used to create our secondary dependent measure: absolute error in number of charges.

To examine whether the manner of estimating past expenses affected future expense estimates, we asked participants to indicate the amount of money the exchange student should set aside to make out-of-town trips. The amount allocated to holiday travel served as a third measure to test H4.

Results

Expense estimates. A 2 × 2 ANOVA on the absolute error in expense estimates revealed a main effect of decomposition and cue type, Fs(1, 51) = 4.13 and 5.18, respectively, ps < .05. There was no interaction effect ($F < 1$). The pattern of the means showed that decomposition was effective at reducing the error in estimates. In the decomposition cue condition, the mean error was almost half when the total estimate followed the decomposition cues (M = $118.85), as compared to when it preceded them (M = $230.26). Interestingly, the errors were lower when participants completed a category-based estimation task (M = $125.50) relative to a calendar-based one (M = $250.07). The robustness of this latter result needs to be established in future work.[2]

Estimates of number of charges. A similar analysis on the absolute error in estimated number of charges also showed that the decomposition strategy was effective at in-

[2]The analysis of the raw "Total Expense" estimates also showed main effects of the two independent variables: decomposition and cue type, Fs(1, 51) = 3.66 and 7.65, respectively, ps < .10 and .05, with a nonsignificant interaction ($F < 1$). The means demonstrated a pattern of overestimation when totals were estimated prior to category estimates (Ms = $1320.31 vs. $1444.48 when decomposition was present vs. absent). In terms of the conceptual model presented in Figure 1, this suggests that participants were aware of the differential accessibility of the expenses. This may be due to the number of expenses in the vignette (fairly high; n = 11) and the amount of information presented (also high). The proxy measure of confidence in the estimates, and estimates of the number of charges, provided convergent evidence for the likelihood that participants were aware that they were sampling from the total expense pool. The mean confidence in estimates was low (4.02), right around the midpoint of a 7-point scale ranging from 1 (*not at all confident*) to 7 (*very confident*), and the mean estimate of the number of charges was low when total estimates followed the decomposition cues (M = 9.92), but it was higher when it preceded them (M = 11.45). Together, this pattern was consistent with the likelihood that participants were aware that they were sampling and, therefore, used a sampling and averaging strategy rather than a sampling and aggregation strategy, leading to overestimation.

creasing the accuracy of the size of the sample of expenses (i.e., the number of charges). When total estimates followed decomposition cues, the mean absolute error was about half of what it was as compared to when total estimates preceded decomposition cues (Ms = 2.54 vs. 5.00), $F(1, 51) = 4.02$, $p < .05$. No other effects were significant.

Estimates of future expense. A 2 × 2 ANOVA on the estimate of holiday expenses revealed a main effect of decomposition, $F(1, 51) = 3.72$, $p < .05$. No other effects were significant. The pattern of the means showed that decomposition led to a significantly smaller estimate of holiday expenses (M = \$540.38 vs. \$789.66). The results strongly support H4.

GENERAL DISCUSSION

A conceptual model was developed of how consumers use memory-based information in estimating future credit card expenses. We argue that memory-based information is available at two levels of aggregation, holistic totals versus episodic individual expenses, and the use of each form of information is contingent on relative accessibility. Given that credit card payments are a frequent behavior, individual expenses are typically less accessible than holistic totals, leading consumers to rely on effort-saving strategies to estimate future credit card expenses.

Study 1 demonstrated that (a) people recall holistic totals in estimating future expenses; (b) the more recent the past expense is, the greater its use in the estimation task; (c) infrequent users of credit cards are more likely to rely on a recall and aggregation of individual expenses rather than a holistic extrapolation than are frequent users; (d) when recalling and aggregating individual expenses, those who are aware of estimation biases are more likely to adjust their estimates upward using total past expenses than are those who are unaware that they are prone to estimation biases; and (e) those who are unaware that they underestimate are more likely to do so. Study 2 demonstrated that (a) clubbing individual expense categories prior to estimation prompts the use of a recall and aggregation (vs. holistic extrapolation) based strategy and (b) a decomposition strategy debiases memory-based estimates. Study 3 validated this latter finding of Study 2 by comparing the estimates of both expenses and number of charges to an externally objective criterion.

Theoretical Contributions

These studies investigated the manner in which credit-card-related expenses were estimated. Although previous research has demonstrated the effectiveness of the decomposition strategy in the context of behavioral frequency estimates (Means et al., 1994; Menon, 1997), we demonstrated its utility in the context of expense estimates, both in the past and for the future. We also demonstrated its utility using a lower effort variant where consumers did not have to actually recall and respond to frequencies for each subcategory of behavior. Rather they had to respond to an easier semantic behavioral frequency scale that served the purpose of activating behaviors or expenses that were less accessible and reduce the errors in estimation.

We argued that individual payments made by credit card were less accessible than those made by cash, particularly for frequent users of credit cards. Holistic monthly totals were, on the other hand, more accessible. The evidence presented in this article supports and adds to the literature that has investigated the differences in consumer behavior as a function of mode of payment (e.g., Feinberg, 1986).

Public Policy and Consumer Welfare Implications

Documenting some of the early reasons why supermarkets in the United States started accepting credit cards as a form of payment, Azzarone (1975) reported that the most commonly cited reason was customer convenience. However, supermarkets soon realized that credit card use led to increased sales, although credit card sales accounted for less than 5% of total sales at this time. Customer convenience itself translated into supermarket sales, as the acceptance of credit cards allowed consumers to impulse shop, with credit card sales about three times the average cash sale. More recently, the well-known direct marketer, L. L. Bean, reported that credit card orders had a 30% higher average value than cash orders in 1980. It is possible that these results merely represent sample differences such that those with credit cards are in a higher income bracket than those who do not use cards. However, it is also possible that people buy more or pay more when using a credit card. Feinberg (1986) demonstrated this effect using a series of laboratory experiments. He found that people were more likely to spend, spent more, and spent it faster, in situations ranging from tipping to purchase, when a credit card was merely present versus absent, and he interpreted his results in terms of a classical conditioning effect.

This is an issue with far-reaching public policy concerns. If consumers spend more than they wish when they pay by credit card, public policy and consumer advocate groups can assist a reduction in this overspending. Our results suggest that increasing the accessibility of individual expenses is successful at this. However, given the heterogeneity in accessibility of individual expenses, our results suggest that decomposition-based methods can be used to assist those consumers at risk of overspending. This would be an interesting area for future research.

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APPENDIX: DIARY OF A VISITING STUDENT: SUMMER 2000

Chris is visiting Berkeley for the summer. Chris has a budget of $6000 for the summer. She has worked hard to save this amount, and plans to use it over a three-month period during which she will go back to school, and tour the area. Her tuition expenses and airfare were a 21st birthday present from her Godmother. However, she needs to pay for the rest of her living expenses. She has decided to put most of her expenses on her credit card so that she can earn credit towards "frequent flyer" miles. However, for small expenses (less than $5), she will pay cash.

The following is a diary she keeps. Here are the details of her first week in Berkeley.

June 1st

Arrived at San Francisco Airport. Drew $100 from the ATM machine at the airport. Took shuttle to I-house ($22 including tips, charged to her card). Was tired. Went down to the café and bought a packet of chips and a bowl of soup ($3.00, cash).

June 2nd

Paid I-house fees for the first month ($1000 including accommodation, breakfast and dinner, charged to her card). Whew! This place is expensive … but at least I don't need to worry about housing (which everyone says is really expensive in the Bay Area). The room is small, but nice.

Registered for courses. I think I am going to have fun!

Met a nice bunch of people and went out with them for lunch (Thai House: $7.95. They took a real long time to bring the credit card slip.).

Went to a late night movie on Shattuck (Ticket: $7.50, Popcorn, Soda and Candy: $7.00; had to pay cash for both.)

Took the bus back (was quite tired; $1.50, cash).

June 3rd

Walked down Telegraph Avenue. Passed Rasputin. Wow! Went in and almost lost track of time (bought 2 CDs: charged $32 to her credit card). Continued walking down the street and was utterly fascinated by the variety of people on the streets and the range of wares they sold. Was really tempted to have my eyebrows pierced—but then thought of what Mom would say—stopped me short! But, I did give in to the temptation of buying a green stone jewelry set and bargained the price down to $18 (I was surprised to find that even the street vendors accepted my credit card)! Gosh, I felt smart … .

Stopped at Blondie's for Pizza and a drink ($5, paid cash for this).

Passed by Cody's and started browsing. What a lovely collection … (Charged $27 … a real bargain … I'd been looking for it everywhere).

June 4th

Decided to check out San Francisco. Walked down to the BART station (its really easier walking down there rather than walking uphill!). Figured out those machines to buy tickets (they didn't have anything like those where I come from! One-way $2.95, cash).

Got down at Union Station and took the trolley ($2 cash) down to Fisherman's Wharf. Bought some t-shirts (5 @ $10 each, charged to my card). Boy, no one told me how cold it gets in San Francisco in the summer! Bought a sweatshirt that had a picture of the Golden Gate Bridge (charged another $35).

June 5th

I really think I have been having "too much fun" (Is there anything like "too much fun"?) I met some cool summer visitors at I-house this morning and I got along fabulously with them. In fact, one was this really cute guy and he asked me out this evening (Not only will I get to know him better – but there's a free dinner, hopefully!). Skipped lunch in anticipation.

We had such a blast—he insisted on paying for everything, but I took him out for drinks afterwards. We went to Blake's and I gave the bartender my credit card for the tab. We stayed until closing ($35).

June 6th

Walked around the Berkeley campus. I think I could walk up and down it through this summer and never go the same way twice! It is so pretty.

Passed the student's union and picked up a roll of film and batteries for my camera ($12, charged to my card).

Had lunch at Smart Alec's, half sandwich and half soup ($5—paid cash for that)

Went to a small convenience store to pick up snack food and drinks to keep in my room, as well as some toiletries ($22—it is so nice that even these small stores have started accepting credit cards nowadays).

June 7th

I should start checking out the beautiful areas around the Bay area. I went today to the Tourist Bureau to ask for package deals for:

Napa Valley
Yosemite
Lake Tahoe
Mendocino
Carmel and Monterrey
Muir Woods
Santa Cruz

There is so much I want to do … and see! This is just my first week here and I feel I've barely done anything. I want to do a lot more in the time left. Sightseeing, shopping, and eating at fun places!