

AN EXPLORATORY INVESTIGATION OF THE COGNITIVE PROCESSES USED TO
ANSWER EXPENDITURE QUESTIONS IN SURVEYS

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The accuracy with which consumers can recall prices paid for products has long been of interest to consumer and survey researchers (Gabor and Granger 1961; Progressive Grocer 1964, 1982; Pearl 1968; Sudman and Ferber 1971, 1974; Allen, Harrell, and Hutt 1976; Zeithaml 1982, 1984; Dickson and Sawyer 1986). Such estimates are an important part of many consumer studies, including the Consumer Expenditure Survey conducted by the Bureau of Labor Statistics.

Despite researchers' interest in the accuracy of expenditure reports, there has been little or no research focusing on the cognitive processes used by respondents to formulate responses to expenditure questions. The implicit presumption has been that objective price information (i.e., the price paid) is encoded in memory at some point during the purchasing process, that this information remains accessible to the consumer, and that this information is retrieved from memory to generate an answer to the expenditure question. In fact, though, the ability of respondents to use episodic memory in answering expenditure questions seems at least occasionally dubious. A respondent sufficiently motivated to use episodic retrieval (as opposed to some estimation heuristic) may not be able to do so because of memory failure or because of never having encoded the expenditure information.

The purpose of this exploratory study is to examine the cognitive processes that respondents report using to answer questions about expenditures for durable and nondurable goods. The effects of several task variables which are hypothesized to affect these processes also are investigated. Validating data to assess the accuracy of respondents' expenditure estimates were not available in this study; therefore, although relationships among task conditions, reported cognitive processes, and the accuracy of price recall are of great interest, the focus of this study is upon the processes used in formulating responses.

BACKGROUND

Several researchers have provided conceptualizations of how consumers may process price information (Jacoby and Olson 1977; Zeithaml 1982; Helgeson and Beatty 1985). These conceptualizations recognize four primary processing stages: (1) initial exposure to objective price stimuli (2) encoding of price information, (3) retrieval of price information, and (4) subsequent use of the retrieved information. The present study primarily is concerned with the third stage, retrieval of information; however, retrieval processes necessarily are dependent upon the initial exposure to and encoding of the price information.

Initial Exposure to Price

The accuracy with which consumers are able to recall the prices of previous purchases is very much dependent upon whether or not consumers are aware of prices at the time of product purchase. One may argue that not all consumers seek out price information when making purchases, particularly for inexpensive, nondurable goods. Such choices may be habitual and near automatic; the perceived cost of the effort needed to acquire price information may not exceed the perceived benefit (Bettman 1979).

Experimental studies indicate that price is one of the two pieces of data most commonly acquired by consumers when considering a purchase, but that price is not always acquired. Jacoby et al. (1977) found that when brand names were not available to laboratory subjects choosing a toothpaste, 83% of the subjects obtained objective price information, but only 57% obtained price data when brand names were available. In another study, Jacoby et al. (1976) reported that 71% of the subjects acquired objective price information about (nondurable) grocery products, and that 44% of all items of information obtained were price data. Similar results were offered by Chestnut (1975). These results show that price information is commonly accessed by consumers but not always.

This conclusion is supported by results from a recent field study (Dickson and Sawyer 1986). Consumers were contacted in a supermarket immediately after putting one of several nondurable products in their shopping carts, and asked whether or not they had checked the price of the item. Forty-two percent said that they had not checked the price.

In sum, results of these studies suggest that many respondents may not be able to use episode retrieval to answer questions about the price paid for a product simply because they were not aware of price at the time of purchase. Other response formulation processes must be used if these respondents are to comply with the question by providing a price estimate. Failure to acquire price information seems more likely for inexpensive goods than expensive goods and more likely for nondurable goods than durable goods, but there are no empirical data to confirm such relationships.

Encoding of Price Information

The encoding of price information concerns the organization and interpretation of meaning to a price stimulus. Most cognitive psychologists believe that the organization and interpretation of meaning results from integration of the price information with other information residing in memory. Therefore, many consumers will not necessarily encode the direct stimulus (i.e., the dollar price), but rather may work with abstractions such as "higher than other brands," "reasonable," "about average," etc. The manner in which price information is

encoded in memory necessarily will affect how and what information about price is subsequently retrieved.

Zeithaml (1982) attempted to measure what she called the degree of sensory encoding (as opposed to objective, or direct, encoding) for twelve grocery products. She observed a significant correlation between levels of sensory encoding and reporting errors in price estimates.

Retrieval of Price Information

Cognitive researchers believe that if a consumer is aware of an objective price and encodes this information in memory, it is permanently stored and subsequently may be retrieved. However, this encoded price information may be very difficult to access, and consumers who experience difficulty in accessing the appropriate information are likely to construct other methods or strategies for estimating a price.

Overall, then, a survey respondent may generate price reports via processes other than direct retrieval (i.e., episodic memory) for at least three reasons: (1) the information was never attended to and thus is not available, (2) the information was not encoded in objective form, and (3) the information is available but is too difficult to access.

What factors affect the likelihood of direct retrieval? Two obvious factors are the amount and routineness of a purchase. Research has shown that individuals spend more time attending to extreme, unusual, or infrequent information (Lynch and Srull 1982). Also, consumers seem more likely to be aware of price for purchases involving greater expenditures. Frequent, non-vivid purchases, on the other hand, probably are more difficult to access (assuming the objective price information is ever encoded) because they are not distinctive. Therefore, there are reasons to believe that factors such as the amount of the expenditure and/or frequency of the purchase may have some effect on the degree to which episodic memory is used to estimate price.

Respondents are probably less likely to use episodic recall to estimate the prices of more distant purchases because temporal distance reduces accessibility. Although respondents may be able to recall objective prices for distant purchase episodes if the necessary cues are used to increase information accessibility, significant cognitive effort may be required.

Price conscious respondents (defined here via consumers' knowledge and concern about price at the time of purchase) should be more likely to rely on episodic recall than respondents who are not price conscious. Price conscious individuals may be viewed as spending more time attending to objective price information, so that information may be more available for price conscious consumers.

Various task conditions also may affect the use of episodic recall of price information. For example, contextual cues that aid in making the purchase episode information more accessible may lead to greater use of episodic recall. By forcing the respondent to focus on the purchase episode, contextual cues may help frame the task so that retrieval of episodic price information

will be easier for respondents to access. Such a process would be consistent with a spreading activation theory of memory (Collins and Loftus 1975).

This study focuses on processes used to formulate estimates of purchase expenditures. Although all processes used in estimating purchase prices are of interest, we primarily are concerned with the effect of several independent variables on the use of episodic recall. The independent variables examined include the approximate price of the purchase, purchase recency, awareness of price at time of purchase, and a contextual cue manipulation. There are a wide variety of variables that may impact the use of episodic recall of price; the variables used in this exploratory study were selected because of their potential impact on process and relative ease of measurement.

METHOD

Questionnaires were administered to 220 junior and senior level students enrolled in two introductory Marketing classes at a large southern university. Questionnaires were passed out face down and respondents were told not to flip through the questionnaire and to answer all questions in the order they appeared. On the first page of the questionnaire respondents were asked to report the price they paid (before taxes) for their most recent purchase for each of twelve different product categories. The twelve categories were as follows: calculator, bread, restaurant meal, haircut, shoes, shampoo, bluejeans, automobile, stereo receiver (or amplifier), lettuce, soft drinks, and sunglasses.

The product categories used in the study were chosen based on several criteria. Pretests were conducted and only product categories for which most pretest respondents reported a previous purchase were selected. Both durable and nondurable products exhibiting a wide range of price levels were used. Some purchase behaviors were considered more vivid (e.g., automobile, haircut) than other behaviors (e.g., lettuce, bread). Also, product categories were chosen that would exhibit variability in purchase frequency both across and within categories.

After estimating the price of their most recent purchase in each of the twelve product categories, respondents turned to the following page where they answered closed-ended questions about the cognitive processes used in making these estimates. For each product category, respondents were asked to select from five process descriptions or an "other" category. The five process descriptions were developed from pretests.

The first process description indicated full use of episodic recall in that the respondent reported recalling the specific purchase episode and the exact price paid. The second and third process descriptions indicated partial use of episodic recall; the specific purchase episode was recalled, but not the exact price paid. In the second process description, respondents indicated having recalled that a slightly lower or higher price than normal was paid, while in the third process the price reported seemed "approximately what would have been paid for the product." The fourth and fifth process

descriptions exhibited no use of episodic recall because neither the purchase episode nor the price paid was retrieved. The fourth process indicated that although no specific information was recalled, the reported price seemed to be about what would normally be paid. The fifth process suggested that not even information about a "normal" price was available and therefore a "best" estimate was given.

In the remainder of the questionnaire, respondents provided information for each of the purchases on whether or not they were aware of the exact prices of the products at the time of purchase, the time elapsed since the most recent purchase, a measure of confidence in the accuracy of their price estimates, and an overall measure of price consciousness. The measure of confidence consisted of respondents' ratings of agreement (on a scale from 1 to 7) with the statement, "I am confident that the price I reported paying for this product is the price I actually paid." The measure of price consciousness was a summed scale consisting of ratings on four seven-point scales. The four items were "I try to buy brands that are on sale," "For most products I buy, price is a very important consideration," "I prefer to buy my favorite brand regardless of its price" (reverse scored), and "I try to buy brands that are lower than average in price." Coefficient alpha for this measure of price consciousness was .80.

One manipulation was included in the study. In the test condition, respondents were asked to report the length of time since the most recent purchase and the store at which the most recent purchase was made before estimating the price of the most recent purchase. In the control condition, respondents were asked only to estimate the most recent purchase price. It was hypothesized that the (self-generated) contextual cues of time and place would help respondents focus on the purchase episode, thus making the price information more easily accessible and resulting in greater use of episodic recall.

RESULTS

Processes Reported in Retrieving Expenditure Information

Table 1 shows the distribution of processes reported by respondents for each of the twelve product categories. Significant variation can be seen across the categories ($\chi^2 = 406.2$, $p < .001$). The percentage of respondents who indicated pure episodic recall, with retrieval of the specific purchase occasion and the exact price, ranged from 90% for a haircut to 27% for a head of lettuce. In more than half the product categories, less than 50% of the respondents indicated "pure" recall. Product classes in this group included some relatively higher priced consumer durables (e.g., stereo receiver, calculator, bluejeans).

It is interesting to note that a haircut was the product category for which the greatest use of "pure" episodic recall was reported and was the only category for which all respondents reported some retrieval of the purchase episode. Why would episodic recall be used to a greater extent for a haircut than for a presumably important, high-priced, vivid purchase of an automobile? A haircut may be a sufficiently

unusual and irregular purchase event (involving its own purchase episode in which no other products are purchased) to be relatively vivid, but yet frequent enough to ensure that the last purchase occasion was relatively recent for most respondents. Also, assuming many respondents are "barber loyal", the price of a haircut may be constant across the last several purchase occasions. This price consistency may strengthen the memory trace of the expenditure level and make this price information more accessible in attempts to recall the most recent purchase episode.

TABLE 1: PROCESSES USED TO ESTIMATE MOST RECENT EXPENDITURES

| Purchase Behaviors ^a | Average Reported Price ^b | Reported Processes | | |
|---------------------------------|-------------------------------------|--|--|--|
| | | Recall of Episode and Expenditure Amount | Recall of Episode But Not Expenditure Amount | No Recall of Episode or Expenditure Amount |
| Haircut | \$ 13.58 | 90% | 10 | 0 |
| Automobile | \$7828.62 | 76% | 18 | 6 |
| Sunglasses | \$ 25.95 | 66% | 26 | 8 |
| Meal at restaurant | \$ 9.33 | 65% | 31 | 4 |
| Shoes | \$ 42.73 | 65% | 33 | 2 |
| Bluejeans | \$ 32.07 | 46% | 40 | 14 |
| Calculator | \$ 39.06 | 45% | 44 | 11 |
| Bread | \$ 0.98 | 44% | 46 | 10 |
| Stereo receiver | \$ 267.73 | 41% | 39 | 20 |
| Six pack/soft drinks | \$ 2.05 | 37% | 41 | 22 |
| Shampoo | \$ 3.34 | 36% | 46 | 18 |
| Head of lettuce | \$ 0.79 | 27% | 39 | 34 |

^a χ^2 associated with relationship between purchase behavior and reported processes = 406.2, df = 22, $p < .001$

^b Rank correlation (Kendall's tau) = .35, $p < .10$

The Effect of Price on Reported Processes

As suggested above, we believe that various characteristics of purchase behaviors will have systematic effects on response formulation processes. One characteristic which may have an impact is the price of the purchase; higher prices may lead to a greater likelihood of use of episodic recall. Table 1 offers data relevant to this relationship and, as can be seen, there does seem to be at least some relationship between price and the reported formulation process. The rank correlation between the average reported expenditures and use of episodic recall across the twelve purchase categories is .35 ($p < .10$).

The Effects of Price Awareness

An obvious reason that episodic recall may not be used to retrieve purchase expenditure information is that respondents were not aware of the price at the time of purchase. Results indicate awareness of expenditure amount was related strongly to the reported process (χ^2 values, for 10 purchase behaviors significant at .01; χ^2 significant at $p < .05$ for the remaining 2 purchase behaviors; χ^2 pooled across behaviors = 356.3, $p < .001$). Results also show that awareness of price at the time of purchase was

strongly related to the specific purchase behavior ($\chi^2 = 255.0, p < .01$). Awareness of purchase prices ranged from 92% for a haircut to only 38% for lettuce. Fewer than 60% of the respondents reported that they were aware of the price at the time of purchase for each of the nondurable goods examined.

The Effect of Price Consciousness

It was felt that the general level of price consciousness of the consumer might affect the process used in at least two different ways. Price consciousness could affect whether or not the consumer was aware of the price at the time of purchase, and hence affect the subsequent ability to use episodic recall. Also, price conscious and nonprice conscious consumers may encode price information differently. For example, from a levels of processing perspective (Craik and Lockhart 1972), one might expect "deeper" encoding of price from price conscious consumers. Variance in encoding of expenditure data may result in use of different retrieval strategies.

Examination of the relationships among price consciousness, price awareness, and price estimation processes showed (1) significant and consistent relationships between price consciousness and price awareness, but (2) in general, non-significant relationships between price consciousness and response processes. For all twelve of the purchase behaviors, higher price consciousness was positively associated with awareness of price at the time of purchase and these relationships were statistically significant for eight of the twelve purchase behaviors. However, higher price consciousness was associated with greater use of episodic recall for only eight purchases, one (bread) of which was statistically significant. The four purchase behaviors for which greater price consciousness was not associated with episodic recall of price were automobiles, shoes, calculators, and restaurant meals. We might expect price consciousness to have more of an impact on processes used to estimate the prices for low-priced nondurable goods purchases; although results were not strong, the hypothesized positive relationship between price consciousness and use of episodic memory was found for all of the nondurables in this study.

The Effect of Purchase Recency

A negative relationship between purchase recency and use of episodic recall of price was hypothesized. The rationale underlying this hypothesized relationship is that the more distant the most recent purchase occasion, the greater the difficulty of accessing and retrieving the price from memory, and thus the less likely the respondent to report episodic recall of price. Results pertaining to this relationship are shown in Table 2.

For each of the twelve purchase behaviors, high and low purchase recency groups were formed via median splits. Across each of the twelve behaviors, the groups with the more recent purchases reported more use of episodic recall, as hypothesized. The relationship between purchase recency and episodic recall was statistically significant for ten of the twelve behaviors and was highly significant on a pooled basis ($\chi^2 = 133.9, df = 23, p < .001$).

TABLE 2: THE EFFECT OF TIME SINCE MOST RECENT PURCHASE ON REPORTED PROCESS

| Purchase Recency | Reported Process | | | Value |
|--------------------|-----------------------------------|---------------------------------------|-------------------------------------|-------------------|
| | Recall of Episode and Expenditure | Recall of Episode But Not Expenditure | No Recall of Episode or Expenditure | |
| Haircut | | | | |
| 1-20 days | 94% | 6 | -- | 2.8 ^f |
| >20 days | 86% | 14 | -- | |
| Automobile | | | | |
| 1-22 months | 84% | 11 | 5 | 3.5 |
| >22 months | 73% | 23 | 4 | |
| Sunglasses | | | | |
| 1-23 weeks | 77% | 22 | 1 | 10.8 ^d |
| >23 weeks | 59% | 30 | 10 | |
| Meal at restaurant | | | | |
| 1-2 days | 76% | 23 | 2 | 10.0 ^d |
| >3 days | 56% | 39 | 6 | |
| Shoes | | | | |
| 1-8 weeks | 77% | 22 | 2 | 13.5 ^d |
| >8 weeks | 53% | 45 | 2 | |
| Bluejeans | | | | |
| 1-16 weeks | 62% | 33 | 5 | 25.4 ^c |
| >16 weeks | 30% | 48 | 22 | |
| Calculator | | | | |
| 1-17 months | 59% | 37 | 4 | 15.9 ^c |
| >17 months | 32% | 54 | 14 | |
| Bread | | | | |
| 1-6 days | 56% | 37 | 6 | 10.5 ^d |
| >6 days | 34% | 54 | 12 | |
| Stereo Receiver | | | | |
| 1-24 months | 48% | 34 | 18 | 1.6 |
| >24 months | 39% | 45 | 16 | |
| Soft drinks | | | | |
| 1-7 days | 53% | 33 | 14 | 21.2 ^c |
| >7 days | 22% | 50 | 28 | |
| Shampoo | | | | |
| 1-21 days | 36% | 52 | 11 | 6.3 ^e |
| >21 days | 35% | 41 | 24 | |
| Lettuce | | | | |
| 1-13 days | 40% | 41 | 19 | 12.4 ^d |
| >13 days | 20% | 39 | 41 | |

^a Purchase recency categories based on median splits for each of the behaviors

^b Pooled χ^2 across all behaviors = 133.9, $df = 23, p < .001$

^c_p < .001

^d_p < .01

^e_p < .05

^f_p < .10

Respondents' Confidence in Price Estimates

Validating data which would permit an assessment of the relationship between process and expenditure estimate accuracy were not available in this study. However, two measures of respondents' confidence in the accuracy of their responses were obtained. Such confidence measures often are obtained in research concerning cognitive aspects of survey response (Mingay 1986).

It was anticipated that respondents who reported use of episodic recall of a purchase episode and specific expenditure would have greater confidence in their responses than respondents who reported use of other processes. Relevant results are shown in Table 3.

TABLE 3: THE RELATIONSHIP BETWEEN RESPONSE PROCESS AND CONFIDENCE IN RESPONSE ACCURACY

| Purchase Behaviors | Total Sample | Confidence in Accuracy of Expenditure Estimate | | | | F Value |
|--------------------|--------------|--|---------------------------------------|-------------------------------------|--------------------|---------|
| | | Recall of Episode and Expenditure | Recall of Episode But Not Expenditure | No Recall of Episode or Expenditure | | |
| Haircut | 6.8 | 6.9 | 6.0 | ---- | 27.7 ^b | |
| Automobile | 6.4 | 6.9 | 4.9 ^a | ---- | 89.4 ^b | |
| Sunglasses | 6.1 | 6.7 | 5.4 | 3.4 | 81.0 ^b | |
| Meal at restaurant | 6.5 | 6.9 | 5.7 ^a | ---- | 151.2 ^b | |
| Shoes | 6.3 | 6.9 | 5.4 ^a | ---- | 81.8 ^b | |
| Bluejeans | 5.9 | 6.8 | 5.5 | 4.2 | 78.9 ^b | |
| Calculator | 5.7 | 6.7 | 5.0 | 4.1 | 52.5 ^b | |
| Bread | 5.7 | 6.8 | 5.2 | 3.6 | 77.2 ^b | |
| Stereo Receiver | 5.2 | 6.7 | 4.9 | 3.0 | 67.0 ^b | |
| Soft drinks | 5.3 | 6.5 | 5.1 | 4.0 | 47.3 ^b | |
| Shampoo | 5.5 | 6.8 | 5.2 | 3.7 | 78.6 ^b | |
| Lettuce | 4.9 | 6.8 | 4.9 | 3.4 | 81.7 ^b | |

^a Processes in columns 2 and 3 have been combined because fewer than 10 respondents reported no recall of the purchase episode or the expenditure

^b $p < .01$; ^c $p < .05$

Respondents' confidence in the accuracy of responses was measured via their agreement with the statement, "I am confident that the price I reported paying for this product is the price I actually paid." Results show that respondents who reported use of episodic recall of the purchase episode were more confident about the accuracy of their expenditure estimates than respondents reporting other processes. The relationship between process and confidence in the accuracy of the estimates was highly significant ($p < .001$) for each of the twelve purchase behaviors. For respondents who reported episodic recall of the purchase episode and the price paid, the mean rating of confidence in the accuracy of the estimate (on a 7-point scale) across the twelve purchase behaviors was 6.8.

Manipulation of the Process Used to Estimate Expenditure

One experimental manipulation was used in this study in an attempt to increase use of episodic recall of prices. In the experimental condition, respondents were asked the amount of time since their most recent purchase and the name of the store where their most recent purchase was made before they were asked about the price paid for their most recent purchase. Respondents in the control condition were asked only about price; questions about purchase recency and store name were not asked prior to the expenditure questions. It was hoped that the purchase recency and store location questions would act as contextual cues that would help the respondent focus on the purchase episode and make expenditure data more easily accessible.

Use of this experimental manipulation did not result in greater reports of use of episodic recall of price. Also, as might be anticipated given the strong relationship between process and confidence in the accuracy of the estimate, this cueing manipulation did not lead to greater confidence in the estimates. The implications of this result are discussed in the following section.

DISCUSSION

Overview of Results

Results of this study indicate that episodic

recall is not always used to formulate answers to questions about expenditures, and that use of episodic recall varies significantly across purchase behaviors. Two factors, reported awareness of price at the time of purchase and the recency of the last purchase, were shown to be associated with the processes used for estimating expenditures. A third variable, price consciousness, was not significantly related to processes. However, it was anticipated that the relationship between price consciousness and process would be strongest for nondurable products; for all four nondurable products in this study, results were in the hypothesized direction (greater price consciousness leads to greater use of episodic recall), and for one of the four products the relationship was statistically significant.

Reports of episodic recall were strongly associated with greater confidence in the accuracy of estimates of expenditures. These results suggest that accuracy may be improved by encouraging greater use of episodic recall; unfortunately, the contextual cue used in this study in an attempt to promote episodic recall did not have a significant effect on the reported process.

Study Limitations

This study was viewed as exploratory in nature and many of the measures employed are of questionable validity. For example, respondents provided information about the process used to estimate price for each of the twelve purchase categories after responding to questions about the prices paid for each of the twelve categories. Although process responses were given within several minutes of the formulation of the response, recall of the process for one purchase category probably is subject to some interference from processes used for other product purchases. Also, the provision of process descriptions may preclude respondents from reporting other methods of estimating price (although an "other" category was provided). Hypothesis guessing may have been a problem in that some processes may have been seen as more desirable to report than others.

Other variables used in this study also are subject to measurement error. Respondents were

asked to estimate the time since their most recent purchase and reports of such estimates generally are not very accurate (Ganesh 1985). It is not clear that respondents can accurately report whether or not they were aware of an exact price at the time of the most recent purchase; perhaps if a specific price cannot be recalled, many respondents simply assume they were never aware of it.

Other limitations relate to the generalizability of the results. Student subjects were used and questionnaires were completed in a classroom setting. Results concerning processes used to formulate expenditure estimates may not generalize to other populations or research settings.

Future Research

Despite these limitations, we feel that the results of this study suggest at least three directions for future research. First, the relationship between the processes used to estimate price and the accuracy of estimates should be examined in a study in which validating data are available so that accuracy can be assessed. Also, an immediate protocol after the provision of an expenditure estimate should be used to measure process to increase the validity of the response formulation data.

Assuming the relationship between use of episodic recall and accuracy is found to be positive, further research appears warranted on the effect of task manipulations on formulation processes. The failure of contextual cues to increase use of episodic recall in this study suggests that manipulation of the response formulation process in applied survey settings may be difficult to accomplish. While methods of encoding price information are beyond the control of the researcher, a better understanding of encoding strategies may suggest manipulations that aid in the retrieval of expenditure data.

Finally, a better understanding of the conditions and purchase behaviors for which estimates can be improved would be helpful. For example, almost all respondents report use of episodic recall for estimating the price of their most recent haircut and respondents appear extremely confident about the accuracy of their estimates. Manipulations may not be effective or necessary for this purchase behavior. Similarly, it would seem useful to have some idea about the length of time for which respondents generally recall episodic data for given product classes. A different questioning technique perhaps should be used for a respondent who bought a pair of shoes three months ago than for a respondent who purchased shoes two weeks ago. Also of interest is whether or not the formulation process varies with demographic variables such as age and education.

This study has provided interesting information concerning response formulation processes for expenditure questions in surveys, and results indicate that further research is warranted. It appears that the importance of this area as a research stream will be dependent primarily on two factors: (1) whether accuracy can be shown to be related to formulation processes, and (2) whether practical

manipulations of process can be developed. Future research investigating these questions should prove intriguing.

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