Age Differences in Information Processing: Understanding Deficits in Young and Elderly Consumers

DEBORAH ROEDDER JOHN
CATHERINE A. COLE*

Limitations in the information-processing abilities of young and elderly consumers have generated considerable interest among consumer researchers, marketing practitioners, and government regulators. Most of the research in this area has concentrated on finding which types of deficits characterize both age groups. Little attention has been given to the possibility that the occurrence of these processing deficits may be dependent on task conditions. This article proposes to provide a better understanding of the difficulties experienced by young and elderly consumers by describing the basic processing deficits that characterize these age groups and identifying the task factors likely to affect the severity of these deficits. The article also relates these findings to theoretical, methodological, and managerial issues involved in studying and reacting to the difficulties faced by young and elderly consumers.

Questions regarding the information-processing abilities of young and elderly consumers have generated considerable interest on the part of researchers, regulators, and marketing practitioners. Attention has focused on the ability of these two age groups to understand, evaluate, and use product-related information to make informed product choices. The existence of age-related deficits in these areas has given rise to regulatory concern over the fairness of commercial messages and marketing techniques aimed at the young and elderly. Age differences are also of concern to marketing practitioners, who face the problem of tailoring marketing communications to fit the processing abilities of both age groups.

In addressing these concerns, research on young and elderly consumers has concentrated on the issue of *whether or not* these age groups possess the processing abilities needed to understand, critically evaluate, and use product information. Researchers have examined both age groups in an effort to pinpoint the skills and deficits that characterize each group. In so doing, they have uncovered several deficiencies that present special difficulties for young and elderly consumers in the marketplace. Young children, for example, demonstrate less understanding of advertising's persuasive intent (Blatt, Spencer, and Ward 1972; Robertson and Rossiter 1974; Ward, Reale, and Levinson 1972; Ward, Wackman, and Wartella 1977), recall less advertising information (Blatt et al. 1972; Hendon, McGann, and Hendon 1978; Rubin 1974; Ward et al. 1972; Ward et al. 1977), and use fewer sources and less information when selecting products than older children (Capon and Kuhn 1980; Ward et al. 1977; Wartella et al. 1979). Similarly, elderly adults have been pictured as more easily persuaded and deceived (Phillips and Sternthal 1977; Waddell 1975), less aware of unfair business practices (Zaltman, Srivastava, and Deshpande 1978), using fewer informational aids such as unit pricing and open-dating (Bearden and Mason 1979), processing information at a slower rate (Phillips and Sternthal 1977), and remembering less product-related information than younger adults (Cole 1983; Stephens 1982; Stephens and Warrens 1984; Ziethaml 1982).

Little attention, however, has been directed toward the equally important issue of *when* young and elderly consumers can be expected to exhibit these processing abilities and deficits. Researchers have viewed both groups as either having or not having certain processing abilities without considering the possibility that they may exhibit different ability levels in different task situations. Young children, for example, may remember just as much commercial information as older children and adults if the advertisement contains only one or two product claims that are repeated several times

*Deborah Roedder John is Assistant Professor of Marketing, University of Wisconsin-Madison, Madison, WI 53706. Catherine A. Cole is Assistant Professor of Marketing, University of Iowa, Iowa City, IA 52240. Comments on earlier versions of this article made by JCR reviewers are gratefully acknowledged.

throughout the commercial. Similarly, elderly consumers may have no difficulty comprehending advertising if it is presented in a self-paced medium such as print rather than an externally-paced medium such as television. As these examples suggest, abilities may emerge under some task conditions that are less evident or totally absent in others. By failing to recognize the importance of the task environment, it is quite possible that previous studies may have underestimated the abilities of young and elderly consumers and overestimated the difficulties faced by both age groups.

A better understanding of the basic processing deficits faced by the young and elderly and a better specification of the task factors likely to affect the emergence of these deficits are needed. Inquiry along these lines would appear to have important implications for theoretical, methodological, and practical issues in this area. In theoretical terms, task factors could be incorporated into our current understanding of age differences in information processing. Task factors, such as information quantity and information format, have been widely recognized as influential in such areas of consumer information processing as decision making and choice (Bettman 1979; Punj and Stewart 1983). Yet, the special importance of these factors in determining the level and nature of age differences in consumer information processing has remained unrecognized. In the area of methodology, the identification of task factors affecting age differences would provide needed direction in designing consumer tasks for use with the young and elderly. And a fuller understanding of processing deficits would enable both regulatory agencies and marketing practitioners to pinpoint areas of concern and to design strategies to deal with the special problems of the young and elderly.

The purpose of this article is to identify and examine task factors that affect the severity of processing deficits in young and elderly consumers. Task factors likely to be important in this regard are identified by examining the types of basic processing deficits exhibited by these age groups. Once identified, empirical evidence of the influence of these factors on the performance of the young and the elderly is reviewed. In addressing these topics, there is heavy reliance on experimental evidence gathered by developmental psychologists working in two independent areas. The first area examines processing deficits and task effects in young children by comparing the performance of these children (under age 12) with that of older children (age 12 and over). The second area examines processing deficits and task effects in elderly adults by comparing the performance of this group (age 65 and over) with that of young and middle-aged adults.[1] It should be noted that direct comparisons between young children and elderly adults are not pursued in either research area because of methodological problems in studying such disparate age groups. In addition to the two areas just listed, a third and much smaller body of research, gathered by consumer researchers working with young and elderly consumers, is also incorporated into the review when possible.

The discussion that follows is divided into three sections. The first section describes the basic types of deficits experienced by young and elderly individuals. Limitations related to memory capacity, memory strategies, and knowledge bases are discussed in turn. The next section examines the task factors likely to affect the occurrence of these deficits in both age groups. Information quantity, information format, instruction set, and response format are considered as important factors in this regard. The final section discusses the implications of these findings for a number of theoretical, methodological, and managerial issues in this area.

INFORMATION PROCESSING DEFICITS IN THE YOUNG AND ELDERLY

The existence of age differences in remembering, understanding, and evaluating information is well documented in numerous developmental investigations. Compared to the general adult population, young children and elderly adults do not perform as well in a variety of learning and problem-solving situations. Difficulties in these situations are commonly found in children until they reach early adolescence and in adults as they reach retirement age.

Understanding the factors responsible for the differences has long been the objective of developmental research with the young and elderly. Age differences have been attributed to a number of cognitive limitations thought to be present in young children and elderly adults. Although research with young children has proceeded independently from investigations of the elderly population, several similarities exist in the types of deficits uncovered for both age groups. The problems encountered by young children have been linked to limitations in memory capacity, memory strategies, and knowledge bases. In a similar vein, the difficulties faced by elderly adults have been associated with limitations in memory capacity and memory strategies. These deficits are summarized in Table 1.

[1]It should be noted that the appropriate age cutoff for classifying individuals as elderly is open to debate. Much of the research cited in this review uses 65 as an arbitrary cutoff point for old age. Other researchers have argued that several age cutoffs should be used to acknowledge the existence of subgroups among the elderly, such as early old age (ages 65–74) and advanced old age (ages 75 and over) suggested by Butler and Lewis (1977) or later maturity (ages 58–67), early longevous (ages 68–77), and later longevous (ages 78 and older) suggested by Barrett (1972). Subgroups such as these are not addressed in this review due to the fact that subgroups are not consistently acknowledged in developmental studies of information processing.

TABLE 1

PROCESSING DEFICITS IN THE YOUNG AND ELDERLY

Type of deficit	Major findings: Young children	Major findings: Elderly adults
Memory capacity	No support for deficits in short-term memory capacity in terms of "slots" in working memory	Elderly adults experience modest declines, at most, in short-term memory "slots" Elderly adults are subject, however, to slower processing speeds
Memory strategies		
Encoding	Young children often fail to encode semantically, fail to use visual imagery, fail to use rehearsal strategies, and fail to use organizational strategies	Elderly adults often fail to encode semantically, fail to use visual imagery, and fail to use organizational strategies
Retrieval	Young children fail to use retrieval cues efficiently to guide memory search	Elderly adults fail to use efficient retrieval strategies
Knowledge base	Less developed knowledge bases in young children amplify difficulties with encoding and retrieving information	No evidence of decrements in knowledge bases in the elderly

Memory Capacity

Young Children. Age differences in learning and problem solving among children have often been attributed to limitations in memory capacity (Case 1974; Pascual-Leone 1970). According to this view, young children experience difficulties because they have fewer of the "slots" in working memory needed for storing and processing information. Limitations in memory capacity place an upper limit on the amount of information young children can handle at one time. Learning and problem-solving situations that involve large amounts of information overwhelm the limited capacity of younger children.

Although younger children typically remember less in short-term memory tasks, recent evidence questions the view that this difference is due to limitations in memory capacity (Chi 1976, 1977, 1978). In carefully controlled experiments, little support was obtained for the hypothesis that memory capacity varies with age. The findings seem to suggest that limitations in memory strategies and knowledge bases are more influential than memory capacity in producing age differences in children's learning and problem solving.

Elderly Adults. Researchers working with the elderly have also considered the possibility that elderly adults may have fewer slots in which information can be held than young adults. The evidence regarding this issue is mixed. A few studies have suggested that primary memory is unimpaired in elderly adults (Craik 1968; Raymond 1971), whereas other studies have suggested that there may be a modest decline in short-term memory with age (Arenberg 1976, Burke and Light 1981; Craik and Byrd 1982; Craik and Simon 1980; Hartley and Walsh 1980; Hasher and Zacks 1979; Horn, Donaldson, and Engstrom 1981; Parkinson and Perey 1980; Rabinowitz, Craik, and Ackerman 1982; Robertson-Tchabo and Arenberg 1976; Salthouse 1980). This discrepancy between findings is quite likely due to differences in the way that short-term memory capacity has been assessed (Salthouse 1980). Regardless of measurement, however, it seems clear that elderly adults experience only a modest decline, if any, in short-term memory capacity.

Given findings such as these, a number of researchers have suggested that it is not so much reduced memory capacity that impairs the elderly as it is the slowing down of central nervous activity. The possibility that slower central nervous activity contributes to a generalized decline in the rate of cognitive processing has received some support to date and remains a viable explanation for many of the elderly's difficulties (Anders, Fozard, and Lillyquist 1972; Birren 1956, 1965, 1974; Cerella, Poon, and Fozard 1981; Jones 1956; Macht and Buschke 1984; Madden 1985; Salthouse 1980, 1982; Salthouse and Somberg 1982; Waugh, Thomas, and Fozard 1978).

Memory Strategies

Young Children. The most popular explanation for age differences among children focuses on the acquisition and use of memory strategies for learning and problem solving. Young children fail to use a variety of strategies typically employed by older children and adults to facilitate the encoding and retrieval of information. Older children have a better understanding of these strategies and recognize their usefulness for enhancing learning and problem solving (Flavell and Wellman 1977). Failures to use memory strategies have been attributed to two types of deficits: production deficits and mediational deficits (Flavell 1970). Children with production deficits do not spontaneously produce strategies in response to learning or problem-solving tasks. However, when prompted to do so, these children are able to use strategies to improve their performance in many situations. Children with mediational deficits may follow instructions to use processing strategies but cannot utilize the strategies to enhance remembering or problem solving. Mediational deficits are common in preschoolers, whereas production deficits are more

characteristic of children in the early elementary school grades (Brown 1975b).

Deficits such as these underlie young children's failures to use various strategies for encoding and retrieving information. *Encoding strategies,* which promote the efficient representation and storage of information in memory, are seldom used by young children on a spontaneous basis. Failures to use semantic encoding, imagery, rehearsal, and organizational strategies are prime examples in this regard. Rather than focus on the semantic features of stimuli, which facilitate learning and memory, young children tend to encode the sensory features of stimuli (Bach and Underwood 1970; Hall and Halperin 1972). Although this tendency appears to be less pronounced with pictorial stimuli (Ghatala and Levin 1981, 1982), semantic encoding is typically not exhibited by young children unless they receive instructions to do so. Mental imagery, linking mental images to incoming information, is a second strategy often neglected by young children. These children fail to take advantage of this mnemonic device unless they are given explicit instructions to use imagery as a way to learn or remember information (Jusczyk, Kemler, and Bubis 1975; Kemler and Jusczyk 1975; Yarmey and Bowen 1972). Rehearsal, which involves the repetition and elaboration of incoming information, is a third encoding strategy commonly used by older but not younger children. Young children, once again, will fail to take advantage of this strategy unless they are given instructions on using rehearsal strategies and prompted to do so (Bray et al. 1977; Kellas, McCauley, and McFarland 1975; Naus, Ornstein, and Aivano 1977; Naus, Ornstein, and Kreshtool 1977; Ornstein, Naus, and Liberty 1975). Organizational strategies, needed for structuring and grouping incoming information, constitute a final source of encoding difficulties for young children. These children fail to structure information in meaningful ways unless they are given explicit instructions to do so or are presented with material that incorporates its own organizational scheme (Bjorklund, Ornstein, and Haig 1977; Hall and Madsen 1978; Lange and Griffith 1977; Liberty and Ornstein 1973; Moely et al. 1969; Ornstein and Corsale 1979).

Similar limitations are evident in children's use of *retrieval strategies,* which facilitate access to previously stored information. In contrast to older children, younger children do not take advantage of retrieval cues to direct memory searches unless they are given additional guidance and continual prompting (Ashcraft, Kellas, and Keller 1976; Emmerich and Ackerman 1978; Kobasigawa 1974). These difficulties are particularly evident with retrieval cues that are less than totally compatible or congruent with cues available at the time of information presentation (Ackerman 1982; Ceci and Howe 1978; Geis and Hall 1978).

Elderly Adults. Different researchers at different times have implicated encoding and retrieval activities in their attempts to identify sources for the elderly's memory deficit (Craik 1977; Smith 1980). The central issue has been whether the elderly are simply unable to use efficient memory strategies (processing deficiencies) or whether, if given prompts, they can employ and benefit from efficient strategies (production deficiencies). These deficits closely follow the ones described for children: processing deficiencies are similar to mediational deficits in children and production deficiencies are the same for both the elderly and children.

With regard to *encoding strategies,* elderly adults often fail to encode items semantically. This tendency can contribute to the elderly's poorer performance on recall and recognition tests compared to the performance of younger adults who spontaneously use deep encoding strategies. Findings from several studies suggest that the elderly's failure to use semantic encoding is due to a production deficiency. When given specific encoding instructions, these investigations find no age differences in free recall, cued recall, or recognition (White, cited in Craik 1977; Craik and Simon 1980; Cerella, Paulshock, and Poon 1982; Johnson 1973). However, a second set of studies has reported that orienting tasks designed to equalize encoding do not always reduce the size of age differences in recall and recognition (Cole 1983; Eysenck 1974; Simon et al. 1982). This line of evidence suggests that processing deficiencies are also involved in the elderly's encoding failures. Although results in the area are mixed, findings do appear to depend to some extent on whether recognition, cued recall, or recall is used as the dependent variable. Processing deficiencies are often found when recognition is used as the dependent variable, whereas both processing and production deficiencies have been found with recall as the dependent measure.[2]

Limitations in the use of rehearsal and organizational strategies have also received attention in studies of the elderly. Investigators have found some evidence of production deficiencies in the elderly's use of rehearsal strategies and organizational strategies. The rate of rehearsal and the use of elaborative rehearsal appears to decline with age (Salthouse 1980; Waugh and Barr 1980) but can be facilitated by specific instructions about how to rehearse incoming information (Sanders et al. 1980; Schmitt, Murphy, and Sanders 1981). Similarly, elderly adults tend to not use organizational strategies for storing incoming information unless instructed to do so (Craik 1977; Eysenck 1974; Hultsch 1974; Perlmutter 1978; Smith 1977). This tendency remains even when the stimulus information is quite amenable to organization. In fact, very often, stimulus materials with the

[2]In general, recognition measures provide better information than recall measures about encoding deficiencies. Recall tasks do not provide external cues to aid memory search, so one cannot attribute any observed age differences to encoding deficiencies alone. Retrieval deficiencies may also be responsible.

most potential for organization produce the greatest differences between young and elderly adults (Craik 1968; Heron and Craik 1964; Kausler and Puckett 1979; Laurence and Trotter 1971; Taub 1974).

Finally, the elderly fail to use efficient *retrieval strategies* to guide access to previously stored information. Several studies provide evidence for the existence of production deficiencies in the use of cues to direct information retrieval. When cues are provided by the experimenter to guide memory search, age differences are greatly reduced and many times eliminated altogether (Hultsch 1975; Laurence 1967; Smith 1977). An additional set of studies, however, fails to confirm the ability of cues to equate recall in elderly and younger subjects (Drachman and Leavitt 1972; Mueller, Rankin, and Carlomusto 1979; Perlmutter 1979). As before, methodological differences seem to be responsible for the disparity in results. It appears that the type and timing of the retrieval cue influence the degree to which cues will reduce age differences in recall (Rabinowitz et al. 1982; Smith 1977).

Knowledge Base

Young Children. Although most explanations of age differences in children have centered on memory strategies, researchers are becoming more interested in differences in knowledge bases as an important factor in developmental trends in learning and problem solving (Glaser 1984). Demonstrations of age differences even when strategy usage has been equated across age groups have led investigators to examine variations in content-specific knowledge as a possible explanation (Chi 1977; Lindberg 1980). Knowledge bases, which consist of information about concepts and relationships among concepts, develop with age as children gain experience in specific areas and domains (Brown 1975b; Chi 1978; Reese 1976). Because prior knowledge affects the encoding and storage of new information, young children with limited experience and restricted knowledge bases find themselves at a disadvantage compared to older children and adults (Chi 1976, 1977; Lindberg 1980). Knowledge deficits also limit young children's ability to use certain types of memory strategies in an efficient and effective way. For example, failures to use organizational strategies (Lindberg 1980) and retrieval cues (Ackerman 1982) can be partially attributed to problems in recognizing patterns and relationships among data that depend upon well-developed knowledge structures.

Elderly Adults. A major source of information regarding developmental trends in knowledge bases is provided by intelligence testing. In order to understand developmental patterns, a number of researchers have distinguished between two types of intelligence: fluid and crystallized (Horn 1967, 1970, 1975, 1978; Horn and Cattell 1966, 1967; Horn and Donaldson 1976, 1977, 1980). Fluid intelligence—which is reflected in tests of figural relations, memory span induction, and most processes involved in acquiring new information—decreases with increased age in adulthood. Crystallized intelligence—which is reflected in tests such as vocabulary, general information, comprehension, arithmetic, and reasoning with familiar material—is stable across adulthood. Given that crystallized intelligence represents an individual's knowledge base, it appears that the knowledge base of elderly adults remains intact and that age differences are most likely due to difficulties in acquiring and using new information (Beeson 1920; Berkowitz 1953; Botwinick 1975; Bromley 1974; Brown and Ghiselli 1949; Corsini and Fasett 1953; Cunningham 1975; Foulds and Raven 1948; Garfield and Blek 1952; Gilbert 1935; Howell 1955; Jones 1955; Jones and Conrad 1933; Kausler and Puckett 1980; Kinsbourne 1974; Owens 1966; Reed and Reitan 1963; Vernhage 1965; Wechsler 1958; Weisenburg, Roe, and McBride 1936; Willoughby 1927).

TASK FACTORS AND PROCESSING DEFICITS

Processing deficits have been identified as the factor responsible for many of the difficulties faced by young children and elderly adults. Young children fail to use a variety of memory strategies known to facilitate the encoding and retrieval of information. Young children are also limited with respect to the knowledge base they bring to bear on learning and problem-solving tasks. Elderly adults are susceptible to difficulties with strategy usage and tend to exhibit processing capacity limitations as well.

Deficits such as these suggest a number of task factors likely to affect the performance of the young and elderly. As a starting point, *information quantity* would appear to be quite influential. As the number of informational units or chunks increases, so does the level of processing skill required to encode and utilize incoming information. Considering the limited memory strategies available to young children and elderly adults, increases in processing demands of this type have the potential to quickly overtax the abilities of both age groups.

Information formats can also contribute to the level of processing deficits exhibited by young children and elderly adults. The manner in which information is presented can either increase or decrease the need to use sophisticated encoding strategies. Information presented in a visual or pictorial mode can reduce the need for visual imagery on the part of young children and elderly adults who do not spontaneously employ imagery as part of their repertoire. Information organized in some meaningful way, e.g., categorically or thematically, can reduce the need for the young and elderly to use organizational strategies of their own. Variations in the order in which information is presented can increase the need for processing strategies in young chil-

dren. Information presented at an early point in a task, for example, requires the use of rehearsal strategies, which are often lacking in younger children. In each of these cases, format differences are likely to affect performance levels by influencing the degree of strategic intervention required on the part of both young children and elderly adults.

Performance levels can be affected even more directly by *instruction sets* that suggest the use of specific processing strategies and provide guidance with respect to using these strategies. Because many of the difficulties experienced by the young and elderly appear to be the result of production deficits, instructions to use specific strategies are likely to be particularly effective in reducing or even eliminating performance decrements. Instructions regarding semantic encoding, visual imagery, rehearsal, and organization would appear to be particularly promising in this regard.

Response formats represent a final set of factors likely to influence the level of deficits exhibited by the young and elderly. Some methods for measuring performance appear to place greater processing burdens on subjects than others. Due to limitations in using retrieval strategies often found in young children and elderly adults, formats that require extensive information retrieval without prompts or cues are likely to overwhelm both age groups. Less demanding formats, involving recognition or cued recall, for example, provide a possible approach for facilitating the performance of the young and elderly. In sum, the processing deficits just described suggest several task factors that need to be considered when assessing the abilities of the young and elderly: (1) information quantity, (2) information formats, (3) instruction sets, and (4) response formats. Empirical evidence regarding the influence of each of these factors is summarized in Table 2.

TABLE 2

TASK FACTORS AFFECTING THE YOUNG AND ELDERLY

	Major findings	
Task factors	Young children	Elderly adults
Information quantity	Young children are disrupted by relatively large amounts of information easily handled by older children	Large amounts of information present greater difficulties for elderly individuals
Information format		
Mode of presentation	Young children remember information better when it is conveyed in a pictorial format or accompanied by pictures	Elderly adults remember information better with visual aids but do not appear to benefit from televised presentation
Organization	Young children recall information better when it is organized semantically or thematically	No evidence of reduced deficits with thematically organized material
Order	Young children have difficulty remembering and using information presented earlier in task situations	No evidence of deficits due to the order of information presentation
Instruction sets	General instructions are beneficial for older children, whereas specific instructions regarding the use of memory strategies are needed to benefit younger children	Specific instructions regarding the use of memory strategies are beneficial for the elderly
Response format	Young children perform better in recognition tasks than in recall tasks	Elderly adults generally perform better in recognition than recall tasks

Information Quantity

Young Children. Problems with information quantity appear to be quite pervasive in young children. Because they have less developed skills, young children are likely to be disturbed by amounts of information that are easily handled by older children and adults. When information loads are reduced, abilities can emerge in very young children that are usually found only in much older children (Gelman 1978). For example, even preschool children can perform fairly complex numerical tasks if the task involves small sets of objects (Baron, Lawson, and Siegel 1975; Chi and Klahr 1975; Schaeffer, Eggleston, and Scott 1974). Limitations regarding information quantity have also been uncovered in recent examinations of children's choice behavior. Both the number of choice alternatives and the number of attributes per alternative present difficulties for young children. Young children, for example, have been found to make choices on the basis of one or very few attributes rather than considering the wide array of information available to them (Capon and Kuhn 1980; Wartella et al. 1979). Young children also make less consistent choices when the number of choice alternatives is relatively large (Roedder, Sternthal, and Calder 1983).

Elderly Adults. Relatively large amounts of information can also be expected to present particular problems for elderly adults. By using fewer processing strategies, and by processing at slower speeds, the elderly can be expected to exhibit problems with information loads that pose little difficulty for younger adults. A number of researchers have found that, as memory loads increase, the performance of elderly subjects declines more rapidly than the performance of younger subjects (Inglis 1959; Talland 1965; Welford 1958, 1980; Wright 1981). Similar trends are evident in a recent study of age differences in consumers' preference judgments (Capon, Kuhn, and Gurucharri 1981). Elderly adults were less consistent in their product ratings and incorporated somewhat fewer product dimensions

into their overall product judgments than middle-aged adults.

Information Format

Young Children. Children are affected by the manner in which information is presented in addition to the quantity. Information formats influence the effort required to process information and thereby affect the difficulty of tasks. Changes in format can enhance children's processing skills and reduce the impact of strategy deficits.

Among the most important format factors is *mode of presentation.* For children, as well as adults, pictorial representations are superior to verbal or written presentations. Although the explanation for this is in dispute (see Kee, Bell, and Davis 1981), children do remember stimuli better when the information is portrayed in a pictorial format or when accompanied by pictures. Information conveyed in a pictorial form is remembered better than that conveyed in written form (Cole, Frankel, and Sharp 1971; Dilley and Paivio 1968; Ritchey 1980) or in verbal presentations (Cramer 1976; Horowitz 1969; Kee et al. 1981; Siegel and Allik 1973; Rohwer, Kee, and Guy 1975).

Pictures also have a facilitative effect when they accompany verbal and written material. Written material accompanied by pictures is remembered better than the written text alone (Rustead and Coltheart 1979). The addition of pictures to verbally presented material increases recall over that obtained with verbal presentation alone (Cramer 1976; Horowitz 1969; Kee et al. 1981; Nelson 1980; Rohwer et al. 1975). And videotaped presentations appear to be more effective than both verbal presentations (Chandler, Greenspan, and Barenboim 1973; Farnill 1974) and verbal presentation accompanied by pictures (Shultz and Butkowsky 1977).

A second factor affecting children's performance is *information organization.* Information presented in an organized format reduces the need for subjects to place their own organization on incoming information. Thus, organization can facilitate processing in young children who may not have well-developed organizational schemes of their own and who may not use organizational strategies in storing information. Children can recall more material when related pieces of information are blocked together rather than presented in random fashion (Cole et al. 1971; Kobasigawa and Middleton 1972; Kobasigawa and Orr 1973; Ornstein et al. 1975; Yoshimura, Moely, and Shapiro 1971). A similar effect has been found for thematic order in stories and action sequences. Children remember more information in the correct order if the action is presented in temporal order (Brown 1975a; Brown and Murphy 1975; Collins et al. 1978).

The *order* in which information is presented also affects children's ability to process incoming information. Although information recently presented seems to be equally accessible to children of all ages, younger children have difficulty remembering information presented earlier in a task. Older children appear to be capable of remembering information presented much earlier in a task because they use mnenomic strategies absent in younger children (see Hagen, Jongeward, and Kail 1975). As a result, younger children are unlikely to make sound judgments when the situation requires the use of information presented much earlier in a task (Austin, Ruble, and Trabasso 1977; Feldman et al. 1976; Kun, Parsons, and Ruble 1974; Parsons et al. 1976).

Elderly Adults. Elderly adults are also affected by the manner in which information is presented. Consider first the *mode of presentation.* Early research suggested that pictorial formats would not aid recall for elderly adults as it did for young adults. This prediction was based on the belief that visual memory declines more steeply with age than verbal memory (Winograd and Simon 1980). Recent investigations have failed to support this line of reasoning, demonstrating that visual aids do enhance recall for elderly as well as younger adults (Keitz and Gounard 1976; Park and Puglisi 1985; Park, Puglisi, and Sovacool 1983; Winograd, Smith, and Simon 1982). However, this facilitating effect is typically not enough to increase the performance of elderly subjects to the level of younger adults. Performance gaps appear to remain intact for a wide range of stimulus materials and conditions (Taub 1975, 1979; Taub and Kline 1976, 1978).

Questions regarding the elderly's sensitivity to different modes of presentation have also addressed print versus television formats. Although younger adults seem to benefit when information is presented in a television format, elderly adults do not react in the same manner. In fact, elderly adults consistently remember less information than their younger counterparts whether print or television formats are used (Cavanaugh 1983, 1984; Cole 1983).

Similar results have been found in studies examining the elderly's sensitivity to *information organization.* Evidence relating to this issue has been gathered by researchers investigating age differences in memory for prose passages rather than for the unorganized word lists often used in developmental research (for comprehensive reviews in this area, see Glynn and Muth 1979; Hartley, Harker, and Walsh 1980; Spilich 1983). If elderly adults are particularly sensitive to information organization, stimulus information presented in prose passages should reduce age differences in recall compared to those age differences usually observed when an unorganized format of word lists is used. The evidence gathered in this area fails to support this line of reasoning; elderly adults continue to recall less information than younger adults even when prose passages are used (Dixon et al. 1982; Gordon and Clark 1974b; Moenster 1972; Spilich 1983). It appears that the the-

matic organization available in a prose passage does not facilitate recall performance for the elderly unless they are prompted to use this organization in order to improve recall (Meyer and Rice 1981).

Finally, *order* of presentation affects recall in elderly adults. Recency effects, showing heightened memory for information recently presented, have been found in the recall of elderly adults as well as younger adults. These order effects, however, do not appear to be any stronger in the elderly than in adults of other ages (Hagen and Stanovich 1977; Lorsbach and Simpson 1984).

Instruction Sets

Young Children. Children often fail to recognize the type of processing skills and strategies needed to successfully complete a task. Instruction sets can sometimes alleviate this problem by providing information about the objective of the task or by suggesting ways to solve the task. Both types of instruction sets can enhance children's performance by directing and focusing their efforts.

General instructions regarding the purpose of the task seem to be effective mainly for older children. Instructions such as "remember" or "memorize" seem to be sufficient to evoke the use of appropriate strategies for these children (Appel et al. 1972; Salatas and Flavell 1976; Wellman, Ritter, and Flavell 1975; Yussen et al. 1974). Young children can be helped by instruction sets that are more specific and directive. Instructions that suggest strategies to aid performance are particularly helpful. Young children respond well to instructions to verbally rehearse incoming information (Bray et al. 1977; Hagen, Hargrave, and Ross 1973; Ornstein, Naus, and Stone 1977) and to instructions to visualize or construct images of incoming information (Danner and Taylor 1973; Jusczyk et al. 1975; Kemler and Jusczyk 1975; Yarmey and Bowen 1972; Yuille and Catchpole 1973).

Elderly Adults. Instruction sets would appear to be beneficial for elderly adults, since they report using memory strategies less frequently than do younger adults. Evidence relating to this issue supports this hypothesis for certain types of instruction sets. The elderly do not seem to benefit in most cases from general instructions to learn or memorize incoming information (Sanders et al. 1980). Explicit instructions about specific strategies appear to be much more promising in this regard (Hulicka and Rust 1964; Hulicka, Sterns, and Grossman 1967; Hulicka and Weiss 1965; Rowe and Schnore 1971). Several researchers have been successful in reducing the deficits of elderly subjects with explicit instructions to use strategies such as visual imagery (Canestrari 1968; Hulicka and Grossman 1967; Poon and Walsh-Sweeney 1981; Treat, Poon, and Fozard 1981; Treat and Reese 1976). Other researchers, however, have found that mediational instructions do not necessarily benefit elderly adults more than younger adults (Mason and Smith 1977; Witbourne and Slevin 1978). Considering both lines of evidence, there appears to be little doubt that the elderly benefit from specific instruction sets, but whether or not the elderly benefit more than younger adults seems to be open to further questioning.

Response Format

Young Children. A variety of formats can be used to assess children's abilities in learning and problem-solving tasks. The type of questioning selected by the researcher often has an influence on children's performance levels. Changing the questionnaire format can sometimes produce changes in performance that are large enough to eliminate age differences between younger and older children.

Differences between recognition and recall formats provide the best example of this. In recognition formats, learning is assessed by asking children to recognize what information (pictures, words) was previously presented versus not presented. In recall situations, learning is assessed by asking children to play back everything they remember, without external cues to aid memory. Recall situations are more difficult for children, because these situations require children to retrieve information from memory without external prompts and because these situations involve children's verbal abilities (Brown 1975a). For example, children typically recognize much more commercial-related information than they are able to recall (Donohue, Henke, and Donohue 1980; Gianinno and Zuckerman 1977; Macklin 1983; Wartella et al. 1978; Wartella et al. 1979). These differences are most noticeable in younger children who have limited retrieval skills and verbal abilities. In the case of advertising, the difference between recognition and recall is usually larger for younger rather than older children (Wartella et al. 1978; Wartella et al. 1979).

Elderly Adults. Research with the elderly also documents the importance of response formats in influencing performance levels. A good deal of attention has been focused on differences between recall and recognition formats. Recall formats are likely to be more difficult for elderly adults because of the retrieval deficits experienced by this age group. In support of this prediction, large age differences between elderly and younger adults have typically been found when recall formats are used. However, when recognition formats are used, age differences in performance are usually reduced and sometimes disappear all together.

Most of the controversy in this area has involved the question of whether or not recognition formats can totally eliminate the age differences in performance that are commonly found in studies that use recall formats. Although early studies found that age differences could

be eliminated if recognition formats were used (Schonfield and Robertson 1966), several more recent studies have found that age differences remain even when recognition formats are used. Evidence of age differences in recognition have been obtained using a wide variety of stimulus materials including nonsense syllables (Gordon and Clark 1974a), words (Erber 1974, 1978; Fozard and Waugh 1969; Gordon and Clark 1974a; Harkins, Chapman, and Eisdorfer 1979; Kausler and Kleim 1978; Rankin and Kausler 1979), sentences (Fullerton and Smith 1980), and prose passages (Gordon and Clark 1974b). The contradiction between the earlier and later findings appears to be the result of differences in the way in which recognition was measured between studies. Less stringent measures that were developed by simply counting the number of correct responses tend to produce significantly smaller age differences than stricter recognition measures that correct for guessing (White and Cunningham 1982).

IMPLICATIONS

The major finding reported in this article is that young children and elderly adults exhibit different levels of learning and problem-solving ability in different task situations. Due to limitations in such areas as processing speed, use of memory strategies, and knowledge bases, young children and elderly adults are particularly sensitive to factors in the task environment such as information quantity, information formats, instruction sets, and response formats. Decrements in the performance of these age groups are most evident in tasks that (1) contain large amounts of information, (2) convey the information in formats that make encoding difficult, (3) include few prompts or instructions to guide processing, and (4) require difficult response formats such as recall in order to record task performance. When one or more of these conditions is made less demanding, the difficulties faced by the young and elderly are often reduced and sometimes eliminated altogether. These observations have theoretical, methodological, and managerial implications for understanding, investigating, and adapting to age differences in information processing.

Theoretical Implications

Based upon the evidence reviewed here, a scenario of how processing skills progress throughout an individual's lifetime can be constructed. Throughout childhood, knowledge bases are developed as children accumulate, interpret, and organize new information and experiences. At the same time, children are also developing a repertoire of strategies that can be used when storing, organizing, and retrieving such information from memory. As both areas develop through childhood, children's deficits in such areas as learning and problem solving become less evident and are less pronounced as the task environment changes. By adulthood, individuals typically have a well-developed information-processing system that includes a full repertoire of mnemonic strategies and an extensive knowledge base. Strategies initially acquired during childhood are utilized on a more efficient basis, and performance tends to be less susceptible to task differences. As individuals enter their elderly years, the processing system slows down and becomes less automatic. Although the elderly maintain their existing knowledge bases and repertoire of strategies, their access to and use of this knowledge appears to break down. Processing becomes slower, less efficient, and more easily disrupted by task factors and demands.

Viewed in this manner, findings relating to the developmental differences that characterize childhood and old age provide more than just an understanding of each age group in isolation. Rather, they provide a basis for understanding life-span development and for comparing processing skills at different stages in the life span. Evidence regarding the processing difficulties faced by young children and elderly adults can be compared, for example, to gain a better understanding of the nature of these deficits in both groups. By comparing adults to these two age groups, these findings can also extend our understanding of processing abilities in the adult population.

Processing Difficulties in Young Children versus Elderly Adults. The preceding scenario suggests that the processing difficulties faced by young children and elderly adults are characterized by both similarities and differences. Comparisons between these groups can best be understood by considering a simple multistore model of memory (Atkinson and Shiffrin 1968; Bettman 1979). According to this model, incoming information is passed from the sense organs to a set of sensory stores (SS) and, if attended to, is transferred to a short-term memory store (STM). This store is of limited capacity, capable of holding a small amount of information for a short period of time. Given this limitation, information in STM is likely to decay unless it is transferred to long-term memory (LTM) for permanent storage. This store is viewed as being essentially unlimited in capacity and acts as the permanent repository of information. The transfer of information between STM and LTM is achieved by using a variety of encoding and retrieval strategies often referred to as control processes.

With reference to this model, *similarities* between the young and elderly are evident in their use of control processes. Both groups appear to underutilize memory strategies for transferring information from STM to LTM and for retrieving information from LTM to STM. For both groups, this failure seems to be due, either fully or partially, to production deficits. That is, the deficits that young children and elderly adults exhibit can often be alleviated to some extent by conditions

that encourage both groups to utilize appropriate memory strategies.

Despite these similarities, there are also differences that characterize the processing difficulties of both groups. Consider first the use of control processes. Although both groups underutilize encoding and retrieval strategies, it appears that the reason for this underutilization may differ between young children and elderly adults. For young children, part of the difficulty seems to lie in their failure to understand that strategies are necessary or helpful for learning and problem solving. The evidence reviewed here suggests that simply instructing young children to "learn" or "memorize" does not facilitate performance. Performance is only heightened by instructions explaining specific strategies and their use. A second part of the problem for younger children would also seem to be their failure to understand what types of strategies are helpful in performing what types of tasks. Although young children can be instructed to use a memory strategy for a specific task, they do not typically transfer the use of this strategy to other similar situations. Strategies are not automatically employed in appropriate situations until young children build up rules associating certain strategies with certain situations.

Different factors appear to be responsible for the existence of production deficits in elderly adults. Once individuals reach adulthood, limitations resulting from a failure to understand both the importance of basic control processes and when these control processes might be appropriately employed usually disappear. The evidence reviewed here suggests that the source of difficulty for elderly adults may be related more to the actual execution of control strategies. It seems quite possible that strategies are not executed efficiently because elderly adults process information at a much slower pace. Strategies that were once accessed and utilized on an almost automatic basis take much longer to execute. Instead of the knowledge deficit exhibited by young children, elderly adults appear to be operating under more of a capacity deficit.

Additional differences emerge when one considers aspects of memory other than control processes. Young children, for example, appear to suffer from deficits in their long-term knowledge bases. Because of the role that LTM plays in interpreting, integrating, and evaluating information, limitations in LTM contribute to young children's difficulties in encoding incoming information. The use of strategies to group and organize incoming information, for example, is largely dependent on semantic knowledge stored in LTM. Elderly adults, in contrast, do not appear to have deficits in their long-term knowledge bases. In fact, their experience and expertise may compensate for limitations in control processes when faced with familiar tasks. Elderly adults are more likely to encounter difficulties in adding new information and manipulating previously stored information in LTM because of their diminished processing speed.

Processing Abilities in Adults. Evidence regarding the information-processing difficulties faced by young children and elderly adults provides a basis for understanding the processing abilities in the adult population. A consideration of the types of deficits exhibited by these special age groups yields important insights into the functioning of the adult processing system. In particular, these findings highlight the abilities commonly found among adult processors and suggest the conditions under which these abilities may become diminished.

First, the evidence reviewed here underscores the efficiency with which adults employ control processes to encode and retrieve information. The control processes of adults proceed with knowledge and routines often lacking in young children and with execution skills often lacking in the elderly. By adulthood, it would appear that individuals (1) have developed a repertoire of strategies for handling information, (2) have developed associations that identify which strategies work well in which situations, and (3) have well-practiced routines for executing these strategies that require little conscious effort. Information-processing deficits similar to those found in young children are unlikely to occur unless adults are faced with unfamiliar tasks that limit the usefulness of strategies developed for processing information in more typical settings. Although it is quite possible for adults to construct new strategies for unfamiliar situations, the efficiency with which these strategies are utilized is likely to be more characteristic of information processing in children than in adults. Deficits in information processing similar to those experienced by elderly adults would also seem to be an infrequent occurrence for adults unless they are faced with tasks involving very demanding memory loads and fast rates of presentation. Although basic strategy utilization occurs efficiently in adults, at some point, memory loads and time pressure may combine to interrupt even the well-practiced and efficient routines typically used by adult processors.

Second, the findings reported here highlight the richness and complexity of the long-term knowledge base that adults possess and utilize in processing information. In contrast to children, adults possess knowledge about processing strategies and routines as well as basic semantic knowledge about a variety of subjects and topics. Knowledge of this type appears to be utilized on a consistent and efficient basis by adults to provide a context for processing new information and for guiding the way such information will be processed. Deficits similar to those found in young children are unlikely to occur unless adults are faced with unfamiliar topics or task settings. In such situations, without a knowledge base to guide processing, adults will be subject to the same

difficulties facing young children without procedures and contexts needed to facilitate information handling.

Finally, the evidence considered here points to the efficiency with which adults process information in short-term memory. Although capacity is limited at some point for individuals of all ages, the speed with which adults process information is underscored by the difficulties often faced by elderly adults in this regard. Deficits similar to those found in elderly adults, however, might be expected to emerge under conditions that diminish the efficiency with which adults usually process information. Tasks involving unfamiliar topics, complex information, or difficult presentation formats might characterize the types of settings likely to slow down the processing system in adults in a manner similar to that commonly experienced by elderly adults.

Methodological Implications

Evidence that task factors often reduce and sometimes eliminate difficulties faced by the young and elderly suggests a number of methodological directions for future developmental research. Key among them is the necessity of considering the special problems of young children and elderly adults in designing studies. Because these groups are particularly sensitive to factors in the task environment, careful consideration should be given to the design of experimental stimuli, instruction sets, and dependent measures. Although one could conceivably incorporate alternative forms of experimental stimuli, instruction sets, and dependent measures into a study to ensure that task effects do not cloud the true abilities of young children or elderly adults, this approach is unlikely to be a practical one due to sample-size requirements and costs. A more realistic approach would involve minimizing task effects by designing stimuli, instruction sets, and measures in a way that does not overly handicap young children and elderly adults. Experimental stimuli, for example, should convey information in a format that is conducive to processing. The evidence reviewed here suggests that information presented in a visual and well-organized format would be suitable for this purpose. Instruction sets should also be designed to be clear and comprehensible to subjects of all ages. For young children, in particular, descriptions must be very specific, conveyed in simple language, and accompanied by concrete examples. Dependent measures should be designed with similar principles in mind. In addition, response formats that require the recall and unaided retrieval of information should be used with caution in collecting information from young children and elderly adults.

Beyond these considerations, the findings reported here suggest that task factors be incorporated into experimental designs as a way of pinpointing the source of processing deficits among young children and elderly adults. If age differences are reduced or eliminated by changing some factor in the task environment, and if changes in this factor can be related to specific processing skills, then the source of age differences in performance can be attributed to differences in these processing skills. As an illustration of this, consider the finding that elderly adults remember less information from television advertising than do younger adults. One explanation for this finding could be that elderly adults process information at a slower pace and thus have difficulty processing television commercials, which transmit information very quickly. In order to investigate this possibility, one might conduct an advertising experiment with young and elderly adults in which some task factor related to processing speed would be manipulated. In this case, the rate of presentation might be manipulated by using time compression to examine the extent to which presentation rate influences age differences in advertising recall. If rate of presentation either reduces or eliminates age differences between young and elderly adults, processing speed would be implicated as a source of the elderly's deficits.

Pursuing developmental research in this manner offers the flexibility needed to examine different types of deficits in different age groups. This approach can also accommodate investigations of age differences at several levels of complexity. The simplest design requires at least two age groups and two levels of one task factor (see Table 2). More complex designs, needed to examine multiple sources of processing deficits, can be constructed by adding additional task factors. In the experiment just described, for example, a second task factor could be incorporated to investigate the possibility that retrieval deficits contribute to the gap between young and elderly adults in recalling advertising information. Adding additional factors in this fashion also provides an approach for examining alternative explanations for age-related deficits. Because age groups vary on a number of different dimensions, the precise nature of the deficits experienced by young children and elderly adults can be difficult to isolate.[3] Elderly adults, for example, may recall less information from television advertising as a result of limitations in auditory or visual acuity that are quite common among individuals in their sixties and seventies (Schaie 1981). In such a case, perceptual difficulties might be ruled out as an alternative explanation by incorporating an additional factor into the design that varies visual or auditory complexity.

Managerial Directions

Findings regarding the influence of task factors on the processing abilities of the young and elderly suggest the need for special communication strategies geared

[3]For a review of developmental influences on life-span development other than the cognitive factors considered here, see Baltes, Reese, and Lipsitt (1980).

to these two age groups. Practices commonly used for other age groups may not be the most effective for establishing brand awareness and communicating product benefits to audiences composed of young children and elderly adults. Strategies may need to be adapted to overcome the processing difficulties encountered by both groups.

Concerns of this nature are most likely to arise when *advertising strategies* aimed at young and elderly consumers are designed. The evidence reviewed here suggests that several adjustments may be necessary in the areas of media selection, creative strategy, and evaluation. Modifications in *media selection* would appear to be most important for the elderly segment. Considering this group's difficulties with television formats, advertisers would be well advised to seek out print alternatives for carrying commercial messages. Print vehicles offer the beneficial visual format of television without penalizing the elderly for slower processing speeds, which broadcast vehicles may do.

Creative strategies also need to be tailored to meet the special needs of young and elderly consumers. In terms of content, the most important recommendation for both groups is to avoid overloading commercial messages with information. Considering the difficulties both groups face with regard to information quantity, product messages should be simplified as much as possible. This does not necessarily mean that shorter copy should be used for both age groups. It does, however, imply that the number of product attributes stressed in one advertisement should be minimized and that visuals accompanying the copy should not add information over and above that conveyed by the advertising copy. With respect to creative execution, several recommendations seem in order for young children and elderly adults. Both age groups benefit from visual presentations that can be readily incorporated into television and print formats. Information organization and order are additional concerns for young children. Because young children often have difficulty with material that is not thematically ordered, techniques such as flashbacks and quick cuts should be used with caution. Although these techniques do not usually interfere with comprehension in adults, young children may not be able to reorder the events in a flashback sequence and may not be able to bridge the gap between quick cuts in television commercials. Ordering of product information should also be approached with caution given the strong recency effect exhibited by young children. The most reasonable approach to the problem of information ordering is to repeat important copy points and brand names at the end of commercial messages. Although this type of repetition is probably beneficial to some extent for audiences of all types, ordering is most important for young children, who may remember only the last few frames of television commercials.

Evaluation methods for testing the effectiveness of advertising messages would appear to be a third area for modification. Measures of advertising effectiveness that involve recall testing should be used and interpreted with caution for both young and elderly adults. Due to the difficulties with recall formats experienced by both age groups, recognition tests should be examined as a possible alternative for assessing what young and elderly viewers learn from advertising. Recognition tests may demonstrate a much greater registration of copy points and brand names on the part of young and elderly consumers than do recall tests. Although recall formats have been generally preferred over recognition tests for a variety of reasons, recognition tests can be developed that are sensitive enough to register differences in learning and that are easy enough to administer (see Singh and Rothschild 1983).

Considering that difficulties such as these exist when designing and implementing mass media strategies for the young and elderly, a final recommendation for advertisers is to place more emphasis on *point-of-purchase materials.* Increased emphasis in this area seems warranted on several grounds. First, point-of-purchase materials provide a number of retrieval cues that can be beneficial for remembering previously stored product information. Because many young and elderly individuals experience retrieval problems, these groups should particularly benefit from the provision of such cues. Second, point-of-purchase materials provide another opportunity for communicating product information at a much closer point in the decision process. Information at this point is likely to be particularly effective with young children, who often depend on the most recently-presented bits of information when making product decisions.

In designing point-of-purchase materials, many of the same guidelines can be applied as those suggested for mass media advertising. Visual aids, for example, are likely to be beneficial for both age groups and should be incorporated into point-of-purchase displays and product labels. Visuals that incorporate frames or pictures from television and print advertisements are likely to be quite effective memory aids. Visuals may also prove effective in highlighting important product information on labels. Considering the large amounts of information on most labels, visual aids or symbols could alleviate the difficulties faced by the young and elderly in this situation. Elderly consumers, for example, might benefit from a symbol indicating the level of salt or cholesterol contained in grocery items.

CONCLUSIONS

Age differences in information-processing ability were examined to provide a better understanding of the difficulties facing young and elderly consumers and to identify the task factors likely to affect the severity of these deficits. Limitations in memory-strategy usage and

knowledge-base development were found to be the source of processing deficits in young children. In contrast, limitations in memory-strategy usage and processing speed were identified as the source of processing deficits in elderly adults. Deficits in both age groups were found to be most evident in tasks involving large amounts of information, information conveyed in less-than-optimal formats that lacked prompts or instructions to guide processing, and difficult response formats for recording task performance.

On the basis of this evidence, future research should acknowledge the possibility that young children and elderly adults may exhibit different levels of ability in different task situations. Rather than continuing to focus on the issue of *whether or not* young and elderly consumers possess certain skills, researchers should begin to address the question of *when* these age groups can be expected to demonstrate such skills. Although task factors are often a consideration even with younger adults, the fact that changes in the task environment often reduce and sometimes eliminate age differences in processing abilities renders task considerations crucially important in developmental research. Considering the wide array of task factors that affect performance levels in both groups, an adequate understanding of processing in young and elderly consumers seems unlikely without further evidence in this area.

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