Age Differences in Consumers' Processing Strategies: An Investigation of Moderating Influences

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Relative to younger adults, older adults appear to exhibit greater use of schema-based, as opposed to detailed, processing strategies. This relationship is investigated in an experimental study that examines the moderating influences of two marketing-relevant variables, incongruity of message items and optimal time of day. Signal detection analysis performed on recognition measures serves as a basis for assessing strategy use. Both older and younger adults, during their optimal times of day (morning and evening, respectively), engage in detailed processing, but this tendency is particularly pronounced for the elderly when exposed to high-incongruity cues. By contrast, during their nonoptimal time of day, older adults seem to rely on schema-based processing regardless of the level of incongruity, whereas younger adults remain relatively detailed in their processing strategies. Theoretical and practical implications for marketing are discussed.

Among the significant trends currently shaping North American demography is the aging of the baby boomer generation. With birth rates declining and life expectancies increasing, the elderly segment of the population is expected to continue on its path of disproportionate growth for several decades to come. This phenomenon has recently garnered a good deal of media attention, and, consequently, marketers have started to identify and develop products and services that would appeal to the elderly segment. But while there appears to be widespread agreement about the importance of more effectively targeting and communicating to the senior market, relatively little theory-based research exists in the consumer behavior literature to guide marketers in addressing these issues. Efforts to understand the elderly consumer have thus far tended to appear in one of two forms, either literature reviews (see, e.g., Phillips and Sterntthal 1977; John and Cole 1986) or applied research on the changing nature and roles of elderly consumers, which was not intended to address theoretical issues (see, e.g., Greco [1989]; Tepper [1994]; Ursic, Ursic, and Ursic [1986]; for notable exceptions, see Cole and Gaeth [1990]; and Cole and Houston [1987]). The relatively small number of theoretically motivated investigations of elderly consumers is somewhat surprising in light of the volume of theoretical and empirical research that has been undertaken by gerontologists and cognitive aging psychologists in the last decade.

Although a variety of substantive issues regarding cognitive aging resist consensus, a general finding in the literature is that older adults exhibit memory deficiencies when compared to their younger counterparts (Kausler 1990; Salthouse 1991). A number of theoretical explanations have been advanced by cognitive aging researchers to explain such age-related impairments in memory. A widely accepted theoretical approach involves conceptualizing age differences in cognitive performance as a reflection of reduced processing resources available to older adults (see, e.g., Craik 1983; Craik and Byrd 1982; Hasher and Zacks 1979; Zacks and Hasher 1988).

To the extent that people's processing resources diminish with age, older people, when compared to younger people, would be expected to rely on less effortful processing strategies. Accordingly, one might expect an age-related shift from relatively detailed processing of information content to more heuristic or schema-based forms of processing. Consistent with this notion, researchers who adopt a life-span developmental approach to the

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study of adulthood (e.g., Labouvie-Vief and Schell 1982; Rybash, Hoyer, and Roodin 1986) postulate that people tend to rely increasingly on experiential and contextually based forms of processing as they age. This view holds considerable intuitive appeal, in that it suggests an ability to be adaptive and to compensate for age-related loss in processing capacity.

Indeed, previous research suggests that older people tend to rely differentially on schema-based processing whereas younger people are relatively more likely to engage in detailed processing (Hess 1990; Reder, Wible, and Martin 1986). Schema-based processing is generally considered to be easier to engage in than detailed processing because it involves assessing information at a theme or schema level rather than at the level of specific details. In contrast, detailed processing requires the ability to perform the relatively effortful task of directly searching memory contents and making exact memory matches, which may exceed older adults’ processing capacity.

The preceding line of reasoning suggests that it would be possible to influence the magnitude of age differences in processing strategies by varying the process-resource requirements of a task, or the processing capacity or efficiency of older versus younger adults. The purpose of the present research is to investigate age-related differences in the use of processing strategies and, to the extent that differences do exist, examine what factors might have a moderating influence on them.

THEORETICAL BACKGROUND

Our analysis of age-related processing differences is based on current theoretical notions concerning age-related variations in processing resources and working memory capacity (see, e.g., Craik and Byrd 1982; Zacks and Hasher 1988). Specifically, aging is thought to be associated with a reduction in available processing capacity, and, as demands on capacity increase, the memory performance of older adults relative to younger adults is disproportionately impaired. In the present research, I postulate that a complex interaction of subjects, materials, and task variables can represent varying levels of processing resources required of and available to an individual.

Accordingly, I conceptualize an individual’s processing strategy or level of memory performance as varying not only as a function of age, but with external factors (e.g., nature of to-be-remembered materials, type of test, rate of presentation/pacing, instructions, and incentives/rewards) as well as subject-related factors (e.g., optimal time of day, verbal ability, prior knowledge, motivation, and health). While the view advanced by John and Cole (1986) that age differences in memory abilities are contingent upon interactions among various task factors is consistent with the theory presented here, I explicitly posit that individual difference variables such as optimal time of day can also serve in a moderating role.

In the present research, two factors are specifically considered with regard to how they might affect age differences in use of processing strategies: message incongruity (an external factor) and optimal time of day (a subject-related factor). These factors are selected for study not only because they are of theoretical interest (in that they represent conditions with varying levels of processing resource requirements and availability), but because they are potentially actionable dimensions of practical interest to marketers.

Incongruity. One factor that has been found to stimulate greater detailed processing is the presence of information that is incongruent with expectations. In general, when people are exposed to message items that are inconsistent or incongruent, they attempt to reconcile or integrate these items with the remainder of the message information (Hastie 1980; Srull 1981), such that the items in question are better recalled and recognized than those consistent with expectations. In studies with younger subjects, better memory for incongruent than congruent information has been reported for scenes (see, e.g., Friedman 1979), scripts (see, e.g., Bower, Black, and Turner 1979), objects in real-world settings (see, e.g., Pezdek et al. 1989), as well as traits or personality characteristics (see, e.g., Hastie and Kumar 1979). Results consistent with this view have also been obtained in consumer studies; for instance, when consumers are exposed to product information containing high-incongruity items, they tend to be relatively detailed in their processing of individual product attributes (Meyers-Levy and Maheswaran 1991; Meyers-Levy and Tybout 1989; Sujan 1985).

Within the aging and memory literature, the extant research on incongruity is mixed in its conclusions, and so it is difficult to supply it with an overarching framework. In general, older adults and younger adults do appear to exhibit a similar pattern of results regarding their ability to detect perceptual and semantic inconsistencies across a variety of domains (i.e., both younger and older adults generally have better memory for inconsistent than consistent information; Hess and Tate 1991; Light and Anderson 1983; Mäntylä and Bäckman 1992; Zelinski and Miura 1988). However, at least two central issues remain unresolved with respect to the effects of incongruity and aging. First, it is unclear whether age differences exist in the magnitude of the incongruity effect. Whereas some studies suggest that younger adults perform better than older adults at remembering incongruent information (see, e.g., Hess and Slaughter 1990; Hess and Tate 1991), others seem to suggest no age difference in this regard (see, e.g., Light and Anderson 1983; Mäntylä and Bäckman 1992). The specific reasons for such discrepancies across studies are unclear, because of variations in stimuli and experimental procedures. In accord with my theoretical view, I postulate that the effect of incongruity on age-related processing differences can be understood as a function of the materials used and task demands. For example, when a task is not particularly resource-demanding (e.g., exposure to highly meaningful materials),
older adults may be as capable as younger adults in accurately detecting changes in incongruent items. However, in situations that are relatively more resource-demanding (e.g., exposure to complex and novel stimuli), older adults might be expected to encounter more difficulty processing incongruent items than younger adults. It would thus be reasonable to expect that older adults will be relatively impaired in their processing of incongruent information, to the extent that task demands exceed the limits of their processing resources.

The second unresolved issue regarding the effects of incongruency on different age-groups involves whether or not age-related processing differences decline, increase, or remain constant across levels of incongruence. No study has yet been conducted to clarify the systematic relationships between aging and different levels of incongruency. Thus, a goal of the present research is to provide a theoretical account of differential effects of age on memory performance and strategy use across varying levels of incongruence, as well as an empirical investigation of this account.

The so-called capacity view of mental activity, as advanced by Kahneman (1973), provides a useful basis for conceptualizing age differences in processing across different levels of incongruence. In his influential book on attention and effort, Kahneman (1973) asserts that a rise in the demands imposed by a mental activity may serve to increase the availability of momentary capacity. But, given that older adults, relative to younger adults, are thought to have decreased availability of processing resources, we might speculate that the momentary availability of processing capacity available to older adults occurs at higher levels of incongruence. Specifically, I postulate that older adults are capable of benefiting from an additional boost to capacity from exposure to incongruity, but that it occurs when performing a task involving high, compared to low, levels of incongruence. In other words, whereas younger adults possess the processing capacity necessary for sensitivity to even low levels of incongruence (as shown by Meyers-Levy and Maheswaran [1991]), older adults may require higher levels of incongruence to experience a similar boost to resource capacity. Items that are only mildly atypical may be unlikely to promote elaborate, detailed processing in older adults; they might, for instance, tend to view the minor aberration in cue content as irrelevant, rather than incongruent, with respect to the relevant schema. We would thus expect that with mildly discrepant information, older adults rely primarily on schema-based processing; but when aided by the nature of the stimuli (e.g., high-incongruity cues), they may be induced to engage in more detailed processing. In sum, I propose that younger adults engage in relatively detailed processing across different levels of incongruence, whereas older adults will be stimulated to engage in detailed processing only when the incongruity of the incoming message is relatively high. As such, we might expect the magnitude of the age differences in processing strategies to be smaller when exposed to high-incongruity compared to low-incongruity items.

**Optimal Time of Day.** A second factor of primary interest in the present research concerns the tendency for individuals to achieve optimal performance in cognitive tasks (as well as numerous other types of tasks) when there is a match between their peak in circadian arousal and the time of testing, a phenomenon termed the “synchrony effect” by May, Hasher, and Stoltzfus (1993). Previous research has long suggested a relationship between time of day and many different types of human performance (Blake 1967; Colquhoun 1971; Brown and Graeber 1982). Studies on circadian rhythms and human memory processes have attributed time-of-day effects to variations in arousal levels, which have been shown to be associated with changes in body temperature as well as performance efficiency in a variety of memory tasks (Folkard 1982). Furthermore, people have been found to reach acrophase (peak performance time) at a consistent level of circadian arousal, occurring at fairly regularly timed points in the day; however, some people have been found to reach their peak in the morning, whereas others do so in the evening (Horne and Östberg 1977). These findings have led researchers to suggest recently that individual differences in peak performance periods may moderate general time-of-day effects (Anderson et al. 1991; Bodenhausen 1990; May et al. 1993; Petros, Beckwith, and Anderson 1990). The studies used Horne and Östberg’s (1976) Morningness–Eveningness Questionnaire (MEQ) to assess individuals’ peak time of day. This self-assessment questionnaire has been widely used to categorize people as “morning” versus “evening” types. Specifically, performance of individuals who are “morning” types has been found to peak in the morning and decline across the day, while that of “evening” types improves across the day (Anderson et al. 1991; Petros et al. 1990).

On the basis of the evidence that there are indeed individual differences in peak performance times (which may in turn affect the capacity and efficiency of working memory), Bodenhausen (1990) examined the extent to which being tested during an optimal time period, versus a nonoptimal time period, affected people’s tendency to engage in analytic processing or to rely on stereotypes when making social judgments. He found that subjects exhibited greater stereotypic biases when judgments were rendered during a nonoptimal time of day (i.e., in the evening for “morning people” and in the morning for “evening people”). Other studies involving memory processes have demonstrated that optimal time of day influences recall of prose (Petros et al. 1990), as well as speed of retrieval of physical, nominal, and semantic information from memory (Anderson et al. 1991).

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"The term “circadian” (circa + dies in Latin, meaning “about a day”) is typically used to denote the approximately 24-hour physiologic rhythm, which has been observed in virtually all plants and animals, under near-constant environmental conditions (Halberg et al. 1959)."
With respect to aging, there is mounting evidence that the vast majority of older adults are "morning types" (i.e., reach their mental peak in the morning), whereas younger adults (particularly those of college age) tend to reach their peaks in the late afternoon or evening (Hoch et al. 1992; May et al. 1993; Mecacci et al. 1986), and that age-related differences are greatly reduced when memory performance is assessed in the morning (May et al. 1993). Indeed, May et al. (1993) suggest a number of potentially serious concerns when time-of-day effects are excluded from aging studies. They investigated the extent to which a match between acrophase and time of testing contributes to age-related differences in performance, finding that differences in optimal performance periods clearly influence recognition accuracy for both younger and older adults. In particular, they found that younger adults exhibited better recognition when tested during their peak performance period (in the afternoon) than during their nonpeak performance period (in the morning); their hit rate was higher in the afternoon than in the morning, while the reverse was true for false alarms. Likewise, older people were better at recognition at their peak time (in the morning) than at their nonpeak time (in the afternoon). Their hit rate remained quite high across the day, while their false alarm rates increased in the afternoon. This pattern of results appears to be consistent with the suggestion that, throughout the day, older people increasingly rely on schema-based processing, whereas younger people engage in relatively greater amounts of detailed processing.

These studies have clear implications for assessing strategy-use differences based on age. Specifically, they suggest that the effects of a match (or mismatch) between acrophase and time of testing can affect the type of processing strategies used by younger and older people. Further, older people may have greater processing resources available in the morning, such that presenting information in the morning, as opposed to afternoon or evening, may serve to reduce age-related processing differences.

Incongruity and Optimal Time of Day. Of major interest in the present research is how incongruity and optimal time of day might together influence age differences in processing. In particular, I seek to examine the extent to which these two factors influence older adults to engage in more detailed processing not only compared to other older adults, but relative to younger adults as well. Presence of high-incongruity cues and optimal time of day are both conditions that are likely to enable and stimulate detailed processing. As such, we might expect older adults to engage in detailed processing when presented with high-incongruity cues in the morning, while we expect younger adults to do so in the afternoon or evening. To the extent that processing occurs in the morning, we might expect older adults to engage in greater detailed processing of high-incongruity message items compared with younger adults, because the older adults not only benefit from increased resource capacity during their peak time of day but also are aided by the nature of the message itself to engage in detailed processing. Conversely, younger adults are expected to engage in extremely detailed processing in the afternoon, such that age differences in processing of high-incongruity items are increased in the afternoon. The predictions with respect to age differences in processing of low-incongruity cues are less clear. While younger adults might engage in relatively high levels of detailed processing in the presence of low-incongruity cues regardless of the time of day, older adults may engage in detailed processing during optimal time of day (morning) and rely on schema-based processing during nonoptimal time of day (afternoon or evening). We might then expect no age differences in the degree of detailed processing of low-incongruity message items in the morning, but for younger people to be much more detailed in their processing in the afternoon when compared to older people.

Experimental Study

A study was conducted to examine how differences in age-related processing might be moderated by two factors: incongruity of message item (high or low) and match or mismatch between one's peak performance period and time of testing (optimal or nonoptimal time of day).

Method

Subjects. Subjects were either younger adults (between 18 and 22 years old, \( \bar{X} = 19.5 \) years) or older adults (between 65 and 79 years old, \( \bar{X} = 69.4 \) years). Younger adults were undergraduate students at a southeastern university and older adults were community-dwelling volunteers recruited through the Duke University Center for the Study of Aging and Human Development. The older adults were selected from a database on the basis of their having completed at least two years of college-level education and being in good general health. These criteria were imposed in recruiting older subjects in order to minimize the effects of potential confounds in explaining age differences. All subjects were given the Extended Range Vocabulary Test (ERVT; Educational Testing Service 1976) in order to assess verbal ability. As is often the case with relatively well educated samples, older subjects had higher vocabulary scores (\( \bar{X} = 39.5 \)) than younger subjects (\( \bar{X} = 25.9 \)). In addition, the subjects were selected on the basis of their scores on the Morningness-Eveningness Questionnaire developed by Horne and Östberg (1976). Subjects were scored according to the procedures outlined in that study. Total scores ranged from 16 to 86 with the following Morningness-Eveningness categories: 16–30 (definitely evening), 31–41 (moderately evening), 42–58 (neither morning nor evening), 59–69 (moderately morning), 70–86 (definitely morning). A total of 125 younger subjects and 88 older subjects were initially recruited for the study. The distribution of those younger and older subjects among each
of the five morningness-eveningness categories is presented in Table 1.

Out of the 125 younger subjects, forty (32 percent) who were classified as neutral types (neither morning nor evening types), and five (4 percent) classified as morning types were not included in the study sample. Of the 88 older subjects recruited for the study, all but three were retained in the study. All of these remaining 85 subjects fell into either the definitely morning or moderately morning categories; the three excluded older subjects were classified as neutral types. The fact that 96 percent of the recruited elderly sample were “morning types” lends further support to previous findings that the vast majority of older adults tend to reach their mental peak in the morning.

Eighty younger subjects and 85 older subjects were thus retained for the study. All older subjects had relatively high morningness scores ($X = 67.4$), indicating that their optimal time of day is in the morning, and all younger subjects had relatively strong eveningness scores ($X = 34.6$), such that their optimal time of day is in the evening. The difference in morningness-eveningness scores of the younger and older subject groups was significant ($F(1, 164) = 1,253.7, p < .001$). Subjects were compensated ($8) for their participation in the experiment.

**Design.** The design for the study was a $2 \times 2 \times 2$ factorial, with three between-group factors. The critical factors in the study were age (young or old), time of testing (morning or evening), and incongruity of message (low or high).

**Materials.** The stimuli for the study took the form of a written description of a news program closely resembling ABC’s *Nightline* (a widely known example of an in-depth news program) and was based largely on the questionnaire developed by Meyers-Levy and Maheswaran (1991). Information presented to subjects concerning the program’s format and host paralleled *Nightline*, such that the background facts included in the program’s description were generally congruent with the in-depth news show schema. In total, nine such facts congruent with *Nightline* and the in-depth news show schema were presented (e.g., the show is an in-depth news program, airs for half an hour, is hosted by a well-known broadcaster and journalist, presents experts on featured issues, etc.).

The message also identified nine issues that were said to be scheduled for discussion on the show. Six of these issues were common to all message descriptions, and all six were topics consistent with the *Nightline*-type schema. Three additional issues varying in their incongruity (low or high) with programming typical of *Nightline* were included in the message. These low-incongruity (celebrity profiles, political correctness, healthful nutrition) and high-incongruity (poetry readings, magic performances, award-winning recipes) issues received mean ratings of 4.58 and 8.31, respectively (on a nine-point scale, with higher numbers indicating greater incongruity) in a pretest study. These issues were placed in about the middle of the message and were embedded among congruent message items. Pretests performed on 51 younger and 51 older subjects established that both age-groups viewed the issues equivalently in terms of incongruity, familiarity, interest/liking, importance/relevance, and television viewing habits.

**Experimental Procedure.** Questionnaires containing the experimental materials were randomly distributed to subjects. The cover sheet indicated that the purpose of the study was to examine subjects’ opinions and reactions to a new television program that may soon be introduced. Subjects were informed that what was of interest were their general reactions to the proposed programming, and they were asked to read the description at their own pace.

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3Ideally, morningness/eveningness and age should be fully crossed factors. But, as May et al. (1993) point out, since very few younger subjects are morning types, and virtually none of the older subjects are evening types, these two factors will be perfectly confounded.

4Reports of the pretest results have not been included because of space limitations but are available from the author.
Half the subjects received descriptions containing three low-incongruity message items, while the other half received descriptions containing three high-incongruity message items. In addition, half of the younger and older subjects were tested in the morning (8:00 or 9:00 a.m.), while the other half were tested in the late afternoon (4:00 or 5:00 p.m.).

After reading the program description, subjects performed a filler task for approximately five minutes involving a series of general questions about their television viewing habits. These questions were included to limit short-term memory effects. Directly following the filler task, subjects were given a recognition test in which they were asked to indicate, by a yes or no response, whether or not various features had been mentioned in the program description. They were then asked to rate how similar they thought the new program was to a number of different current shows, such as 60 Minutes, Nightline, and CNN Headline News. Next, subjects performed another filler task, followed by more questions about their television viewing habits as well as the frequency with which they watched Nightline. Subjects were then asked a variety of questions regarding their media habits and common activities, and they filled out the MEQ. Finally, demographic information on the subjects (e.g., age and gender) was collected, followed by ratings of how interesting the subjects found the study, how involved they were throughout the study, and how motivated they were to answer each question as accurately as possible. After completing the experimental session, the subjects were debriefed, paid, and dismissed.

**Dependent Measures.** The primary dependent measure in the study was recognition. No time limit was imposed on subjects as they performed the recognition task. Subjects were alerted that some of the items in the 18-item recognition task might be foils (i.e., never-presented items). The included items varied in terms of both whether they had actually appeared in the message ("old" vs. "new") and whether they were congruent or incongruent with Nightline. The test items consisted of five congruent message items (e.g., segment on drug abuse, aired after the evening news), five congruent foils (e.g., a segment on gun control, segment on worldwide hunger), three critical incongruent message cues (low-incongruity cues: a segment scheduled on celebrity profiles, near-death experiences, and healthful nutrition; high-incongruity cues: a segment scheduled on poetry readings, magic performances, and award winning recipes), and five incongruent foils (e.g., segment on high school science fairs, Dow Jones Industrial averages reported regularly). Which five incongruent foils were included in the test was determined by the input condition for each subject. Subjects in the low-incongruity condition received three low-incongruity foils and two high-incongruity foils, while those in the high-incongruity condition received three high-incongruity foils and two low-incongruity foils. Each subject received the same two low-incongruity foils and two high-incongruity foils in the test; however, those in the low-incongruity condition received an additional low-incongruity foil and those in the high-incongruity condition received an additional high-incongruity foil. Sets of recognition scores for incongruent foils were thus calculated for both low-incongruity foil items and high-incongruity foil items.

The congruity of the foils with a Nightline-type program was also determined in a pretest. When rated on nine-point scales, with higher numbers indicating greater incongruity, the foils referred to as congruent received an average rating of 1.95, while those referred to as incongruent received average ratings of 4.34 for low-incongruity foils and 8.62 for high-incongruity foils. No significant age differences were observed for these ratings ($F < 1$).

Subjects' assessments of how similar the stimulus program was to Nightline, the intended schema exemplar, and other news-related programs were also collected. The similarity judgments were obtained on a seven-point scale with anchors of 1 as "very similar" and 7 as "not at all similar." The assessment of how similar the stimulus program is to Nightline was to serve as a manipulation check for whether the two levels of incongruent cues were indeed viewed by subjects as differing in incongruity. We might also expect to see evidence of more schema-based processing in those subjects that perceived a greater similarity between the stimulus program and Nightline.

In order to determine subjects' familiarity with in-depth news shows, such as the stimulus program, the frequency with which subjects watched Nightline as well as television in general was assessed. In addition, given that very little information about older adults' daily media and consumer habits is publicly available, a series of questions about when they read newspapers, read magazines, and go shopping was posed. Finally, ratings of interest, involvement, and motivation levels with respect to the study were collected.

**Results**

**Manipulation and Confounding Checks.** To assess whether or not subjects perceived low- and high-incongruity cues in the manner intended, an ANOVA was performed on subjects' ratings of how similar the two versions of the program description (containing the mildly incongruent statements and containing the highly incongruent statements) were to the schema exemplar (i.e., Nightline). As might be expected, this analysis revealed that the stimulus program was perceived to be significantly less similar to the schema exemplar given greater incongruity of critical cues ($X = 2.33$ and $X = 3.13$ for low- and high-incongruity conditions, respectively, on a seven-point scale; $F(1, 152) = 8.08, p < .005$). All other treatment effects on this measure were not significant.

A chi-square test was performed comparing how much television the younger and older subjects generally watched and, in particular, the frequency with which they
watched Nightline, the in-depth news program most like the stimulus program. Consistent with results from the pretest, this analysis revealed that older adults currently watch more television than young college students ($\chi^2(2) = 31.08, p < .01$), but that there were no age differences in how much television was watched daily in the past 10 years ($\chi^2(2) = 3.38, p > .21$). More important, no age differences emerged in how often Nightline was watched currently ($\chi^2(3) = 1.66, p > .64$) or in the past 10 years ($\chi^2(3) = 0.86, p > .83$). Hence, age differences in familiarity with the schema exemplar are unlikely to offer a plausible explanation for treatment effects on the critical dependent measures in the study.

Finally, ANOVAs were performed for treatment effects on subjects’ ratings of interest, involvement, and motivation levels with respect to the study. Two significant results were obtained. First, a marginally significant effect of optimal versus nonoptimal time of day was found; subjects performing the task at optimal time of day, as opposed to nonoptimal time of day, found the task to be more interesting ($\bar{X} = 2.43$ vs. $\bar{X} = 2.76$, on a seven-point scale with anchors of 1 as “very interesting” and 7 as “not at all interesting”; $F(1, 163) = 2.80, p < .09$). Second, subjects exposed to high-incongruity cues were somewhat more motivated to answer each question as accurately as possible compared to those exposed to low-incongruity cues ($\bar{X} = 1.50$ vs. $\bar{X} = 1.78$, on a seven-point scale with anchors of 1 as “very motivated” and 7 as “not at all motivated”; $F(1, 157) = 5.34, p < .02$). No other significant treatment effects on levels of interest, involvement, and motivation were found ($F$’s < 1).

In sum, the manipulation checks revealed that subjects generally perceived the stimulus materials in the intended manner. Furthermore, results obtained from checks for potential confounds suggest that other factors such as familiarity and task involvement are unlikely to account for treatment effects on critical dependent measures.

**Processing Strategies Implied by Recognition Patterns.**

Previous research suggests that recognition accuracy can serve as a valid indicator of processing strategy, yielding inferences similar to those implied by other indicators (e.g., processing time and protocols; Meyers-Levy and Maheswaran 1991; Reder and Anderson 1980). Reder and colleagues (Reder and Anderson 1980; Reder et al. 1986) have suggested that recognition can help identify people’s manner of processing, provided that the recognition test includes both old message items (targets) and new items (foils) that are plausible and thematically related to the previously presented message.

Meyers-Levy and Maheswaran (1991) extend this type of analysis and suggest how further insights can be gained about the use of processing strategies by varying incongruity during both study and test. They suggest that subjects’ use of a schema-based or detailed processing strategy is detectable by inspecting their accuracy in recognizing incongruent message items and congruent foils. The use of a schema-based processing strategy in determining recognition should result in less accurate recognition of both types of items: the inconsistency of the incongruent message items with the schema should lead to the false conclusion that such items are “new,” while the consistency of the congruent foils with the schema should lead to the false conclusion that these items are “old.” By contrast, if subjects were to adhere to a detailed processing strategy and attempt to match the memory probes for these items with corresponding item representations in memory, high levels of accurate recognition for items of both types should result. That is, subjects should be successful in matching the incongruent message items while refraining from matching the congruent foils, thereby producing accurate “old” and “new” recognition judgments, respectively. With respect to congruent message items and incongruent foils, high levels of accurate recognition should result regardless of the processing strategy employed. This is expected because, if a schema-based strategy is employed, congruent message items should be accurately judged as old on the basis of their consistency with the schema, and incongruent foils should be accurately judged as new on the basis of their inconsistency with the schema. Likewise, if a detailed strategy is employed, accurate old and new judgments should be derived by undertaking the matching of memory probes for these items with representations in memory.

In summary, the use of a schema-based processing strategy would be suggested by accurate recognition of congruent message items (high hit rates) and incongruent foils (low false alarm rates). This should be accompanied by low hit rates for incongruent message items and high false alarm rates for congruent foils. In contrast, relatively high hit rates for congruent and incongruent message items and low false alarm rates for congruent and incongruent foils alike would imply the use of a detailed processing strategy.

Table 2 presents mean hit and false alarm rates for each type of recognition test item by treatment. Consistent with predictions, younger adults appear to be using a detailed strategy in recognition, particularly when exposed to high-incongruity cues during their optimal time of day (late afternoon or evening). This is evidenced by the younger subjects’ relatively high hit rates and low false alarm rates for congruent and incongruent test items alike.

The data also suggest that older adults employ a relatively detailed strategy when exposed to high-incongruity cues during their optimal time of day (morning). At their nonoptimal time of day (late afternoon or evening), the elderly seem to rely on a schema-based strategy in assessing recognition. Consistent with what would be expected for schema-based processing, older adults are relatively inaccurate in their recognition of incongruent message items and congruent foil items. With respect to recognition of congruent message items and incongruent foils, the evidence initially appears to be somewhat mixed. Although the elderly are accurate as expected in their recognition of congruent message items in the high-
### TABLE 2

**MEAN PERCENTAGE OF HITS, FALSE ALARMS, AND A’ VALUES, CATEGORIZED BY TREATMENTS**

<table>
<thead>
<tr>
<th>Time of day, age, and incongruity</th>
<th>Hit rates</th>
<th>False alarm rates</th>
<th>A’</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Congruent message items</td>
<td>Incongruent message items</td>
<td>Congruent foils</td>
</tr>
<tr>
<td>A.M.:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low incongruity (n = 20)</td>
<td>.81</td>
<td>.62</td>
<td>.23</td>
</tr>
<tr>
<td>High incongruity (n = 20)</td>
<td>.81</td>
<td>.75</td>
<td>.16</td>
</tr>
<tr>
<td>Mean</td>
<td>.81</td>
<td>.68</td>
<td>.20</td>
</tr>
<tr>
<td>Old:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low incongruity (n = 21)</td>
<td>.89</td>
<td>.60</td>
<td>.21</td>
</tr>
<tr>
<td>High incongruity (n = 23)</td>
<td>.97</td>
<td>.88</td>
<td>.17</td>
</tr>
<tr>
<td>Mean</td>
<td>.93</td>
<td>.74</td>
<td>.19</td>
</tr>
<tr>
<td>P.M.:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low incongruity (n = 20)</td>
<td>.82</td>
<td>.60</td>
<td>.12</td>
</tr>
<tr>
<td>High incongruity (n = 20)</td>
<td>.84</td>
<td>.80</td>
<td>.04</td>
</tr>
<tr>
<td>Mean</td>
<td>.83</td>
<td>.70</td>
<td>.08</td>
</tr>
<tr>
<td>Old:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low incongruity (n = 20)</td>
<td>.73</td>
<td>.55</td>
<td>.44</td>
</tr>
<tr>
<td>High incongruity (n = 21)</td>
<td>.81</td>
<td>.59</td>
<td>.43</td>
</tr>
<tr>
<td>Mean</td>
<td>.77</td>
<td>.57</td>
<td>.43</td>
</tr>
</tbody>
</table>

*For subjects in the low-incongruity condition, the false alarm rates for low- and high-incongruity foils are based on recognition of three and two items, respectively. For subjects in the high-incongruity condition, the false alarm rates for low- and high-incongruity foils are based on recognition of two and three items, respectively.*

Incongruity condition, they are less so in the low-incongruity condition. Furthermore, the data indicate relatively high false alarm rates for low-incongruity foil items during nonoptimal time of day (\( \bar{X} = .34 \) and \( \bar{X} = .40 \) for low- and high-incongruity conditions, respectively), which appears inconsistent with evidence supportive of schema-based processing. I propose that the results, nonetheless, favor the view that older adults engage in schema-based processing during their nonoptimal time of day. When the incongruent foil items are highly incongruent, older adults are quite accurate in their recognition regardless of the level of incongruity to which they were exposed in the study (\( \bar{X} = .10 \) and \( \bar{X} = .08 \) for low- and high-incongruity conditions, respectively). We might thus speculate that during nonoptimal time of day, the elderly suffer from an overall decrement in recognition performance, such that they are particularly insensitive to lower levels of incongruity. This issue is further addressed in the Discussion section.

**Signal Detection Analysis.** Signal detection analysis of the recognition data offers formal support for inferences with respect to age differences in the use of schema-based processing and detailed processing strategies. Subjects who use a schema-based strategy should exhibit relatively poor discrimination between message and foil items because judging how consistent an item is with the in-depth news show schema fails to distinguish between (1) items that are new or never presented, but consistent with the schema, and (2) those that truly appeared in the message. In contrast, subjects who use a detailed strategy should show good discrimination between new and old items due to their having undergone the detailed process of matching recognition test items with encoded message items.

Using the methodology outlined by Grier (1971), A’ measures were calculated.4 The A’ measures were then analyzed separately for recognition of congruent (five messages and five foils) and incongruent (three messages and five foils) items. Table 2 presents the means of these scores categorized by age, incongruity, and time of day. An A’ value of .50 would indicate perfect indiscrimina-

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4The A’ measure is a nonparametric analogue to d’, a more commonly used sensitivity measure of signal detection theory (SDT). The A’ measure is used in our signal detection analysis because of the limited number of recognition trials given to individual subjects, and because it has the advantage of being calculable no matter what the hit and false alarm rates (including hit rates of 1 and false alarm rates of 0; Boice and Gardner 1988). Analyses of d’ scores were also performed using standard procedures for dealing with empty cells (see Macmillan and Creelman 1991) for a comprehensive explanation and, with few minor variations, were found to be equivalent to the results obtained with A’ measures.
tion between message and foil items, while a value of 1.00 would represent perfect discrimination. Subjects engaging in greater schema-based processing should thus have lower A' scores for both congruent and incongruent items while those performing detailed processing should have relatively high A' scores for both congruent and incongruent items.

Analyses of the main effects of age, incongruity, and time of day on A' measures revealed a number of significant effects. As expected, younger subjects were better than older subjects at discriminating between congruent message and foil items \(F(1, 157) = 7.37, p < .007\) as well as between incongruent message and foil items \(F(1, 157) = 3.72, p < .05\). Although discrimination between congruent message and foil items was not significantly different between low-incongruity and high-incongruity conditions \(F(1, 157) = 1.64, p > .20\), discrimination between incongruent message and foil items was significantly better for those in the high-incongruity condition compared to those in the low-incongruity condition \(F(1, 157) = 5.25, p < .02\), as would be expected. Subjects were better at discriminating between both congruent as well as incongruent recognition items during their optimal (as compared to nonoptimal) time of day \(F(1, 163) = 3.20, p < .07\), for congruent items; and \(F(1, 157) = 2.82, p < .10\), for incongruent items).

The main effects were qualified by interaction effects of age and time of day. As predicted, significant interaction effects of age and time of day were obtained for both discrimination between congruent message and foil items \(F(1, 157) = 21.35, p < .001\) and discrimination between incongruent message and foil items \(F(1, 157) = 9.52, p < .002\). This suggests that younger adults do indeed employ a relatively detailed strategy in recognition across time of day while older adults use a detailed strategy in the morning but a schema-based strategy in the afternoon. I did not, however, obtain a significant interaction effect of age and incongruity on A' scores for congruent or incongruent items \(F(1, 157) < 1\). It thus appears that these experimental results did not support the idea that higher levels of incongruity, by themselves, would differentially cause the elderly to use a more detailed processing strategy. I speculate that the boost in processing resources thought to be afforded by high-incongruity cues is, in general, insufficient to induce greater detailed processing in the elderly. The following analysis of the three-way interaction, including incongruity as a factor, appears to provide empirical support for this explanation.

Tests of the three-way interaction effects of age, incongruity, and time of day yielded several significant results. As was expected, a significant three-way interaction on discrimination of incongruent message items and foils was found \(F(1, 157) = 3.95, p < .05\); see Fig. 1), while the interaction on discrimination of congruent message items and foils did not approach significance \(F < 1\). Before presenting further analysis that is necessarily limited to the incongruent message items and foils data, I will briefly point out that the pattern of results for treatment effects on A' for congruent message items and foils was consistent with my predictions. Lower A' scores for the congruent as well as incongruent items by the elderly, during their nonoptimal time of day, suggest a reliance on schema-based processing. By contrast, the A' scores for congruent items for the other conditions (older adults at optimal time of day, and younger adults at both optimal and nonoptimal time of day, collapsed across levels of incongruity) were relatively high.

A series of simple effect tests were performed on the incongruent message and foil items to test specific predictions made about the relationships among the three factors of interest. First, and most important, older subjects were more accurate in their discrimination in the morning, compared to in the afternoon or evening, across both levels of incongruity \(F(1, 157) = 17.36, p < .001\); however, they appeared to be disproportionately aided by high-incongruity cues over low-incongruity cues in the morning \(F(1, 157) = 8.25, p < .002\). This lends support to the notion that high-incongruity cues are not by themselves sufficient to stimulate detailed processing, but, when exposed to such cues at their optimal time of day, the elderly’s A’ scores are as high as the younger adults’ scores at their optimal time of day \(F < 1\), and higher than those of younger adults processing at their nonoptimal time of day \(F(1, 157) = 2.72, p < .05\).

Second, there was no significant difference in discrimination of incongruent items and foils by younger and older adults when exposed to low-incongruity cues in the

\[A' = \frac{H + FA - H}{4H(1 - FA)}\]

\[FA = \text{false alarm rate (Aaronson and Watts 1987; Macmillan and Creelman 1991). If } H > FA, \quad A' = 0.50 + \frac{(H - FA)(1 + FA - H)}{4FA(1 - H)}\]

\[\text{and if } H < FA, \quad A' = 0.50 - \frac{(FA - H)(1 + FA - H)}{4FA(1 - H)}\]
morning ($F < 1$). This lends strong support to the notion that older and younger adults do not differ in their levels of detailed processing when exposed to information containing low-incongruity cues in the morning. Evidence was also obtained for the proposition that, when exposed to information containing low-incongruity cues in the late afternoon, younger adults tended to be much more detailed in their processing than in the morning, while older adults tended to rely primarily on schema-based processing; corresponding $A'$ scores for younger adults were higher than those of older adults ($F(1, 157) = 2.72, p < .05$). Finally, as would be expected, in the afternoon, younger adults were more accurate than older adults at discriminating among old and new items when exposed to high-incongruity cues, thereby suggesting greater detailed processing by younger adults ($F(1, 157) = 9.54, p < .001$).

The results suggest that higher levels of incongruity, by themselves, will not trigger greater detailed processing in older adults during their nonoptimal time of day. Older people, however, generate surprisingly high discrimination scores for both congruent and incongruent items when exposed to high-incongruity cues rather than low-incongruity cues in the morning. The elderly appear to be disproportionately aided by the high-incongruity cues only at their optimal time of day. This suggests that older people can benefit from being exposed to certain types of stimulus materials (perhaps in the form of a boost to capacity as a function of task demands, as suggested by Kahneman [1973]), but only if they have sufficient mental capacity available to begin with, such as during their optimal time of day. At their nonoptimal time of day, the elderly appear to be relying more on schema-based processing, as evidenced by their low discrimination scores.

**DISCUSSION**

Several intriguing findings emerge from this research. Most important, older adults appear to be able to engage in levels of detailed processing equivalent to those of younger adults, given appropriate task conditions. The optimal time of day condition in my experiment seems to have served the intended purpose of sufficiently expanding the elderly’s cognitive capacity to the extent that they are able to engage in high levels of detailed processing. In the morning, older adults show a dramatic improvement in recognition accuracy when the stimulus materials serve to further facilitate detailed processing. Exposure to higher levels of incongruity during optimal time of day led to superior recognition performance by the elderly, thereby suggesting greater sensitivity to cue incongruity. What is surprising is the extent to which benefit accrues to older subjects when high-incongruity rather than low-incongruity cues are presented during their optimal time of day. The benefit is such that their degree of detailed processing is actually equivalent to that of younger adults in the afternoon (i.e., their optimal time of day).

In addition, it is worth noting that during their nonoptimal time of day, the presence of any level of incongruity may, by itself, not be sufficient to prompt greater use of detailed processing in the elderly. By contrast, even low levels of incongruity seem to be sufficient for younger subjects to engage in detailed processing during their nonoptimal time of day. Younger adults are sensitive to low levels of incongruity in their processing, presumably because they are not subject to decrements in resource capacity. The overall pattern of results thus suggests that it may be particularly important to consider time-of-day effects when presenting older people with incongruent information.

Furthermore, the present research lends support to previous findings that suggest age differences in the relative use of schema-based and detailed processing. Older adults were, in general, found to rely more on schema-based processing, while younger adults engage in detailed processing. I also replicated previous findings suggesting that individuals’ detection of cue incongruity tends to stimulate greater detailed processing, as does performing a task during optimal time of day when compared to nonoptimal time of day. The interaction effect between age and time of testing on recognition performance, obtained by May et al. (1993), was not only replicated, but was found to be stronger in the present study. Even though a directionally similar pattern of results was found for recognition performance in my study and that of May et al. (1993), I identified conditions under which older subjects were not merely equivalent to, but more accurate than, younger adults. The present study also offers insights into age differences in use of processing strategies, which May et al. (1993) do not address. In addition, by examining the effect of message incongruity, and how it interacts with age and time of day, I not only demonstrate that the elderly can be differentially aided by the nature of the to-be-remembered stimuli to use a detailed processing strategy but also offer new insights to advance the understanding of the relationship between aging and incongruity.

A finding that deserves further emphasis is the elderly’s poor recognition in discriminating between message and foil items in the afternoon. The older adults appear to perform poorly in the afternoon regardless of whether they are exposed to low- or high-incongruity messages cues. This seems to be, in large part, driven by high false alarm rates during nonoptimal time of day. Higher false alarm rates for older compared to younger adults have been reported in a number of aging studies that have examined response items that are either acoustically or semantically related to the target items (see, e.g., Gerard et al. 1991; Rankin and Kausler 1979; Smith 1975). Although these studies typically do not report the time of testing, it seems quite possible that a significant number of the older subjects were tested in the afternoon, when
they tend to commit a greater number of false alarm errors.

Analyses of error rates in the context of the present study are thus potentially informative about what may underlie the high false alarm rates in the elderly. In the morning, although they make more errors with congruent than incongruent foils, older adults’ false alarm rates appear to be similar to those of younger adults. In the afternoon, older adults continue to be more vulnerable to false intrusions for congruent compared to incongruent items, but they make substantially more false alarm errors with respect to both types of foils ($\bar{X} = .43$ vs. $\bar{X} = .23$, respectively). A closer inspection of the elderly’s false alarm data during their nonoptimal time of day yields several results that merit further consideration. As previously mentioned, separate analyses of false alarm rates were performed for low-incongruity and high-incongruity foils. It was thought that although the false alarm rates for both low- and high-incongruity foils would be low relative to congruent foils, they might well be higher for low-incongruity than high-incongruity foils, irrespective of the incongruity condition to which subjects were assigned. Although no such effects are obtained for younger adults, older adults do indeed exhibit higher false alarm rates for low- as compared to high-incongruity foils ($\bar{X} = .37$ vs. $\bar{X} = .09$, respectively). This unpredicted effect, taken in concert with their absence during their optimal time day, potentially serves to enhance our understanding of older adults’ recognition performance. I speculate that during their nonoptimal time of day, the elderly’s cognitive abilities degrade considerably in the sense that they are relatively insensitive to lower levels of incongruity and process low-incongruity foils in a manner similar to that used for congruent foils. This suggestion is not necessarily inconsistent with my view that older adults rely on schema-based processing during their nonoptimal time of day; the analyses performed on the hit and false alarm data are in fact generally consistent with evidence supportive of schema-based processing. We might thus speculate that the criteria used by older adults for evaluating a schema may shift, becoming alternatively more stringent or lax across time of day. Further research might formally investigate this suggestion.

A number of other issues regarding age-related processing differences remain to be addressed. An important, managerially relevant issue awaiting future research is the extent to which age differences exist in the ability to encode and retrieve the name and information for a particular brand. Given that consumers often misattribute memorable ads to dominant brands in the marketplace, it stands to reason that this tendency is exaggerated among the elderly. Further investigations of the cognitive processes underlying the elderly’s greater vulnerability to false intrusions may offer fruitful avenues for investigating the pervasiveness of this phenomenon and conditions that mitigate it. Another issue meriting consideration is how age differences in processing might impact consumer-related responses such as choice and persuasion. The present study might, for instance, be extended by integrating its findings with those of persuasion research. Based on our understanding of when older consumers tend to engage in detailed versus schema-based processing, we can study how the persuasion effects traditionally obtained within the Elaboration Likelihood Model (Petty and Cacioppo 1986) may be moderated.
Another interesting finding from my data collection was that about half of the older people indicated a clear preference for grocery shopping in the morning or early afternoon, whereas younger people tended to do so in the late afternoon or evening. This is consistent with results of Mason and Smith (1974), namely, that the majority (69 percent) of mature consumers did their food shopping before noon. Our analysis also indicated that older people prefer to shop for items other than groceries in the late morning or early afternoon. Preferences for shopping during these hours might perhaps be explained by the fact that many of these services do not open until 10 A.M., whereas grocery stores typically open earlier in the morning or stay open 24 hours. Again, younger adults seem to prefer the afternoon and evening hours for their non-grocery-shopping activities. Older people’s distinct tendency to engage in shopping behavior in the morning might partly be explained by the older person’s having greater physical energy in the morning, as well as difficulty driving in the dark. It is also quite conceivable that the elderly know that they are more mentally alert and energetic in the morning and reserve those hours to engage in tasks that pose a relatively greater cognitive or physical challenge.

Regardless of the specific reasons for why the elderly tend to do more shopping in the morning than in the afternoon or evening, the fact that they do so provides useful information to retailers who are concerned with communicating messages to the elderly about the products and services in their stores. A significant proportion of older consumers visit stores in the morning, when they are at their mental peak and are therefore more capable of accurately processing the provided information.

Finally, marketers targeting older consumers might air their commercials as early in the day as is practicable. Television ads, however, regardless of when they are presented, cannot be processed in a self-paced manner. Thus it is unclear whether or not older people will be able to process television ads at any time in a detailed manner, particularly since they are generally slower at processing than younger people. This is a topic that merits further study; however, some preliminary insight can be gained from the limited data collected in the present study. At least two-thirds of the older subjects tended to have the television on while performing other activities. It seems rather unlikely that, under such a divided-attention condition, older people would be able to engage in detailed processing even at their optimal time of day. Given that at least two-thirds of the older subjects also indicated that they kept the radio on in the background while performing other activities, a similar line of reasoning might be applied to their processing of radio commercials, although such purely auditory processing may place different demands on individuals than television advertising.

LIMITATIONS

Some cautionary notes regarding the results of the present study are in order. My study used a cross-sectional design, in which I compared samples of people assumed to be representative of different age-groups. In order to guard against the influence of potential confounds, younger and older subject groups were carefully screened and matched for health and educational level. This, along with controlling for other potential confounds (e.g., motivation, interest, prior knowledge about the study domain) enabled us to ensure the internal validity of our experiment and, in so doing, a compromise in external validity was necessitated. The elderly in the general population are far more likely than the members of my sample to suffer from health problems (e.g., early stages of dementing illnesses such as Alzheimer’s disease and multi-infarct dementia) and have lower educational levels (e.g., left school early in life). In addition, I acknowledge the limitations associated with using only one set of experimental materials to understand age differences in processing. Although it might be argued that the materials used in the present study are more “ecologically valid” than materials typically used in cognitive aging research, we need to be cautious nonetheless in drawing conclusions about age-related differences with regard to processing in “real-world” consumer contexts. It is thus important to bear in mind that any conclusions drawn from the study may be limited to only a select group of older people. As such, insights gained from this research might be most useful to marketers of products or services whose target group comprises well-educated, healthy, and community-dwelling elderly consumers (e.g., vacation tour packages, investment advice, adult education classes).

With these caveats in place, I offer the present work as preliminary evidence that time-of-day effects can play a decisive role in understanding age differences in processing, particularly so with respect to the strategies elderly consumers bring to bear when processing information presented to them.

[Received April 1996. Revised February 1997. Brian Sternthal served as editor and Joseph W. Alba served as associate editor for this article.]

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AGE DIFFERENCES IN CONSUMERS' PROCESSING STRATEGIES


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