It Seems Like Only Yesterday: The Nature and Consequences of Telescoping Errors in Marketing Research

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When asked to place the time of a past event, people have a systematic tendency to recall that recent events occurred farther back in time (backward telescoping) and distant events occurred more recently (forward telescoping) than is actually the case. In this article, I provide a conceptual analysis and an empirical examination of the extent of telescoping errors in marketing research and the implications of these errors. The results show that (a) on average, consumers underestimate the time since purchasing a durable good; (b) the magnitude of forward telescoping errors increases and the propensity to make backward telescoping errors decreases with the time since purchase; (c) telescoping errors affect future purchase intentions; and (d) telescoping biases vary across different demographic segments. A propositional inventory linking telescoping errors to product, respondent, and situational factors is presented for future research.

One of the oldest findings in time perception is Vierordt's (1868) law: People tend to underestimate the length of long time intervals and overestimate the length of short time intervals. One consequence of this error of time perception is a phenomenon known as telescoping (Neter, 1970, pp. 16–17; Sudman & Bradburn, 1974, p. 67). People have a systematic tendency to recall that distant past events occurred
more recently (forward telescoping) and recent events occurred farther back in time (backward telescoping) than was actually the case. This phenomenon is commonly experienced in daily life and is the cause of such a phrase like "it seems like only yesterday."

Telescoping not only is a subject of interest for philosophers and poets, it also has practical importance for survey researchers. For example, firms often ask consumers when they last bought a particular product or how many times they bought a product during a specified range of time, say the last 30 days. Government agencies ask individuals about their expenditures in different categories or whether they had been victims of different crimes in specified past periods. The answers to these questions may be biased by telescoping errors.

Marketing researchers need to understand the nature and consequences of telescoping errors. Marketing surveys often ask consumers to recall when they last bought a product (e.g., an automobile or an appliance). Firms often use these recall data to estimate when consumers will replace their existing products. Telescoping errors in the recall data may bias these estimates of actual replacement rates, causing forecasts of sales to be erroneous. Recall questions are also used to estimate the frequency of events. Estimates of purchase frequency are often used as inputs to forecasts of market size and brand-share (Menon, 1993). Telescoping errors can bias estimates of frequency of occurrence, overstating or understating the true frequency. For example, in estimating how often consumers made purchases during the last 30-day and 60-day intervals, the consumers overstate their actual purchases as verified by scanner data (Cook, 1987). Similarly, the U.S. Bureau of the Census has found that adding up respondents' reported crime experiences in the last month grossly overestimates the overall level of crime (Cook, 1987). Some attitude studies use the time since an event last occurred as a covariate: The time since a commercial was last viewed may help to explain consumers' attitudes toward a product, the time since a store was last visited may help to explain consumers' attitudes toward the store, and the time since a person last exercised may help to explain his or her attitude toward physical fitness and health. Telescoping errors in self-report measures of these covariates can create systematically biased findings in such attitude studies.

In this article, I have the following three objectives:

1. To review the psychological and survey research literature on telescoping errors and discuss its implications for marketing researchers.
2. To demonstrate empirically some previously unexplored consequences of telescoping errors in a marketing context.
3. To develop an inventory of propositions (Ps) to be tested in future studies of telescoping and time perception.
RESEARCH ON TIME PERCEPTION

The psychological literature on time perception dates as far back as the 1800s (Nichols, 1890; Vierordt, 1868) and continues to be an area of active research (for extensive reviews, see Block, 1990; Friedman, 1990). Most of the psychological research on time perception has focused on the perception of very short (within short-term memory range) or moderate (ranging from minutes to hours) time intervals. This research is mainly experimental and has focused on the relation between actual and perceived time for these short time intervals. For example, Allan (1979) found support for a linear relation between objective and subjective time for intervals of under 10 sec.

A smaller set of studies has examined time perception for longer time intervals (days to years; Linton, 1975; Squire, Chace, & Slater, 1975). Most of this work is observational and employs real-life events as stimuli (Brown, Shevell, & Rips, 1986; Linton, 1975, 1978; Squire et al., 1975; Wagenaar, 1986). In a typical study, participants are asked to recall the dates or to estimate the relative recency of personal events or events from the news (Estes, 1985). Typical results are reported by Underwood (1977), who found that the time since a recent event is often overestimated, whereas the time since a remote event is often underestimated.

Memory Encoding of Temporal Information

Telescoping errors that distort the accuracy of a recalled date could stem from how temporal information is encoded in memory and how such information is retrieved from memory (Huttenlocher, Hedges, & Prohaska, 1988). In this section, I describe various models for how information about time is encoded in memory. In the next section, I describe models of how temporal information is retrieved from memory (Friedman, 1990, pp. 28–40).

The time-tagging model (Yntema & Trask, 1963) posits that some representation of time is part of the stored memory for an event (i.e., every event is effectively stamped with a time marker). When the event is recalled, the time as well as other aspects of the event are remembered. Proponents of this model differ on whether time is tagged internally through a biological clock or whether people simply notice and encode the date and time of important events (Linton, 1975). Although people do encode the time of certain salient events (e.g., birthdays and anniversaries), there is little evidence that time is stored automatically for all events (Wagenaar, 1986). Despite this controversy, the model is still considered in current psychological research (e.g., Huttenlocher, Hedges, & Bradburn, 1990).

The conveyor belt model (Hintzman, Block, & Summers, 1973; Murdock, 1974) posits a sequential organization of memory with events stored in the order in which
they occurred. Because the time between events is stored, the relative age of an event can be inferred. This model can explain why forward telescoping errors occur for distant events (Friedman & Wilkins, 1985). When an individual tries to judge the recency of an event, he or she scans serially backward through memory as if incrementing a time counter for each recalled event. Because only the order or the time between events is stored and not the date of an event, this model suggests that if a particular event is forgotten, more remote events would be recalled as occurring more recently. However, this model is limited in its ability to capture other known phenomena. For example, in many experimental studies of time memory, participants are asked where a particular item occurred in a list of items to which they were exposed. The model predicts that accuracy would be highest for items at the end of the list and would decline for items at the beginning of the list. However, it is a common finding that items from the beginning of the list are placed accurately. Furthermore, knowledge of the temporal contiguity of two events is not a useful cue for recalling one of them (Wagenaar, 1986). Nevertheless, the model’s success in explaining certain patterns in dating errors sustains its consideration in current research (Huttenlocher et al., 1990).

According to the trace-strength model (Morton, 1968), a person’s estimate of the recency of an event is based on the strength of the memory trace. Assuming that the memory trace is established when the event occurs and that people can discriminate between different strengths, the recency of an event can be judged by the strength of the memory trace. Several studies have found evidence against this model (e.g., Tzeng, Lee, & Wetzel, 1979). For example, this model cannot explain the ability to accurately place the items at the beginning of a list. A variant on this model suggests that rather than the trace strength, people use how much detail they recall about an event as a cue to infer how long ago a past event occurred (Brown, Rips, & Shevell, 1985).

The inference model (Friedman & Wilkins, 1985) suggests that people do not directly encode information about time or relative time, but rather they infer it from other knowledge. The model assumes that people have detailed knowledge of patterns of natural and social time, such as seasons, holidays, school years, and daily schedules, and have memorized the dates of salient events such as birthdays and anniversaries (Estes, 1980). This detailed knowledge is separate from knowledge of specific events. When people try to recall the time of a past event, they link these two sets of knowledge to infer logically when the event must have taken place. For example, if an individual is asked when she last went to a museum, she might reason that it must have been a Sunday, or during a vacation, or when a certain friend came to visit (Friedman, 1990). Verbal protocols support this model. The model also explains some systematic scale inaccuracies in time memory; that is, for different events, people have differing accuracies in recalling time of day, day of the week, month, season, or year (Friedman, 1987). Furthermore, cues that are helpful for inferring one scale of time (e.g., the time of day) may be of no help in
inerring a different scale (e.g., the year). Thus, Friedman (1987) found that individuals could quite accurately recall the time of day that an earthquake had occurred (near lunch time), but they were inaccurate in recalling larger time scales (e.g., the month). According to this model, memory accuracy for time declines with the age of an event because over time, people forget the more detailed information that would be useful for inferring the time of the event.

The final model is the reminding model (Hintzman, Summers, & Block, 1975), which assumes that the time order of many pairs of events is encoded in memory. If a new event reminds an individual of a prior event, the temporal order of the pair is stored in memory, resulting in a large number of cross-referenced events. The model implies that order information should be more accessible for related events than for unrelated events. As an example, Friedman (1990) suggested that it is an easier task to order the Chernobyl and Three Mile Island accidents than to order the Three Mile Island accident and the most recent appearance of Halley's comet, although both pairs of events are separated by about the same number of years. However, Tzeng and Cotton (1980) demonstrated that judgments about the temporal order of different category pairs are more accurate than if individuals were just guessing. The reminding model also cannot cogently explain participants' accurate memories for the items beginning a list or for scale effects (i.e., remembering time of day but not day of week).

Although each of these models provides explanations of some time memory phenomena, each has significant limitations in explaining other empirical results. Thus, there is no clear consensus among psychologists for any one of the models. In fact, it is likely that more than one process is implicated in the encoding of time in memory (Huttenlocher et al., 1990).

Memory Retrieval of Temporal Information

The authors of several recent articles suggested that telescoping errors may be a result of how time information is recalled from memory. Specifically, demand effects, the use of heuristics, and bounding and rounding processes were offered as explanations.

The survey research literature suggests that responses to behavioral frequency questions may be biased upward due to demand characteristics (Loftus, Klinger, Smith, & Fiedler, 1990; Sudman, Finn, & Lannom, 1984). Wishing to provide useful information, respondents prefer to give too much information (e.g., report more purchases) than too little. Although demand effects can explain forward telescoping errors (i.e., the overstatement of actual frequencies), they cannot explain backward telescoping errors for recent events. Demand effects also cannot explain inaccurate recall of the date of a specific event unless the respondent was led to believe that recent (or distant) events were desirable.
Burton and Blair (1991) suggested that errors previously attributed to telescoping may be due to the heuristics that respondents use to answer behavioral frequency questions. For example, a respondent asked to estimate how many times he or she has eaten in a restaurant in the last 12 months might use a heuristic such as, “We eat out every Sunday.” Failure to account for exceptions to the rule would create inaccuracies. Whether the frequency is over- or underreported may depend on the specific heuristic used, and it may be worthwhile to reexamine the frequency data previously explained by telescoping errors. Although the use of heuristics can explain why responses to behavioral frequency questions are biased, their use cannot explain why specific events are dated inaccurately.

Recent studies by Huttenlocher and colleagues (Huttenlocher et al., 1988; Huttenlocher et al., 1990) suggested that forward telescoping errors can be explained by retrieval processes involving bounding and rounding. These authors argued that the forward telescoping bias occurs when a temporal estimate is constructed from increasingly inexact (but not biased) memory over time. People do not recall exactly when an event occurred and restrict their estimate to a boundary in temporal memory (e.g., last year, last month, last week). Huttenlocher et al. (1990) called this a bounding effect. They also found that when asked to recall how long ago an event occurred, participants used calendar prototypes (e.g., 5, 7, 10, 14, 21, 30, and 60 days). Because these prototypes are farther apart for more temporally distant events, more estimates are rounded down than are rounded up, resulting in a forward bias. Huttenlocher et al. (1990) found that bounding and rounding effects fully account for observed forward telescoping effects. In a related article, Rubin and Baddeley (1989) also proposed that telescoping errors are not the result of biased memory and that these errors can be fully explained by three factors: (a) retention is better for recent events than for events further back in time, (b) errors in recall are unbiased but increase linearly with the time since occurrence, and (c) bounding effects as described earlier. However, research by Kemp (1994) suggested that bounding and rounding effects do not fully account for telescoping errors. Kemp observed telescoping errors among participants who dated news and historical events, both when they were and were not provided boundaries for the event dates. Furthermore, Kemp examined participants’ verbal protocols while they were dating events and found little evidence that bounding and rounding effects were responsible for telescoping errors.

Further examination of these models is needed to determine whether memory for time is unbiased and telescoping errors are solely a result of retrieval processes or whether there might also be distortions in the representation of time in memory.

Context Effects Due to the Recall Question

Answers to recall questions have been shown to be a function of both information stored in long-term memory and information provided by the questionnaire (Burton
& Blair, 1991). Several studies have examined how altering the questionnaire influences respondents' propensity to make telescoping errors.

Neter and Waksberg (1964) suggested the use of bounded recall for eliminating telescoping effects in panel studies of behavioral frequencies. They described how the Census Bureau used bounded recall to assess the magnitude of these effects. With bounded recall, respondents are provided with a list of their reported expenditures from a previous interview. They are then asked to report any additional expenditures made since the previous ones. This method clearly defines the time period of interest and is effective in reducing telescoping effects in recall of major expenditures. For example, in one study of expenditures on repairs and alterations, 40% more expenditures were reported in a 1-month unbounded study than in a comparable bounded study. In another study on the frequency of durable good purchasing, an unbounded study elicited a 23% higher purchase frequency estimate than did a bounded study (Neter & Waksberg, 1964). Of course, this method requires that the interviewer have information on prior purchases.

Sudman and Bradburn (1974) suggested several methods for improving the accuracy of responses to behavioral frequency questions. These methods reduce errors of telescoping and errors of omission (i.e., forgetting episodes). One approach, which instructs the respondent to use any available records (e.g., receipts or bank statements), has been shown to control for telescoping effects but not for errors of omission. Another suggested approach is aided recall (i.e., providing the respondent with specific memory cues). Cook (1987) also suggested aided recall as a method for tapping more accessible elements of memory. For example, rather than directly asking a respondent how many episodes of a particular television show she or he watched in the last month, an aided recall question is structured by providing the respondent with a description of different episodes of the show. Although aided recall has been shown to reduce errors of omission, there is some evidence that aided recall may actually increase telescoping effects. Sudman and Bradburn concluded that bounded recall and the use of records are most appropriate when the major source of memory error is due to telescoping effects. In addition, they found that certain interview conditions (e.g., the use of personal interviews vs. questionnaires, placing questions at the end vs. the beginning of the interview, and using open-ended vs. closed-ended recall questions) reduce memory errors.

Loftus and Marburger (1983) similarly found that accuracy can be improved by changing the survey instrument. In particular, they found that telescoping biases could be reduced by directing participants to finer time intervals. For example, respondents could be asked, "Did you buy a new car in the last year? the last six months? the last month?" Also, instructing respondents to use a well-known or personal time cue reduced the forward telescoping effect. For example, respondents could be asked, "Since the eruption of Mount Saint Helens did you ... ?" or "Since your last birthday did you ... ?" In a more recent study, Loftus et al. (1990) found that overestimates of behavioral frequencies are reduced by asking people about
behaviors for two different reference periods. Their results suggest that respondents view this as a cue that precise answers are desired.

Burton and Blair (1991) found that biases in response to behavioral frequency questions may be caused in part by the response formulation process. They suggested that manipulation of the process may improve the accuracy of the responses. In particular, they hypothesized that instructing respondents to use more time to form their responses and providing open-ended rather than closed-ended questions would improve accuracy. However, their results were inconclusive. The authors also suggested that providing estimation rules, frequency information about the population, and contextual cues may improve response accuracy. However, these ideas remain untested at this time.

TELESCOPING ERRORS IN MARKETING RESEARCH

Do Telescoping Errors Occur When Consumers Recall Product Purchases?

Although many marketing studies have reported evidence of telescoping errors (Drayton, 1954; Neter, 1970), there have been few direct empirical investigations of the phenomenon in marketing research contexts. Establishing the occurrence of forward telescoping errors requires comparing the recalled and actual dates of an event of interest. Past studies in marketing have rarely had such an independent validation criterion. For example, Jaeger and Pennock (1961) asked 2,100 respondents to recall the purchase date of their washing machine on two separate occasions that were separated by 1 year. The researchers lacked access to the actual purchase date of the washing machines and could not validate whether the recalled and actual dates of purchase matched. Instead they examined the consistency of responses across the two surveys and found that relative to the first recalled date of purchase, respondents recalled purchasing more recently the second time they were asked. The authors attributed this pattern of responses to forward telescoping errors. Most other studies in marketing have inferred telescoping errors when frequency estimates based on recall data were too high (Neter & Waksberg, 1964; Sudman & Bradburn, 1974).

The second objective of this article is to empirically validate the presence of telescoping errors in a relevant marketing research context. Time perception studies in psychology, where the actual date of an event was known, have shown that people systematically underestimated the time since the event (Loftus & Marburger, 1983; Underwood, 1977; Wagenaar, 1986). Moreover, forward telescoping errors were found to occur more often for salient events and events for which people had greater knowledge (Brown et al., 1985, 1986; Wagenaar, 1986). In a marketing context, one might therefore expect forward telescoping errors to occur for high-involve-
ment, infrequent purchases such as durable goods. Because most previous marketing studies examined frequently purchased nondurables rather than infrequently purchased durables, the studies did not permit such tests. In this study, I directly compared consumers' recalled purchase period of a durable good (a home personal computer) to the actual purchase period, and hence I could directly observe whether telescoping errors occurred. My specific conjecture (C) is:

C1: In recalling the purchase date for a durable good, consumers, on average, underestimate the actual date of purchase.

Does Recall Accuracy Decrease as the Time Since Purchase Increases?

Previous studies have used aggregate comparisons to show that recall accuracy decreases, backward telescoping errors decrease, and forward telescoping errors increase as the time since an event occurred increases (Underwood, 1977). However, few studies have examined how recall accuracy changes over time at the individual level. In the Jaeger and Pennock (1961) study, the consistency of responses decreased with the age of the washing machine (as reported in the first interview). For machines reported to be more than 5 years old, there was more forward (rather than backward) shifting of purchase dates from the first to the second recall occasion, a pattern consistent with forward telescoping. For machines reported to be between 1 and 5 years old, the net shift was consistent with backward telescoping. However, the evidence is not conclusive because the actual purchase date of the product was not known. In this study, I used individual level data to test the following conjectures regarding consumers' recalled purchase date of a durable good:

C2: Recall accuracy decreases as the time since purchase increases.
C3: Backward telescoping errors decrease as the time since purchase increases.
C4: Forward telescoping errors increase as the time since purchase increases.

Do Telescoping Errors Affect Future Purchase Intentions?

Telescoping errors are known to lead to biased estimates of how frequently events occur (Neter & Waksberg, 1964; Sudman & Bradburn, 1974) and thus to biased estimates of past purchase frequencies. However, such errors can also lead to biased estimates of future purchasing. A person who makes a forward telescoping error (i.e., thinks a product purchase occurred more recently than it actually did) may underestimate the probability that this product will break down or become obsolete in a given future time period and in turn underestimate future purchase intentions.
(see Kalwani & Silk, 1982, for a similar conjecture). Thus, a respondent who mistakenly recalls that he or she last purchased a VCR 4 years ago when actually it was purchased 6 years ago (a forward telescoping error) would likely underestimate the probability that this VCR would break down in the next year. Therefore, if asked how likely he or she would be to buy a new VCR in the next year, this respondent would probably underestimate the true likelihood. Similarly, if a respondent mistakenly recalls that a product is older than it actually is (a backward telescoping error), he or she might overestimate future purchase intentions. Such telescoping errors may also affect consumers' decisions whether to repair or to replace a malfunctioning product.

Purchase intentions are routinely used to forecast sales and market-segment-level purchase probabilities in future time periods (Morwitz & Schmittlein, 1992). If telescoping errors affect purchase intentions as just described, decisions based on such data would be questionable. Note that if consumers only make a replacement purchase once their current product actually breaks down or becomes obsolete, telescoping errors will not affect actual replacement sales but will still affect forecasted sales based on purchase intent. Therefore, an important goal of this article is to test whether telescoping errors affect future purchase intentions.

C5: Purchase intentions are understated with forward telescoping errors and are overstated with backward telescoping errors, relative to when recall is accurate.

Do Telescoping Errors Vary Across Demographic Segments?

Skowronski and his colleagues (Skowronski, Betz, Thompson, & Shannon, 1991; Skowronski, Betz, Thompson, Walker, & Shannon, 1994) noted relatively large individual differences in the accuracy of event recall, finding that women are more accurate than men. The authors suggested and tested several explanations for these differences (Skowronski et al., 1994). They found that across event domains, women are more likely than men to encode the exact date of an event in memory. In fact, women provided more accurate estimates than men for almost two thirds of the event domains considered. However, the study also found that men are more accurate than women in event dating for specific domains such as activities involving cars, home improvement, and rest/recreation, suggesting that knowledge or involvement with the activity may lead to greater accuracy. However, as noted earlier, other studies have found that forward telescoping errors are more likely for salient events and events for which people have greater knowledge (Brown et al. 1985, 1986; Wagenaar, 1986).

Skowronski and his colleagues speculated whether the observed gender effects would be replicated if other autobiographical memory methodologies were used.
In a study by Skowronski and Thompson (1990), participants initially kept a diary of their activities and at a later time were asked to recall when different activities had occurred. Gender differences in recall accuracy were eliminated when women’s tendency to write longer diary entries than men was controlled for. However, this tendency does not fully account for the gender effect in other studies (Skowronski et al., 1991). Allowing for the possibility of some variation driven by product category involvement, the literature suggests the following:

C6: Female respondents have more accurate recall of purchase events than male respondents.

Psychological studies of memory and aging have demonstrated a loss of memory function with increasing age (Craik, 1977). These studies typically compare memory performance on recall or recognition tasks across two or three age groups (Herzog & Rodgers, 1989). The results suggest that recall accuracy for past behaviors will decrease with increasing respondent age. However, the evidence from studies that examined age differences in the accuracy of survey reports of past behavior is mixed. Herzog and Rodgers (1989) found no decline in the accuracy of self-reports of past voting behavior with age. Herzog and Dielman (1985) found little evidence that older respondents were less accurate than younger respondents in self-reports of physical health, voting behavior, transportation, charitable contributions, and library patronage. In contrast, Herzog and Dielman found that older respondents were more likely to over- or underreport their chronological age than were middle-age or younger respondents. Sudman and Bradburn (1974, p. 86) found that respondents over 55 were more likely to underreport past purchasing for long time intervals than were respondents under age 55. Although the evidence is mixed, based on the latter studies, I tentatively speculate that recall accuracy for purchase events will be higher for younger respondents than for older respondents.

C7: Younger respondents have more accurate recall of purchase events than older respondents.

Differences in recall accuracy across demographic segments suggest the need for care in selecting the respondent to answer recall questions when several respondents are available (e.g., household-level reports) and the need to factor in respondent type when interpreting the responses. Many marketing studies examine differences in behavior across demographic segments. Differences in the reported frequency of a behavior across demographic segments may indeed reflect that the true rate of participation in the behavior varies across segments. However it is also possible that it is the propensity to make telescoping errors (rather than the true rate of participation) that varies across the segments. My empirical work explores observed differences in responses to a purchase recall question across demographic
segments in an effort to help marketing researchers understand the nature and sources of such differences.

EMPIRICAL ANALYSIS

Data

I used data from a consumer mail panel of U.S. households to examine the relation between the actual and recalled purchase period. The households are members of a large commercially available panel who (among other tasks) respond to multichannel mail surveys on a routine basis. The data are from a subset of 215 panel households that completed multiple mail questionnaires (either five or seven waves of ownership surveys) on home personal computers (PCs). None of these households had a PC at home at the beginning of the study, but all had acquired a single PC by the end. Households were later asked to indicate, during either one or two purchase timing surveys (separated by 1 year), the month and year in which they obtained their PC.

As shown in Table 1, the seven ownership surveys took place between July 1985 and January 1989. The purchase timing recall surveys took place in June 1988 and June 1989. During each ownership survey wave, respondents were asked (among other questions) whether they currently owned a PC at home. A household was coded as actually obtaining a PC during the time interval prior to the first ownership survey wave in which they indicated they currently owned a PC. For example, a household that indicated they did not own a PC during Ownership Survey Wave 1 and Ownership Survey Wave 2 and indicated they did own one during Ownership Survey Wave 3 was coded as actually purchasing the PC between January 1986

<table>
<thead>
<tr>
<th>Survey Wave</th>
<th>Time</th>
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<tbody>
<tr>
<td>Ownership Survey Wave 1</td>
<td>July 1985</td>
</tr>
<tr>
<td>Ownership Survey Wave 2</td>
<td>January 1986</td>
</tr>
<tr>
<td>Ownership Survey Wave 3</td>
<td>July 1986</td>
</tr>
<tr>
<td>Ownership Survey Wave 4</td>
<td>July 1987</td>
</tr>
<tr>
<td>Ownership Survey Wave 5</td>
<td>January 1988</td>
</tr>
<tr>
<td>Purchase Timing Survey 1</td>
<td>June 1988</td>
</tr>
<tr>
<td>Ownership Survey Wave 6</td>
<td>July 1988</td>
</tr>
<tr>
<td>Ownership Survey Wave 7</td>
<td>January 1989</td>
</tr>
<tr>
<td>Purchase Timing Survey 2</td>
<td>June 1989</td>
</tr>
</tbody>
</table>
(Wave 2) and June 1986 (Wave 3). I cannot know with certainty whether the household actually did buy in this period, but I assume that the reported change in ownership status is accurate. Thus, I use the terms actual and reported purchase periods synonymously. The recalled purchase period is taken from the purchase timing surveys in which the households reported the month and year in which they acquired their PC. I pooled the month and year data into 6-month intervals (January through June and July through December for each year), so that the actual and recalled time periods are on the same scale. For one time period (between Ownership Survey Waves 3 and 4) it was necessary to pool the month and year data into a 12-month period.

During Ownership Survey Wave 5 (January 1988), Wave 6 (July 1988), and Wave 7 (January 1989), respondents were also asked to respond to the following future purchase intentions question:

Do you or does anyone in your household plan to acquire a (another) personal computer in the future for use at home?
- Yes, in the next 6 months
- Yes, in 7 to 12 months
- Yes, in 13 to 24 months
- Yes, sometime, but not within 24 months
- No, but have considered acquiring one
- No, will not acquire one

Although the intention question asks respondents to indicate when they will purchase, responses to such scales are predominantly indicators of individuals’ (stationary) purchase rates for fixed time intervals, rather than of their purchase times per se (Morwitz, 1994; Morwitz & Schmittlein, 1992). Therefore, I treat the timed intent scale as if it were a “classic” intent scale by coding the levels as follows: 5 (Yes, in the next 6 months), 4 (Yes, in 7 to 12 months), 3 (Yes, in 13 to 24 months), 2 (Yes, sometime, but not within 24 months), 1 (No, but have considered acquiring one), and 0 (No, will not acquire one). These coded responses are then averaged.

Results

Table 2 reports the actual versus the recalled purchase period for 97 households who responded to all of the first five ownership survey waves, bought their PC sometime between Wave 1 and Wave 5, and responded to the first purchase timing survey during June 1988. Only 58.8% of the respondents accurately recalled their actual purchase period during the follow-up survey. Another 27.8% of the respondents thought they had bought their PC more recently than they actually had, whereas 13.4% recalled purchasing it farther back in time. Of those who recalled
<table>
<thead>
<tr>
<th>Actual Purchase Period</th>
<th>Percentage of Recalled Purchase Period</th>
<th>Percentage of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/85–12/85</td>
<td>16.67</td>
<td>37.50</td>
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<tr>
<td>1/86–6/86</td>
<td>6.76</td>
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<tr>
<td>7/86–6/87*</td>
<td>3.33</td>
<td>6.67</td>
</tr>
<tr>
<td>7/87–12/87</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>All respondents</td>
<td></td>
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<td>All respondents who</td>
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<tr>
<td>recall incorrectly</td>
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</tbody>
</table>

**Note**  The time of recall was June 1988

*The actual time period of 7/86 to 6/87 is twice the length of the other time intervals
TABLE 3
Actual Versus Reported Purchase Periods

<table>
<thead>
<tr>
<th>Actual Purchase Period</th>
<th>Percentage of Recalled Purchase Period</th>
<th>Percentage of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/85-12/85</td>
<td>15.38</td>
<td>35.89</td>
</tr>
<tr>
<td>1/86-6/86</td>
<td>9.10</td>
<td>9.10</td>
</tr>
<tr>
<td>7/86-6/87</td>
<td>2.08</td>
<td>4.16</td>
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<tr>
<td>7/87-12/87</td>
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<td>0.00</td>
</tr>
<tr>
<td>1/88-6/88</td>
<td>0.00</td>
<td>4.00</td>
</tr>
<tr>
<td>7/88-12/88</td>
<td>2.08</td>
<td>0.00</td>
</tr>
<tr>
<td>All respondents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All respondents who recall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>who recall incorrectly</td>
<td>55.81</td>
<td>28.37</td>
</tr>
<tr>
<td>who recall correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>who recall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The time of recall is June 1989

*The actual time period 7/86 to 6/87 is twice the length of the other time intervals
incorrectly, a significantly larger proportion of the respondents (67.5% vs. 32.5%) made forward telescoping errors versus backward telescoping errors, $\chi^2(1, N = 40) = 4.9, p = .027$. Table 3 reports the comparable results for 215 households that responded to all seven ownership survey waves, bought their PC sometime between Wave 1 and Wave 7, and responded to the second purchase timing survey during June 1989. (Some of these households also responded to the first purchase timing survey.) Only 55.8% of the respondents were able to accurately recall their actual purchase period, 28.4% made forward telescoping errors, and 15.8% made backward telescoping errors. Again, a significantly larger proportion of the respondents with inaccurate recall (64.2% vs. 35.8%) made forward telescoping errors than made backward telescoping errors, $\chi^2(1, N = 95) = 8.4, p = .0038$. These results support my first conjecture that, in the aggregate, consumers underestimate the actual purchase date of a durable good.

Figure 1 displays the average recalled (perceived) purchase period against the actual purchase period for these households. The average was computed by using the midpoint of each closed time interval. For the one open interval (earlier than July 1985), the midpoint from January 1985 to June 1985 was used. If recall errors are unbiased, the mean recalled time curve should lie along the 45° line shown in the graph. When the curve is above (below) the 45° line, on average respondents are making forward (backward) telescoping errors. Figure 1 reveals a forward telescoping bias for most time periods. The magnitude of the bias appears to increase with the true age of the product. Backward telescoping errors appear to occur only for recent purchases.\(^2\)

The data in Figure 1 show that recall accuracy decreases, the magnitude of forward telescoping errors increases with the time since purchase, and backward telescoping errors occur only for recent purchases. I test this using three logistic regression models based on the June 1989 recall data. In the first model I regressed a binary variable (whether or not a respondent accurately recalled the purchase interval) as a function of the number of months since purchase. The probability of accurate recall significantly decreases with the time since purchase, $\chi^2(1, N = 215) = -18.93, p < .001$. In the second model I regressed a binary variable (whether or not the respondent made a forward telescoping error) on the number of months since purchase. There is directional but not statistically significant, $\chi^2(1, N = 215) = .1414, p = .71$) evidence that the probability of forward telescoping errors increases with the time since purchase. Finally, I regressed a binary variable (whether or not a respondent made a backward telescoping error) on the number of

\(^2\)Note that backward telescoping errors may be due to an endpoint effect. Consider a respondent who bought a product yesterday, and today is asked to indicate when the product was purchased. This respondent can indicate that the product was purchased today, yesterday, or any infinite number of dates in the past. As the respondent can only make a forward telescoping error in one way (by reporting today) but can make backward telescoping errors in many ways, I would expect the observed result.
months since purchase. The results indicate that the probability of making a backward telescoping error significantly decreases with the number of months since purchase, \( \chi^2(1, N = 215) = -24.64, p < .001 \).

Although the probability of making a forward telescoping error did not vary significantly with the number of months since purchase, it is possible that the magnitude of forward telescoping errors increases with the number of months since purchase. The correlation between the number of months since purchase and the difference in months between the recalled purchase period and the midpoint of the actual purchase period was positive and significant \( (r = .35, p < .001) \). Thus, the magnitude of forward telescoping errors increases with the time since purchase. Repeating this analysis with the starting and ending point of each purchase period showed similar results.

The conclusion that the magnitude of forward telescoping errors increases with the time since purchase was based on a between respondent analysis. A stronger test of this bias would be to examine how recall accuracy changes over time within
respondents. To that end I examined the recall data provided by respondents who
recalled their purchase date on two separate occasions separated by 1 year (the two
purchase timing surveys). These respondents all bought their PC between Owner-
ship Survey Wave 1 (July 1985) and Wave 5 (January 1988). They were asked in
both June 1988 and June 1989 to provide the month and year of their PC purchase.
For the 53 respondents who met these criteria, I examined how their recall changed
over time. In general, respondents' accuracy is low. Only 39.6% of the respondents
accurately recalled their purchase period on both occasions. Another 15.1% of the
respondents provided inaccurate responses but were consistent both times. (Of
these, 75% made forward telescoping errors and 25% made backward telescoping
errors.) The remaining 45.3% of the respondents had a change in recall from June
1988 to June 1989. Of the respondents who changed their recall date, a significantly
larger percentage stated a more recent date (70.8%) than stated a later date (29.2%)
the second time they were asked, $\chi^2(1, N = 24) = 4.17, p = .041$.

Overall, the results support C2, C3, and C4. Recall accuracy decreases as the
time since purchase increases. Backward telescoping errors decrease as the time
since purchase increases. The magnitude of forward telescoping errors increases as
the time since purchase increases. However, the probability of forward telescoping
errors does not vary significantly with time in this study.

I next examined whether errors of recall affect respondents' forecasts of their
future behavior. Specifically I explore whether respondents who make recall errors
differ in their future purchase intentions from respondents who recall accurately.
Table 4 reports respondents' intentions to buy a replacement PC separately for those
with accurate recall, those who made forward telescoping errors, and those who
made backward telescoping errors.

<table>
<thead>
<tr>
<th>Time of Recall</th>
<th>Type of Recall Error</th>
<th>Mean Intent</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1988 (intentions measured in</td>
<td>Backward telescope</td>
<td>2.4</td>
<td>13</td>
</tr>
<tr>
<td>January 1988)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No error of recall</td>
<td>.85</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Forward telescope</td>
<td>1.6</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Backward telescope</td>
<td>1.6</td>
<td>13</td>
</tr>
<tr>
<td>June 1988 (intentions measured in</td>
<td>No error of recall</td>
<td>1.3</td>
<td>57</td>
</tr>
<tr>
<td>July 1998)</td>
<td>Forward telescope</td>
<td>1.1</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Backward telescope</td>
<td>2.1</td>
<td>34</td>
</tr>
<tr>
<td>June 1989 (intentions measured in</td>
<td>No error of recall</td>
<td>.7</td>
<td>116</td>
</tr>
<tr>
<td>January 1998)</td>
<td>Forward telescope</td>
<td>1.8</td>
<td>60</td>
</tr>
</tbody>
</table>
For each time period, I conducted an analysis of covariance, examining purchase intention as a function of recall accuracy at three levels (backward telescoping, no error of recall, and forward telescoping) and using the actual purchase period as a covariate. In all three time periods, intentions are larger for those who make backward telescoping errors than for those who have no errors of recall. This difference is highly significant for January 1989 intentions, $F(1, 92) = 3.97, p = .024$, and marginally significant for the January 1988 period, $F(1, 67) = 2.24, p = .07$, and the July 1988 period, $F(1, 68) = 1.67, p = .10$, based on planned, one-tailed contrasts. Intentions for those who make forward telescoping errors are not significantly different from the intentions for those who have no errors of recall for all three time periods (all $p$s > .15). Finally, intentions for respondents who make backward telescoping errors are higher than for those who make forward telescoping errors for all three time periods. The differences are significant for January 1988, $F(1, 37) = 3.78, p = .030$, and July 1988, $F(1, 38) = 3.30, p = .038$, but not for January 1989 intentions, $F(1, 174) = 1.23, p = .135$.

Overall, these results provide directional (but not always statistically significant) support for C5: Telescoping errors affect future purchase intentions. In retrospect, backward telescoping errors may have a larger influence on purchase intentions than forward telescoping errors for several reasons. First, respondents who make different types of recall errors may differ in systematic ways. For example, respondents who make backward telescoping errors might be more experienced or more frequent PC users than other respondents. They may have also had previous experience with a computer at work, and this may have biased their estimate of when they purchased their home PC. Their experience with computers outside of the home (and not their tendency to backward telescope) could drive increased purchase likelihood. Alternatively, frequent users might erroneously believe that they have been using the product for a longer period of time than is actually the case. Thus, differences in usage frequency, rather than the tendency to make backward telescoping errors, may drive the differences in future purchase intentions. We did not control for such differences. Second, future PC purchases may not always be replacement purchases due to product breakdown or obsolescence (i.e., households may have reasons to own multiple PCs). As such, one might not find a strong relation between errors of recall and future intent. For example, early adopters of PCs may be both more likely to make forward telescoping errors and more likely to purchase multiple PCs than other households. One might therefore expect a weak relationship between forward telescoping errors and future purchase intentions.

I next examine whether recall accuracy is related to respondent gender or age. The results are summarized in Table 5. Although households with only a female head of household made fewer (33.3%) recall errors in the purchase date of a PC than households with only a male head (60.9%), the difference is not statistically significant, $\chi^2(1, N = 65) = 1.98, p = .159$. Men are three times more likely (43.5%)
than women (14.3%) to make forward telescoping errors, $\chi^2(1, N = 65) = 5.15, p = .023$, but there are no significant difference between men and women in the tendency to make backward telescoping errors, $\chi^2(1, N = 65) = .022, p = .882$.

The results provide further support for the robustness of gender differences in the accuracy of dating past events. I replicated the finding that the women are more accurate and are less likely to make forward telescoping errors than men. This study differs from others that demonstrate gender differences in several ways. First, this study holds the memory event constant (i.e., for all respondents the event is a PC purchase). Previous studies have found that forward telescoping errors are associated with salient events. If a PC purchase is more salient or involving for men than women, these results are consistent with previous findings that knowledge or involvement is positively associated with the propensity to make forward telescoping errors. Second, the research methodology is also different. Skowronski and Thompson (1990) had respondents keep diaries of autobiographical events and found that the gender effect was at least partially mediated by women tending to write longer diary entries than men. My findings, based on a different methodology, suggest that gender differences in recall accuracy are not an artifact of the diary methodology.

As shown in Table 5, the tendency to make forward telescoping errors is significantly associated with respondent age, $\chi^2(4, N = 215) = 9.59, p = .048$. All panel members are adults, 18 years of age or older. The tendency to make forward telescoping errors varies marginally across the three age groups, $\chi^2(2, N = 215) =$
5.43, \( p = .066 \). This tendency is significantly greater, \( \chi^2(1, N = 174) = 3.86, p = .049 \), when the head of household is 18 to 30 years of age (45.5%) than when the head is 31 to 60 years of age (23.0%), and it is marginally greater, \( \chi^2(1, N = 193) = 3.13, p = .077 \), when the head of household is 61 or older (39.0%) than when the head is 31 to 60 (23.0%). There were no significant differences in the likelihood of making recall errors, \( \chi^2(2, N = 215) = 1.84, p = .399 \), and in the likelihood of making backward telescoping errors, \( \chi^2(2, N = 215) = 2.32, p = .314 \), across the three age groups. Although the data do not support C7 (i.e., I find no evidence that recall accuracy declines with age), I find a U-shaped relation between age and tendency to make forward telescoping errors. Younger and older consumers are more likely to make forward telescoping errors than middle-age respondents. It is possible that purchasing a PC is a more salient event for younger consumers who might be using it for work and older consumers who might purchase it as a retirement hobby than for middle-age consumers who may have purchased a computer for use by children in the household. Unfortunately, the data do not allow for testing these conjectures.

**DISCUSSION**

**Summary of Results**

This study of telescoping errors and their implications in the context of recalling the purchase period of a durable good suggests four major conclusions.

1. Respondents are quite inaccurate in recalling the period of a past purchase. On average, respondents displayed forward telescoping biases (i.e., thought they bought more recently than they actually had). Across respondents, the magnitude of the forward telescoping bias increased, whereas the likelihood of making backward telescoping errors decreased with the time since purchase.

2. Forward telescoping errors within respondents also increased over time for those who were asked to recall their purchase period twice.

3. Respondents who made backward telescoping errors overstated their intent to buy a replacement product relative to those who made forward telescoping errors and those with accurate recall.

4. There were significant differences in the tendency to make forward telescoping errors across demographic segments.

Overall the tendency to make forward telescoping errors was greater for men than for women and for younger and older adults relative to middle-age adults. The results are especially noteworthy because they were extracted from the same data set using the same group of respondents.
Limitations

The observed levels of forward telescoping in these data may be conservative. The panel members provide information about their PC ownership on a regular basis and were asked the purchase timing questions on two separate occasions. Therefore, these respondents may have more access to when they bought their PC relative to a comparable group that had not been sensitized. For example, when asked once when he or she bought his or her computer, a respondent might actually check a purchase record reducing recall error on the subsequent question occasion. In addition, Skowronski et al. (1994) suggested that respondents should be more accurate in providing the date of an event than in estimating how much time has passed since the event. Because our survey respondents estimated the month and year of the purchase, the degree of telescoping errors may have been lower than if they had been asked to estimate how many months (or years) ago they purchased their PC.

Implications

Although the results may be conservative, they still indicate an overall low level of accuracy and a substantial amount of telescoping error. Now consider a manager who uses the data described in this article to develop a forecast of PC sales for the first half of 1989. Suppose that he or she assumes that the expected volume of sales to new PC buyers in the first half of 1989 is a function of observed sales from the first half of 1988. Reliance on recall data such as in Table 3 would overestimate sales by 20% (i.e., recalled purchase of PCs in the first half of 1988 overestimates the actual number of PCs purchased in that period by 20%). The manager might also assume that some fraction of consumers who purchased their PCs prior to 1986 will replace them in 1989 because of obsolescence. Reliance on these recall data could lead the manager to underestimate replacement purchases by more than 25%.

These results have important practical and theoretical implications. I validated that respondents provide biased estimates of when products were purchased, and if these estimates are used to forecast future sales, these forecasts also will be biased. Moreover, this research showed that telescoping errors lead to biases in respondents' future purchase intentions. Purchase intentions are routinely used to forecast subsequent sales (Morwitz & Schmittlein, 1992). When telescoping errors occur, reliance on purchase intentions could lead to biased forecasts and suboptimal managerial decisions. Telescoping errors could also lead to suboptimal decision making from the consumer's perspective. Erroneous assessments of time since purchase could lead consumers to underestimate the need to repair, upgrade, or replace existing products.

The empirical results presented in this and other articles suggest the need for methods for reducing telescoping errors. Previous studies have suggested that the
use of bounded recall (Neter & Waksberg, 1964; Sudman & Bradburn, 1974),
directing participants to finer time intervals, and providing respondents with a
well-known or personal time cue (Loftus & Marburger, 1983) can reduce telescop-
ing. Alternatively, mathematical models of telescop ing phenomena can be used to
estimate the magnitude of the bias (e.g., Huttenlocher et al., 1990; Sudman &
Bradburn, 1974) and remove it. These results show that the magnitude of forward
telescoping errors increases and the percentage of respondents who made backward
telescoping errors decreases with the time since purchase. In addition, demographic
segments differ significantly in recall accuracy. Hence, models developed to adjust
for telescop ing effects should account for changes in accuracy over time and
heterogeneity in accuracy across demographic segments.

A Propositional Inventory for Future Research

In conclusion, I offer a propositional inventory for testing in future studies of
telescoping errors in marketing research. I focus on how the level of recall accuracy
and the propensity to make forward versus backward telescoping errors when
recalling a product purchase date may vary by product, respondent, and situational
factors.

Product characteristics. Respondents’ accuracy in recalling the purchase
date of a product is likely to be a function of the product’s purchase and its usage
frequency. First, frequently purchased products (e.g., packaged goods) are more
likely to have been purchased recently than infrequently purchased goods (e.g.,
durables). Because recall accuracy is related to the time since purchase, I expect to
observe higher recall accuracy for frequently purchased products. When recall
ers occur, because the tendency to make forward versus backward telescoping
errors is related to the time since purchase, I expect on average to observe forward
telescoping errors for infrequently purchased goods and backward telescoping
errors for frequently purchased goods. Thus, I propose (P):

P1: Average interpurchase time for a product is negatively related to recall
accuracy and positively related to the tendency to make forward versus
backward telescoping errors.

Second, how often and how regularly a product is used should also affect
consumers’ accuracy in recalling when the product was purchased. Recall of
particular usage occasions such as the first usage (and the associated purchase) may
be more difficult for frequently used products than infrequently used products.
Therefore, the level of accuracy associated with recalling when a product was
purchased my decrease with increasing product usage. Furthermore, for frequently
used products, because each use occasion is not distinct, product usage may be viewed as routine. Hence, it may be difficult to imagine not having used the product in the past. Consumers may therefore believe they have owned the product for longer than is actually the case (i.e., they make backward telescoping errors). In contrast, for infrequently used products, a given usage occasion is likely to be more salient. Hence, consumers may be more likely to infer that they purchased their product more recently than is actually the case (i.e., they make forward telescoping errors). Based on this reasoning:

P2: Frequency of product usage is negatively related to recall accuracy and negatively related to the tendency to make forward versus backward telescoping errors.

Respondent characteristics. Recall accuracy and the tendency to make forward versus backward telescoping errors is also likely to vary with characteristics of the respondent such as the respondent’s involvement or knowledge about the product and whether the respondent is making a first-time or a repeat purchase. Overall, one expects recall accuracy to be higher for respondents who are knowledgeable and involved with the product than for less knowledgeable and involved respondents. However, when recall errors are made, one expects a greater tendency to make forward versus backward telescoping errors with increasing product knowledge and involvement. I previously attributed the findings regarding gender- and age-related differences in the tendency to make forward telescoping errors to differences in respondents’ involvement or knowledge about the product. Consistent with these and other findings (Brown et al., 1985, 1986; Wagenaar, 1986), respondents with high levels of product involvement or knowledge are likely to have stronger memories of purchasing the product and may believe they purchased the product more recently than is actually the case. In contrast, respondents with low levels of product involvement are likely to have weaker memories of the purchase and may therefore infer that they purchased the product further back in time than they actually did. Hence:

P3: Product involvement and knowledge are positively related to recall accuracy and positively related to the tendency to make forward versus backward telescoping errors.

Memories concerning first-time purchases of a product are likely to be easier to recall than later, repeat purchases. We therefore expect recall accuracy to be higher for first-time purchases than repeat purchases. When recall errors occur, we expect first-time purchasers to be more likely to make forward versus backward telescoping errors. Consistent with this, all respondents in the survey data were making a
first-time purchase of a PC, and on average, these respondents tended to make forward telescoping errors. We expect this occurs in general because memories of first purchases are probably stronger and more salient than memories of repeat purchases. Repeat purchasers may retrieve memories about the timing of all of the past purchase occasions. Such respondents may therefore think that their most recent purchase occurred further back in time than is actually the case. Therefore:

P4: In recalling the most recent purchase, first time (repeat) purchasers of a product are more (less) likely to have accurate recall and more (less) likely to make forward versus backward telescoping errors.

Situational effects. Situational effects are also likely to affect respondents’ recall accuracy and their propensity to make forward versus backward telescoping errors. Such factors may include how and where the product was marketed or purchased, the price paid, and whether or not the purchase was tied to a specific event (e.g., a vacation or a birthday). In addition, how respondents are asked to recall the product purchase may affect respondents’ recall accuracy and likelihood of making forward versus backward telescoping errors.

When consumers purchase a product in a retail location where they shop frequently, their memory of the specific product purchase may be less distinct than when they purchase it in a retail environment where they shop less frequently. Therefore, recall accuracy may be lower. When recall errors are made, respondents may be more likely to make forward than backward telescoping errors when they recall a purchase in an unusual location because of the salience of the purchase memory. However, when respondents recall a purchase that occurred somewhere that they shop frequently, the specific purchase occasion will be harder to recall and appear to be further back in time than it actually is. Therefore:

P5: In recalling a specific purchase at a retail location, consumers’ frequency of shopping at that location is negatively related to recall accuracy and negatively related to the tendency to make forward versus backward telescoping errors.

Consumers are likely to deliberate more when they consider purchasing expensive versus less expensive products. Therefore, holding constant other aspects of the purchase decision (e.g., a special sale), their memories of purchases of expensive products are likely to be stronger, suggesting greater recall accuracy. At the same time, such purchases may be more salient than memories of purchasing less expensive products, implying a higher probability of forward telescoping when recall errors do occur. Thus:
P6: The price of a product is positively related to recall accuracy and positively related to the tendency to make forward versus backward telescoping errors.

The type of purchase occasion may also affect respondents' likelihood of making telescoping errors. When a product purchase is related to a specific event (e.g., a birthday, anniversary, or vacation), the surrounding associations may allow respondents to infer accurately when the purchase occurred. The presence of such cues should increase recall accuracy when a product purchase is related to a specific event. When the specific date of the event is not coded in memory or accurately inferred, the increased salience of the special event may lead to an increased likelihood of making forward versus backward telescoping errors. Thus:

P7: Purchases related to a specific event are positively related to recall accuracy and positively related to the tendency to make forward versus backward telescoping errors.

Recall accuracy may also be a function of how the recall question is framed. For example, it may be easier for respondents to provide accurate answers to behavioral frequency questions ("how many") than to accurately estimate the date an event occurred ("date when"), because event dates are rarely encoded in memory (Wagenaar, 1986). In turn, Skowronski et al. (1994) suggested that answers to "date when" questions should be more accurate than answers to questions concerning how much time has passed since the event ("how long ago"). Perhaps a "date when" framing suggests to the respondent that a greater level of accuracy is desired in the response than a "how long ago" framing.

When recall errors occur, respondents are more likely to overestimate than underestimate answers with a "how many" framing (assuming the product purchase is socially desirable) because of demand effects (Sudman et al., 1984). Respondents may include purchases from periods outside the period of interest in their estimate of "how many" to appear to be a "good" respondent. Therefore, one should expect on average to observe forward versus backward telescoping errors for a "how many" framing.

The predictions for "date when" and "how long ago" framings are less clear. I speculate that forward telescoping errors will be more likely than backward telescoping errors for a "how long ago" framing because respondents may believe recent events are more desirable than distant events. However, I expect this tendency to be smaller than for a "how many" framing. As in this research, one may observe forward telescoping errors in the aggregate for a "date when" framing. However, at the individual level, the propensity to make forward versus backward telescoping errors will depend on how recently the actual purchase occurred. I therefore do not offer propositions concerning whether I expect a higher or lower
propensity to make forward versus backward telescoping errors for the “date when” versus “the how long ago” and “how many” framings. Overall:

P8: The type of recall question will affect respondents’ recall accuracy. Recall accuracy will be highest for a “how many” framing, next highest for a “date when” framing and lowest for a “how long ago” framing. When recall errors occur, the propensity to make forward versus backward telescoping errors will be higher for the “how many” framing than for the “how long ago” framing.

CONCLUSION

Beyond an empirical research agenda testing these propositions, there is a need to explore the causes of telescoping errors. Does memory itself contain a biased representation of time or are telescoping errors solely a function of the recall process? The memory processes used to answer behavioral frequency, recalled duration, and recalled date questions are of interest in this regard. This level of process understanding may allow discrimination of other memory problems (e.g., errors of omission) that may co-occur with telescoping errors and accentuate or mask the effects of the latter.

Time perception has been studied by researchers in several different fields using diverse methodologies. For example, cognitive psychologists primarily use experiments, whereas social psychologists employ observational or autobiographical methods. Survey researchers typically examine secondary data or use field experiments to study the responses to survey questions. Much remains to be gained by taking a substantive and interdisciplinary perspective and blending multiple methodologies. Although it is known that consumers’ individual memories and experiences affect their purchase patterns, time perception studies at the disaggregate level are rare. Future work should further explore the impact of individuals’ memories and memory errors on their attitudes, future purchase intentions, and purchase behavior. The impact of autobiographical memory on future behavior remains both important and underresearched.

ACKNOWLEDGMENTS

The inspiration for this article comes from the song entitled “Sunrise Sunset” from the musical Fiddler on the Roof.

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