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Sixteen

Everyday Problem Solving

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I. Definitions and Conceptual Issues

A major shift in the study of cognitive aging occurring in the past two decades has been the increased attention given to *contexts*, beyond the experimental laboratory. A corollary of this movement has been a focus on *real-world* problem solving. In the study of real-world problem solving, Kuhn (1992) suggested that researchers need to identify the problems that arise in people's lives and the kinds of thinking they have developed to deal with them. The focus of this chapter is on reasoning and problem solving as it occurs in the everyday lives and real-world contexts of older adults. The first section of this chapter considers definitions of problem solving and characteristics of everyday problem solving derived from the research literature (Section I). In the second part of the chapter, a model for the study of everyday problem solving is presented; the components of the model and relationships among components are briefly discussed (Section II). In the third part of the chapter, the components of the model provide a structure for reviewing the research literature on everyday problem solving (Sections III, IV, and V).

In their 1985 handbook review of problem-solving research, Reese and Rodeheaver (1985) concluded that all problems refer to a transformation of the situation from an initial state to some other state. Problem solving involves assessing the present state, defining the desired state, and finding ways to transform the former to the latter. Decision making refers to the evaluation of these possible solutions and the selection of one for implementation (Reese and Rodeheaver, 1985). The early problem-solving research that addressed issues of external validity often involved little more than substituting more "real life" stimuli within traditional laboratory-based problem-solving paradigms (Rabbitt, 1977; Reese & Rodeheaver, 1985). However, in the past decade cognitive aging researchers have begun to mount major research programs on real-life problem solving in older populations (M. M. Baltes, Mayr, Borchelt, Maas, & Wilms, 1993; Denney, 1990; Park, 1992; Sinnott, 1989; Willis & Schaie, 1993; Willis, Schaie, & Hayward, in press).

Although problem solving has traditionally

Handbook of the Psychology of Aging, Fourth Edition

been categorized as a complex cognitive activity, *noncognitive* factors have been given greater attention in recent applied cognitive aging research. Our position is that to understand the role of intellectual processes in problem solving about real-life issues, it is critical to examine the phenomenon as an entity, including the *context* and *noncognitive* factors, as well as component cognitive processes (Gauvain, 1993).

A. Characteristics of Everyday Problem Solving

Several distinctions have been made between the study of problem solving in the real world and laboratory-driven research approaches to problem solving.

1. *Cognitive and Noncognitive Factors*

First, everyday problem solving cannot be studied as an isolated act of pure cognition (Labouvie-Vief & Hakim-Larson, 1989; Park & Mayhorn, in press). To understand the role of intellectual processes in everyday problem solving, their relationship with other factors influencing problem outcomes must be studied (Blanchard-Fields, 1986; Park, 1992; Willis, 1991). These factors include belief systems, efficacy, emotionality, and the physical and social environment.

2. *The Context*

Human problem solving occurs within meaningful contexts, as people conduct purposeful goal-directed activity (Lawton, 1982). The context is salient not only in its influence on the problem-solving process, but also in *defining* the problem itself (Berg & Sternberg, 1985; Hartley, 1989; Kuhn, 1992). The very nature of the challenges and problems encountered by the elderly in their daily lives is defined in part by the sociocultural context, and thus varies with historical time. Likewise, the problem-solving process involves an interaction of environmental demands and the problem-solving strategies of the individual. Resolution of everyday problems requires a fit or match between the competence of the individual and the environmental demands and resources (Grisso, 1986; Lawton, 1982; Willis, 1995).

3. *Temporal Duration*

Problem solving in the real world is often a temporally lengthier and more iterative process than is represented in laboratory problem-solving tasks (H. Leventhal & Cameron, 1987; Willis & Schaie, 1993). For example, Park and Mayhorn (in press) have described medication compliance as a multiphase process involving comprehension of the instructions regarding the medications, storage of the information in long-term memory, use of working memory to integrate information related to multiple medications, and employment of prospective memory in order to take the medication at the appropriate schedule. Medications for chronic diseases involve problem solving that spans many years.

B. Goal-Directed Everyday Problem Solving

1. *Maintaining Independence*

Problem solving that occurs in the real world is largely defined and guided by the goals of daily living (Gauvain, 1993). Toward what goals, then, are many of the daily activities of the elderly directed? A major concern for many elderly is the maintenance of an *independent lifestyle*. What many elderly fear most is dependence —the inability to care for oneself and the subsequent need for institutionalization. What are the domains of competence that are associated with an independent lifestyle? Interestingly, both psychologists (Lawton & Brody, 1969) and those who provide legal definitions of competence

(Grisso, 1986) have focused on two broad domains: (a) caring for *oneself*, and (b) managing one's *property*. The Uniform Probate Code (1989) distinguishes between legal proceedings regarding care of the person (guardianship) and those related to property (conservatorship).

2. *Instrumental Activities of Daily Living*

Social scientists have identified a set of competencies associated with these two broad domains (Fillenbaum, 1985; Kane & Kane, 1981). *Activities of daily living*, commonly known as ADLs, focus primarily on self-care, including feeding, bathing, toileting, and basic mobility (Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963). *Instrumental activities of daily living*, commonly known as IADLs (Fillenbaum, 1985), are viewed as more complex but essential abilities required in order to live independently. Seven IADL activity domains are commonly cited: managing medications, shopping for necessities, managing one's finances, using transportation, using the telephone, maintaining one's household (housekeeping), and meal preparation and nutrition (Fillenbaum, 1985; Lawton & Brody, 1969).

The majority of real-world problem solving should occur in relation to the type of activities in which the elderly spend considerable amounts of time. Studies in both the United States and Germany indicate that community-dwelling elderly spend more time on IADLs (e.g., meal preparation, shopping, housekeeping, health care) than on any other type of activity. Older adults in Germany reported spending more than half of a typical day on obligatory activities; these activities were usually performed at home and in the morning (M. M. Baltes, Wahl, & Schmid-Furstoss, 1990). In a study in the United States, community-dwelling elderly reported spending a total of 5–6 hr per day in IADLs (Lawton, Moss, & Fulcomer, 1986–1987; Moss & Lawton, 1982). Given the salience of IADL-type tasks for maintenance of independent living and the amount of time spent on these activities by the elderly, our literature review of everyday problem solving will concentrate on these task domains.

II. A Model for Studying Everyday Problem Solving

Most models of problem solving have focused almost exclusively on cognitive aspects and have considered a singular problem domain. Figure 1 presents a more comprehensive model for studying everyday problem solving. The model is based on several assumptions: (a) *Antecedent* characteristics of the problem solver and the sociocultural context must be taken into account; (b) the elderly are active problem solvers who construct a *representation* of the problem and its solution. Representation of the problem includes *cognitive* and *noncognitive* aspects; (c) *task* (problem) characteristics interact with antecedent person variables to influence the problem-solving process; (d) problem-solving competence reflects a *match* between the *individual's* problem-solving skills and the demands and resources of the immediate *environment*.

A. Antecedent Variables

Each individual comes to a problem with his or her own unique developmental history, which influences how the adult defines the problem and selects and utilizes strategies for resolving the problem. Moreover, any problem arises within a particular sociocultural context and historical period. The first domain of antecedents, thus, includes individual-difference variables, such as the adult's (a) objective and subjective health; (b) basic cognitive abilities and skills; (c) personality characteristics; and (d) belief systems. These variables often represent stable or enduring

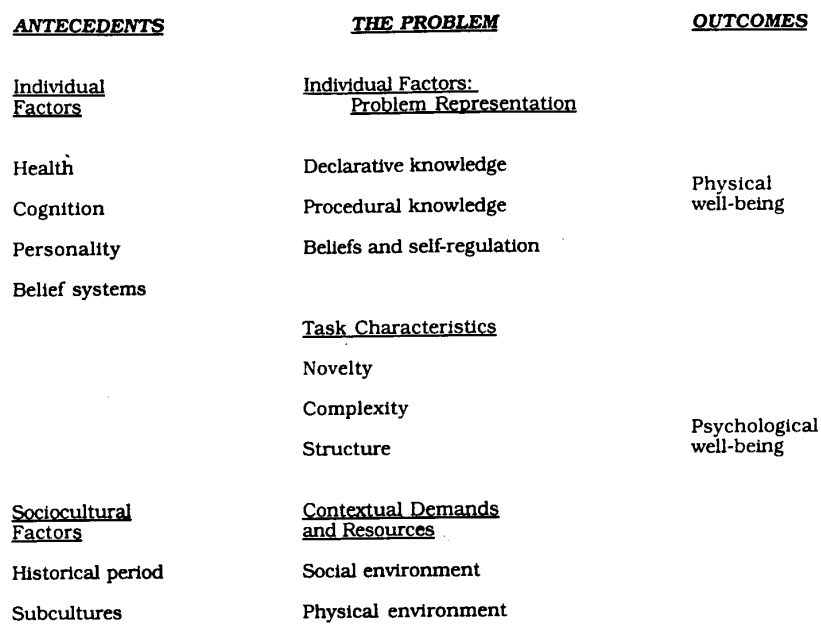

Figure 1 A model for the study of everyday problem solving in old age.

characteristics of the individual that predate a particular problem, but influence how the individual represents the problem and its solution.

The second domain frames the problem and problem solver within a particular sociocultural context and historical period. The sociocultural context influences what a particular society defines as a problem, and the specific tasks of everyday problem solving will vary across historical time (Willis, 1991, 1995). For example, recent technological advances are both contributing to the emergence of particular types of problems as well as providing new forms of solutions. Likewise, the historical period will influence what are considered the most appropriate and socially responsible means of resolving a given problem.

B. The Problem

Adults are seen as active problem solvers who construct a representation of both the problem and the process or strategies involved in solving the problem (Abelson, 1981; Chi, 1985; H. Leventhal & Cameron, 1987). The adult's representation of the problem and its solution involves factors that may vary with the type of problem being solved. For example, studies of *well-structured* problems (Simon, 1978) focus on (a) declarative knowledge, the body of domain-specific knowledge possessed by the adult; and (b) procedural knowledge, the problem-solving strategies and skills that are relevant to the particular problem. In *ill-structured* problems, on the other hand, the problem is not well defined, allowing alternative solution

strategies. Research on ill-structured problems has often focused on the adults' cognitions and beliefs about the problem and about solution or treatment alternatives (Voss & Post, 1988).

The problem solver's efficacy and control beliefs influence the manner in which the individual represents the problem and possible solutions. Likewise, the emotional saliency of the problem and of alternative solutions are important in the study of ill-structured problems (Blanchard-Fields, 1986; Labouvie-Vief & Hakim-Larson, 1989).

C. Contextual Demands

Problem solving does not occur within a vacuum. The context, including the physical and social environment, are important in defining the problem and in either facilitating or hindering problem solutions (Gauvain, 1993; Lawton, 1982). Within the model, the context is considered from two perspectives. When considered under antecedents, the concern is with the macrolevel *sociocultural* context that defines the types of problems and challenges experienced by the elderly within a specific historical period.

When considering the representation and solution of a particular problem, the focus shifts to the individual's *immediate environment*. The concern is with factors such as social support systems and the "user friendliness" of the physical environment. Problem-solving competence represents the *congruence* between the knowledge and skills of the individual and the demands of the immediate environment (Grisso, 1986; Willis, 1995). An individual who appears to be competent in a resource-rich context may appear less able in a deprived environment. Thus, assessment of competence needs to consider both the individual and the resources in the immediate environment.

D. Solution Outcomes

Finally, successful resolution of real-world problems should enhance the physical and the psychological well-being of the problem solver.

III. Literature on Antecedents of Problem Solving

A. Health

Sensory impairment is a major aspect of health as it affects everyday problem solving. Branch, Horowitz, and Carr (1989) studied the relationship between ability to perform tasks of daily living and visual impairment. Changes in self-reports of everyday competence were compared over a 5-year period for a group of elderly who reported good vision at both interviews versus a group of elderly reporting a decline in vision. Those reporting a decline in vision were significantly more likely to report needing assistance with shopping and paying bills. Those suffering visual impairment were 1.5 times less likely to leave their residence and were only half as likely to travel by car.

Physical health is also related to medication compliance, an important task of daily living. Elderly with multiple disease pathologies who were taking multiple drugs with complicated regimens were found to be less compliant (Fincham, 1988).

B. Cognitive Abilities

Several theorists propose multiple forms of intelligence, including a practical intelligence domain and a mechanistic domain. The "mechanics" of intelligence involve basic mental abilities and processes, and the "pragmatics" of intelligence are concerned with everyday cognition and problem solving (P. B. Baltes, Dittman-Kohli, & Dixon, 1984; Berg & Sternberg, 1985). A major issue for multiple intelligence

theories is the definition of the interrelationship among the various forms. According to Berg and Sternberg, "a mechanistic theory is needed to specify the cognitive processes by which contextually appropriate behavior is carried out" (1985, p. 348). The question then arises whether the mechanistic constructs and variables traditionally studied by cognitive aging researchers are relevant to the study of real-world problem solving. There exists considerable debate regarding the relationship between traditional cognitive constructs and practical intelligence (P. B. Baltes, Smith, & Staudinger, 1992; Heidrich & Denney, 1994; Salthouse, 1990; Sternberg & Wagner, 1986).

We have proposed a hierarchical relationship, such that traditional abilities and processes are necessary but not sufficient antecedents for competence in tasks of practical intelligence (Willis, 1991; Willis & Schaie, 1986, 1993). We have conducted a program of research examining older adults' ability to solve everyday problems involving printed material (Marsiske & Willis, 1995; Willis & Marsiske, 1991; Willis & Schaie, 1993). Tasks in each of the seven IADL domains were examined: meal preparation (e.g., nutrition label of food package), transportation (e.g., bus schedule), financial management (e.g., Medicare form), medications (e.g., prescription drug label), shopping (e.g., mail order catalog form), and telephone (e.g., emergency phone listing).

Because different psychometric abilities exhibit different patterns of age-related change in later adulthood (see Schaie, Ch. 15, this volume), it has been of particular interest to determine the specific mental abilities that relate to everyday task performance. Cattell (1987) differentiated between two broad domains of mental abilities. Crystallized abilities (e.g., verbal, social reasoning) are said to reflect acculturation influences, such as level of schooling; in healthy older adults crystallized abilities remain stable, on average, showing little or no decline until old-old age. In contrast, fluid abilities involve abstract reasoning and speeded responding; fluid abilities are said to be affected by neurological assault and to exhibit earlier patterns of decline, beginning, on average, in the mid-60s or earlier. Hence, older adults' performance on everyday tasks would be expected to show different patterns of developmental change, depending on whether such tasks are more closely related to underlying fluid or crystallized abilities.

In research on concurrent relationships between mental abilities and everyday tasks, my colleagues and I found that over half of the variance in older adults' performance on everyday tasks could be accounted for by mental ability performance (Willis & Marsiske, 1991; Willis & Schaie, 1986). Both fluid and crystallized abilities accounted for everyday task performance, although a somewhat greater portion of the variance was accounted for by fluid abilities. However, causal relationships among variables cannot be determined by examination of concurrent relationships. In our hierarchical model of relationships between ability and everyday competence, basic mental abilities have been hypothesized to be salient antecedents of performance on complex tasks of daily living.

To test this hypothesis, my colleagues and I examined whether performance on fluid and crystallized abilities at the first assessment occasion were significant predictors of everyday task performance 7 years later. Both fluid and crystallized abilities were indeed found to be significant predictors. A series of structural equation analyses were conducted to further examine the reciprocal relationship between abilities and everyday task performance (Willis, Jay, Diehl, & Marsiske, 1992). That is, the directionality of the relationship between abilities and everyday tasks was examined by contrasting models

of abilities as predictors of everyday task performance against models of everyday task performance as predictors of abilities. These analyses indicated that fluid ability at the first assessment occasion predicted everyday task performance at the second assessment occasion 7 years later. But everyday task performance predicted abilities at the second occasion less well. These findings were taken as support for our hypothesis that level of functioning on basic mental abilities is a significant antecedent of performance on everyday tasks involving printed materials.

Park has similarly proposed that multiple cognitive components are involved in adherence to a medication regimen (Park, 1992; Park & Kidder, 1995; Park & Mayhorn, in press). Based on prior laboratory-based research on various forms of memory, Park argued that the comprehension and retrospective aspects of memory should be problematic. With regard to comprehension of information on actual prescription drug labels, Morrell, Park, and Poon (1989) found that older adults made significantly more errors on comprehension (21%) than young adults (14%). Likewise, older adults had considerable difficulty with long-term recall of medication information when it was presented in an experimental setting (Morrell et al., 1989). On the other hand, when older subjects were given organizational devices that supported the comprehension, working-memory, and long-term memory aspects of medication cognition, the adherence behaviors of old-old adults were facilitated significantly (Park, Morrell, Frieske, & Kincaid, 1992). Of interest was the finding that the young-old evidenced high adherence rates and were not facilitated by the devices supporting these aspects of memory; it is likely that this finding occurred because the young-old adults already had sufficient cognitive resources to accurately handle the comprehension and retrospective aspects of medication cognition.

C. Personality Characteristics

Longitudinal research has shown that personality traits exhibit considerable stability across the adult life course (McCrae & Costa, 1990). Hence, the inclusion of personality or cognitive-style variables should provide important information on individual differences associated with representation of, coping with, or resolving the problem.

Research on consumer behavior has examined the association between personality characteristics, such as tolerance for ambiguity and cognitive style, and consumers' approach to investigating new products and their willingness to try innovative products (Cox, 1967). When faced with the comparison of new products, those tolerant of ambiguity engaged in more extensive information searches, particularly when ambiguous or discrepant information about products was involved (Schaninger & Schiglimpaglia, 1981). Those intolerant of ambiguity or high in trait anxiety were less likely to be attracted to or to buy products that were novel, complex, or innovative (i.e., having many unfamiliar attributes).

Cox (1967) examined the cognitive styles of simplifiers versus clarifiers in relation to problem solving in the consumer context. Simplifiers tended to react to uncertain or inconsistent product information by avoiding the incongruent information, whereas clarifiers actively sought new and additional information in order to reduce the ambiguity or inconsistencies. Simplifiers resisted changing their product preferences when presented with additional information on products.

The salience of personality characteristics, such as tolerance for ambiguity, has also been noted in medical decision making (E. A. Leventhal, Leventhal, Schaefer, & Easterling, 1993). Compared to middle-aged adults, older patients made quicker decisions about whether they were ill and

also sought medical care sooner when they judged the condition to be serious. Quicker decision making was interpreted as being due to less tolerance of ambiguity and the need to reduce uncertainty on the part of the old. By contrast, middle-aged individuals were characterized as more likely to use the coping defenses of distraction and denial; that is, they were more willing to live with uncertainty and more likely to develop a "wait and see" approach to health problems, even when thought to be serious.

D. Beliefs about Knowledge and Ways of Knowing

Kuhn (1992) suggested that individuals' beliefs about knowledge and ways of knowing influence their approaches to problem solving. Individuals were identified with three types of belief systems, regarding the certainty of knowledge and the process by which knowledge is acquired. First, the *absolutists* believe that knowledge is certain and cumulative. Absolutists hold that even complex questions such as why prisoners become repeat offenders can be answered with complete certainty. Fifty percent of subjects could be classified as absolutists. In contrast, *multiplists* or *relativists* hold that no knowledge is absolutely certain, and that all opinions are of equal validity. Approximately 35% of subjects when reasoning about complex societal problems held that everyone had a right to his or her opinion and hence all opinions could be considered equally valid. The third type was labeled *evaluative*. Knowing was viewed as a process, rather than a certainty, and the focus was on use of thinking, evaluation, and argument in order to examine the relative merits of various types of information.

Kuhn and others (Krammer & Woodruff, 1986) argued that individuals' beliefs about the certainty of knowledge and ways of knowing may be more salient in their approach to the problem than the characteristics of the problem as defined by the investigator. The distinctions between well- and ill-structured problems held by the investigator may be of little relevance, for example, to an absolutist, who approaches all problems with a belief in the certainty of knowledge.

IV. Literature Related to the Problem-Solving Process

A. Task Characteristics

The characteristics of real-life tasks can interact with long-term individual differences to influence the problem-solving process. Three salient task characteristics, novelty, complexity, and structure, are frequently cited in the general problem-solving literature (Chi, 1985; Simon, 1978) and in the aging literature (Hershey, Walsh, Read, & Chulef, 1990; Park & Kidder, 1995; Park & Mayhorn, in press).

1. Task Novelty

The novelty of a task can have either a facilitative or a negative influence on problem solving. In the previous section, the interaction was noted between personal characteristics, such as tolerance for ambiguity and cognitive styles (simplifiers versus clarifiers), and willingness to engage in informational searches associated with problem solving. That is, adult consumers high in tolerance for ambiguity and characterized as clarifiers were more likely to explore and to find attractive new or innovative products with large numbers of unfamiliar features (Cox, 1967; Schaninger & Schiglimpaglia, 1981).

Task novelty may *limit* individuals, particularly experts, in their use of well-honed declarative or procedural knowledge bases. For example, although chess experts were much quicker and more adept at recalling placement of pieces when the placement subscribed to well-known plays, chess experts were at no advantage

compared to novices when placement of pieces was random (Charness, 1981).

Novelty may, on the other hand, *facilitate* problem solutions that require planning and implementing an action. This is particularly evident when the individual is involved in multiple activities and must monitor progress in each activity. Cohen and Faulkner (1989) found that novel, high-priority plans were more likely to be recalled and implemented. In contrast, highly routinized and repetitive everyday tasks become less distinct and less likely to be remembered at the appropriate time. Park and Kidder (1995) suggest that repetitive medication schedules, particularly those with multiple dosages within 24 hours, contribute to failures of prospective memory in medication adherence.

2. *Task Complexity*

Task complexity is related to (a) the *amount* of information needed to solve a problem, and (b) the *search* processes required to obtain information. The search process may involve information retrieval from external sources or from one's own knowledge store.

We have examined older adults' ability to use information from everyday documents (Willis, 1991; Willis & Schaie, 1993). For example, older adults were asked to utilize information on a cereal nutrition label to determine the difference in calories when adding whole versus low-fat milk. We examined what task characteristics contributed to problem-solving complexity (Meyer, Marsiske, & Willis, 1993). Several characteristics of the document contributed to complexity, including (a) the number of propositions in the document; (b) the number of places in the document from which relevant information had to be abstracted; and (c) the number of plausible alternative solution choices available to the subject. As the complexity of the task increased, so did the difficulty of solving the problem.

The interaction between the person characteristics and task attributes were of importance. Older adults with higher levels of functioning on fluid reasoning and verbal ability were more likely to solve tasks of greater complexity.

Task complexity also interacts with the procedural strategies used in problem solving. As the complexity of the task increases, experts use procedural strategies that minimize the informational search process. The demands on working memory and long-term memory increase so that the expert becomes increasingly *selective* in the information that he or she focuses on in the task (Hershey et al., 1990). In contrast, the novice reacts to increases in task complexity by seeking more and more information, thus risking memory overload and inefficiency in executing the problem-solving strategies.

3. *Structure of the Task*

Some in the cognitive sciences (Chapman, 1993; Galotti, 1989; Sinnott, 1989; Sternberg & Wagner, 1986) have argued that the distinction between well- and ill-structured problems is useful in defining real-world versus academic or laboratory problem-solving tasks. Laboratory tasks are said to involve almost exclusively well-structured problems, whereas real-world problems are viewed as almost always ill structured in nature. In well-structured problems, the initial state, the goal state, and the necessary task information are available to the subject (Simon, 1978). Well-structured problems may also have singular solutions (e.g., goal clarity) and an optimal solution path (e.g., use of heuristics and algorithms, Sinnott, 1989). In contrast, ill-structured problems involve (a) a high degree of complexity and minimal definition (e.g., lack of goal clarity); (b) a failure to specify necessary procedural information in instructions; and (c) lack of a set of prescribed rules leading to solution as part of the initial problem statement.

We believe, however, that the realm of real-world problem solving includes *both* well- and ill-structured problems (Willis & Schaie, 1993). For example, tasks such as comparison of medigap insurance plans, programming of a microwave oven, or call-forwarding mechanisms on a phone meet the criteria for well-structured problems. Yet these are activities experienced by many older adults in their daily lives. Although both well- and ill-structured problems are involved in daily living, the distinction between them is a useful one in studying the cognitive processes and strategies that are involved in problem solution. As Chapman (1993) noted, the above definitions of well- and ill-structured problems simply describe the characteristics of the tasks, but they do not provide information on the *cognitive demands* of the two types of problems. According to Chapman (1993),

> Everyday reasoning is 'ill-defined' to the extent that the information given, the permitted operations, or the desired end-states are left relatively unspecified . . . to the extent that heuristics for 'everyday reasoning' have been codified, one might argue that the distinction between formal and everyday reasoning becomes blurred. (pp. 96–97)

Sinnott (1989) suggested that two features (clarity of goals; use and availability of heuristics or algorithms) are particularly salient to the problem-solving process. These are two characteristics that distinguish well- and ill-structured problems. In problems that have clearly defined goals, but in which well-defined strategies are either not available or unknown to the subject, considerable time is spent on identifying or constructing a strategy for solving the problem. In contrast, when the goal is unclear but there is an available, well-defined solution strategy, there is the tendency to apply the heuristic or algorithm in a routinized manner and assume that the goal is "whatever is yielded by the process." In this instance the problem may appear to have been "solved" very quickly. Sinnott (1989) suggested that the tendency to apply an available heuristic in a routinized manner when the goal is unclear is often characteristic of age-related decline in problem solving.

B. Problem Representation and Knowledge Systems

1. *Declarative Knowledge*

Declarative knowledge, defined as knowing which facts are relevant in a particular situation, has been of most concern in the study of well-structured problems (Chi, 1985). Experts have a large body of domain-specific (declarative) knowledge (Hershey et al., 1990; Staudinger, Smith, & Baltes, 1992). Experts' knowledge, compared to that of novices, is stored in larger and sometimes more abstract memory chunks, leading to a more integrated, cohesive understanding of the problem domain. The knowledge domains of experts are organized hierarchically with information indexed in terms of meaningful interrelations, allowing experts to scan their memory of a topic quickly and efficiently.

a. Experts versus Novices One of the most interesting distinctions between experts and novices is that experts attend to fewer pieces of information when engaged in problem solving, compared to novices. However, the information attended to by experts is usually higher order information within the hierarchy of the knowledge base (Hershey et al., 1990). Because experts have both well-organized knowledge hierarchies and well-honed strategies for solving a particular problem, they are more efficient in selecting only the most relevant information and "plugging" it into the problem-solving strategy.

A number of studies have found that novices, in contrast, engage in more complex and time-consuming information searches, and amass large amounts of data in the early stages of problem solving. Hershey et al. (1990) found novices requested

more information and engaged in more complicated information searches in a financial problem-solving task. Having accumulated a mass of information, novices were more likely to reexamine the same information more than once. However, the information sought by novices was at a lower level in the hierarchical structure of domain-specific knowledge constructed by experts. Hershey et al. (1990) suggested that use of lower order information forced novices to engage in more steps in the problem-solving process than experts.

b. Aging and Use of Declarative Knowledge Given their extensive lifetime experiences, the old might be expected to organize and utilize their declarative knowledge in a manner similar to that of experts. The elderly would, thus, have hierarchically organized knowledge bases that were well integrated and that utilized less, but higher order information. Findings in support of these hypotheses are mixed.

Meyer, Russo, and Talbot (1995) examined decision making with respect to a health scenario about breast cancer. Young, middle-aged, and older women were presented with increasing amounts of information about an individual with suspected breast cancer in an unfolding scenario and asked to make decisions about treatment at three stages in the scenario. Older women had no greater prior domain-specific knowledge about breast cancer. They, moreover, sought less information before making a treatment decision. When given further information as part of the unfolding scenario, older women typically did not change their initial treatment decision. In contrast, younger women were more likely to seek additional information, while delaying a decision about treatment, and were more likely to compare and contrast various types and sources of information in making a decision.

For all age groups, the treatment decision was related to (a) the type of information that was remembered about various treatment options from the material presented; and (b) the particular material that individuals considered important and underlined in the material presented. Treatment decisions were only weakly related to information about cancer treatments that subjects had prior to the study. Older adults remembered less information presented during the study. In spite of these differences in use and recall of information related to treatment options, older women made the same decision regarding treatment as the young and middle-aged. The older women reached the same decision based on less information and earlier in the decision-making process than younger women.

A study of managerial decision making reported a somewhat similar pattern of findings (Streufert, Pogash, Piasecki, & Post, 1990). Age differences in a simulated complex decision-making task involving managerial functioning were examined. The youngest management teams engaged in the greatest information seeking; this resulted in a greater number of decisions and a wider range of approaches taken to resolve problems. In contrast, the older managerial teams were less responsive to incoming information and made fewer decisions throughout the course of the task. The older teams spent larger amounts of time discussing issues before implementing decisions. However, again, when an emergency situation was introduced into the ongoing problem-solving task, there were no age differences in the decisiveness or adequacy of responding to the emergency. Although across the whole simulation the old made fewer decisions, there were no age differences in decisions made in the emergency situation.

Several other studies have also reported age-related reductions in the amount of information used and the extensiveness of the information search process undertaken by the old. In studies of consumer behavior involving new and innovative products, younger shoppers were more actively

engaged in a search for greater amounts of information, whereas the old sought less information and considered fewer alternatives in making product choices (Schaninger & Schiglimpaglia, 1981). Likewise, in a study of age differences in seeking of medical care, the elderly were less likely to seek information from outside sources prior to contacting their physician (E. A. Leventhal et al., 1993).

2. *Procedural Knowledge*

Procedural knowledge represents the individual's understanding of how to go about solving a particular problem—how facts relevant in a particular situation can be combined to produce a solution (Chi, 1985). Procedural knowledge has often been represented in the form of a problem-solving *script* that involves a game plan for the organization of the set of operations leading to the solution (Hershey et al., 1990). Abelson (1981) defined a script as "a hypothesized cognitive structure that when activated organizes comprehension of event-based situations" (p. 717). The script may involve a set of rule-based mental operations into which the relevant parameters for a particular problem can be inserted.

Although experts and novices may differ in both declarative and procedural knowledge, deficits in procedural knowledge are considered more limiting. Experts and novices differ in the sequence of steps used to obtain a solution. Experts use information to work forward through a problem; they quickly identify a plan (e.g., script) and work forward from the starting point of the plan to a solution. In contrast, novices, lacking a precise plan, work backward, starting at the goal and trying to develop a plan as they work backward.

a. Speed of Reaching Problem Solutions Experts have been found to arrive at problem solutions faster than novices across a number of problem-solving studies. This finding appears to be due not only to the more extensive declarative and procedural knowledge of experts, but also to the greater efficiency in use of procedural knowledge.

There is, again, a somewhat puzzling similarity with findings from problem-solving research with older adults. That is, older adults reached decisions or problem solutions faster than young adults in several studies. In the Meyer et al. (1995) study of decision making regarding treatments for breast cancer, older women reached their decisions faster or earlier in the problem-solving process than young or middle-aged subjects, although the nature of the decision reached did not differ by age group.

E. A. Leventhal et al. (1993) examined age differences in timing of decisions to seek medical care. The timing of two decision points was examined: (a) time until persons decided they were ill; (b) time from decision of illness until they sought medical care. Older adults reached the decision that they were ill much sooner than did middle-aged adults. In addition, when the condition was thought to be serious, the old sought medical care sooner than the middle-aged. All age groups had equal access to medical care, and the actual or perceived severity of the medical condition for which treatment was sought did not vary by age group. The middle-aged group reported more pain associated with the medical condition, but they were more likely to delay seeking care. Moreover, working outside the home was not related to delay in seeking care.

In their study of managerial functioning and decision making, Streufert et al. (1990) found that older management teams responded as efficiently and as quickly in responding to an emergency situation as young teams. In nonemergency situations, however, the older teams often ignored relevant information and were less responsive to incoming information.

The quicker response of the old in

problem-solving and decision-making situations is particularly interesting, given that a focus on age-related slowing has characterized much of the cognitive aging literature (Salthouse, 1985). A closer examination of procedural strategies employed more frequently by the elderly may be instructive.

b. Top-Down versus Bottom-Up Processing Style Age-related changes in styles of processing information and solving problems have been reported (Labouvie-Vief & Hakim-Larson, 1989; Sinnott, 1989). Researchers, however, differ in their interpretation of the efficacy of these changes. Labouvie-Vief and Hakim-Larson (1989) proposed that there are two modes of thinking and knowing—a youthful ability to think about reality in a formalistic, abstract, and objectified manner, in contrast to a more pragmatic, concrete, and subjective approach to reality sometimes favored in adulthood. The latter mode of thinking reflects sensitivity to the interpersonal context and thus focuses on inner, personal experience as the way of thinking and knowing. Study of cognitive aging until recently has focused almost exclusively on the mode more common in youth, and, in judging mature thought solely in terms of a single mode, has focused on deficits or regression in aging. A vertical or hierarchical, rather than balanced or integrated, ordering of the two modes of thought was imposed. Pragmatic, emotive modes of thinking were devalued and subjugated. Labouvie-Vief suggests that in adulthood there is the unique potential to integrate optimal use of both modes of thought; she proposes that the concept of wisdom reflects this integration.

Labouvie-Vief stated that "as individuals acquire expertise, their knowledge becomes too complex and richly organized to conform to a simple rule-oriented system, and flexible functioning is enhanced by a less explicit and more intuitive approach" (Labouvie-Vief & Hakim-Larson, 1989, p. 80; see also Rybash, Hoyer, & Roodin, 1986). As adults become experts at processing information relating to subjective processes and inner dynamics, this processing style may result in deficits in tasks that require more objective and formal ways of processing. Young adults focus on literal, text-based features of information, whereas older adults summarize the gist along with its psychological and metaphorical meaning. These researchers argue that these changes in modes of thinking do not reflect deficit or compensation, as an integrative response style begins to emerge in middle adulthood—when there is no loss in recall of objective information.

c. Age-Related Processing Styles Sinnott (1989) proposed three age-related processing styles. The *Youthful* style involves intense data gathering and "bottom-up" processing. Young adults possess fewer relevant knowledge structures and compensate by gathering and focusing on data. There is little reliance on past experience, and the approach is largely noncontextual. The *Mature* style, reflected in middle age, is characterized by a balance of "top-down" and "bottom-up" processing modes. The top-down mode makes use of the well-integrated, relevant knowledge bases (e.g., declarative knowledge, heuristics, and algorithms), whereas the bottom-up mode reflects a recognition of the need to seek further information when called for. The *Old* style represents solely or primarily a top-down approach. The old are characterized as utilizing in a somewhat indiscriminate manner the extensive knowledge acquired through a lifetime of experience and heuristics that have proven useful in prior problem-solving situations but may not be optimal in the present situation. Sinnott (1989, p. 96) said that the old style is suited for "rapid, low energy-demand solutions done by the experienced solver with many available structures of knowledge. It was top-down in style with little attention to data, probably because of poor

memory capacities." Meyer et al. (1995) suggested that the quicker decisions regarding breast cancer treatment made by older women may reflect a decrease in the utilization of bottom-up processing even when they were presented with additional relevant information, and a reliance almost solely on the top-down approach.

The issue of "balance" is critical in considering the relative merits of the proposed shifts in processing style suggested by Labouvie-Vief and Sinnott. Effective problem solving involves both types of processing; maturity or wisdom is reflected in achieving an optimal balance of the styles in a particular problem-solving situation.

3. *Cognitions, Beliefs, and Self-Regulation*

Concepts such as declarative and procedural knowledge have more frequently been used in the study of well-structured problems involving formal reasoning processes. In the study of ill-structured problems, there has been recognition of the salience of another type of knowledge—the adult's personal experiences, beliefs, and understanding of the problem and of alternative solution strategies.

a. Personalized Knowledge H. Leventhal and Cameron (1987) argued that a distinction should be made between two types of declarative knowledge, based on their work on a self-regulatory model of medical compliance. Leventhal distinguished between semantic memories, which represent the individual's conceptual knowledge about the problem and episodic memories, or autobiographical information, based on the subject's prior experiences with respect to a particular problem domain. The former type (i.e., semantic memories) is similar to the typical usage of the term *declarative knowledge*. However, the more personalized knowledge (i.e., episodic memories) may be particularly relevant for the elderly, given that they would be expected to have a more extensive bank of experiences and thus would be more disposed to employ this personalized knowledge in problem-solving situations.

Leventhal, moreover, argued that there may be a conflict between the two types of knowledge that may influence the problem-solving process. For example, with regard to medical decision making, the more objective, semantic knowledge may inform a person that certain diseases (e.g., heart disease) are asymptomatic and hence one cannot rely on how one feels in making decisions regarding the efficacy of medications or when to see a doctor. In contrast, the personalized knowledge based on episodic memories may argue that, in the past, sickness was related to not feeling well (e.g., symptoms); hence, if there are no symptoms, then one is not sick. Different decisions and problem solutions will be reached depending on which knowledge system is utilized. Leventhal argued that personalized knowledge (episodic memories), in contrast to the more objective declarative knowledge, is the more critical and predictive of compliance in health problem solving. The primacy of episodic memories is supported in the study by Meyer et al. (1995) in that older women based their rapid decision making on their personal beliefs and fears that quick action was needed before the cancer spread, although information provided to the subjects indicated that cancer spreads more slowly in the old and therefore the elderly had more time for considering alternative treatments.

The individual's own personal belief system or representation of the problem becomes increasingly salient, when the goal of the problem is less clearly defined and there are less well-determined heuristics or algorithms (i.e., procedural knowledge) to employ in solving the problem. This more personalized and contextualized knowledge base is also relevant to the second mode of thinking discussed by

Labouvie-Vief and characterized by Sinnott's old processing style.

b. Self-Regulation and Problem Solving In his research on medical compliance, Leventhal has conceptualized problem solving as a self-regulatory behavior employed by the patient (problem solver) in order to manage a health-related problem (H. Leventhal & Cameron, 1987). A self-regulatory perspective conceptualizes individuals as active problem solvers engaged in attempting to close the perceived gap between their current status and a goal or ideal state. Behavior, such as compliance to a health recommendation, depends on the person's cognitive representations of the current status and goal state, plans for changing the current state, and techniques or rules for appraising progress. Leventhal's self-regulation model of illness involves three stages: (a) cognitive representations of the health threat; (b) formulation and initiation of a plan of action (action or coping stage); and (c) utilization of specific criteria to gauge the success of one's actions (appraisal stage). This leads to modifications in the representation or coping plan, or both.

c. Cognitive Representation of Problem Of particular interest here is the cognitive representation of the problem. This representation includes the individual's *perception* of the severity of the health problem, the potential causes of the health problem, the possible consequences and the perceived benefits or efficacy of treatment, and how the problem manifests itself over time (H. Leventhal & Cameron, 1987). This cognitive representation of illness and treatment is dynamic, evolving over time, and can be modified by feedback from the coping and appraisal stages in the model.

Multiple illness representations may be developed if the individual has multiple illness conditions, as is common with chronic diseases in the elderly. Park has reported considerable intraindividual variability in medication compliance; the same individual may be highly adherent for one drug, but not for another (Park & Kidder, 1995). Park suggests that variability in illness representations for the same individual may account for intraindividual differences in adherence patterns.

What are the possible linkages between cognition and the self-regulatory model of compliance? The self-regulatory model suggests that it must first be determined whether the illness representation is congruent with medical adherence; if the illness representation is not congruent with compliance, then examination of predictors (e.g., cognition) of compliance may be less salient. If one perceives the health problem to be of concern and to have possible serious consequences, and also believes a treatment to be beneficial, then congruency between one's belief systems and adherence is likely.

d. Coping and Appraisal E. A. Leventhal et al. (1993) argued that the speed of seeking medical attention is associated with the elderly's increased need to conserve physical and emotional resources with accompanying age. The strategies that adults use in dealing with health threats are believed to change and to become more efficient with age. These strategies include being strongly motivated to detect and avoid threat as soon as possible, and to do so with minimal expenditure of personal resources. By moving more quickly and efficiently, the older person avoids anxiety and tension that might sap diminishing physical and emotional resources. Older persons have been found to be more active in confronting and coping with health threats (Folkman, Lazarus, Pimley, & Novacek, 1987) and are likely to report adoption of preventive behaviors that require little expenditure of physical energy, such as eating a balanced diet, avoiding salted foods, getting regular medical checkups, and avoiding excessive drinking (Costa & McCrae, 1980; Prohaska, Leventhal,

Leventhal, & Keller, 1985). Young-old adults were also found to be more compliant than younger age groups with regard to medications and medical treatments (Nerenz, Love, Leventhal, & Easterling, 1986; Park et al., 1992).

V. Literature Related to Contextual Demands and Resources

It has been argued that competence does not reside solely in the individual but represents the *congruence* between the abilities of the individual and the demands and resources in the context (Grisso, 1986; Lawton, 1982). A loss of competence resulting from incongruence between the individual and environment may reflect decreases in the abilities of the individual, changes in the environmental demands or resources, or a combination of these. In this final section I consider a few possible ways in which the immediate social and physical environment influence the problem-solving process.

A. Social Environment

The work of Antonucci (1990) suggests that, across the life course, individuals experience multiple convoys of social networks. The individuals within the social support network change across the life course. Given the gender differences in average life expectancy, the social support network of older women often shifts from spouses to adult children and close neighbors or friends. Although the particular individuals within the support network may change, findings from research suggest that perceived level of support does not decline in old age (Antonucci, 1990).

The problem-solving process may be influenced by the older adult's social context in a number of ways. First, one's social contacts may be an important source of declarative knowledge in the problem-solving process. A fundamental aspect of perceived social support is instrumental support, including individuals from whom one can obtain information or advice. Second, individuals in the primary support network may significantly influence one's personalized knowledge and beliefs, which are considered critical in development and modification of illness representations.

Antonucci and Jackson (1987) suggested that efficacy beliefs may be an important mechanism by which one's social support system influences the development and maintenance of competence. These authors proposed that it is through continuous interactions with a successive array of significant or supportive others that the elderly develop and maintain beliefs that they have the ability to meet the demands of the situation and to successfully mount the challenges of daily life.

Significant others in one's social network may serve as a cognitive prosthesis in problem-solving situations, such as medication adherence. Men in a coronary primary prevention trial were found to be more adherent to a medical regimen when they had highly supportive wives. Husbands' compliance was related to wives serving as reminders to take their medication (Doherty, Schrott, Metcalf, & Iasiello-Vailas, 1983). On the other hand, more medication errors were made by elderly living alone.

B. Physical Environment

Features of the physical environment can serve as external aids for memory and problem-solving activities. Natural events may serve as aids. For example, memory for prospective events can be significantly enhanced by the use of ongoing activities as external supports for remembering to perform an action. A prospective memory which is time based (take medications three times a day) may be converted to an event-based memory by linking the taking of medications to meal time (take medications after meals).

Alternatively, external memory aids may be introduced into the environment. Low-tech items in the environment, such as timers, pill reminders, and calendars, have been found to significantly enhance the memory component in a problem-solving task.

VI. Conclusions and Recommendations

The focus of this chapter has been on everyday problem solving. Problem solving that occurs in the real world is largely defined and guided by the goals and everyday activities of the elderly. Because maintenance of independent living is a primary goal of most elderly, special attention has been given to problem solving in domains considered essential for independent living, commonly known as IADLs. Although these are necessary domains of problem solving, few elderly would consider themselves to have a high quality of life if activities were limited to these domains. Thus, everyday problem solving should also be expanded to include such domains as leisure activities, social relationships, and volunteer activities.

In this chapter, I presented a model for the study of everyday problem solving. The model is based on four assumptions: (a) *antecedent* characteristics of the problem solver and the sociocultural context must be taken into account; (b) the elderly are active problem solvers who construct a *representation* of the problem and its solution; (c) characteristics of the *task* (problem) interact with antecedent characteristics of the individual, and they influence the problem-solving process; (d) the elderly's competence to solve a given problem reflects a *match* between the *individual's* problem-solving skills and the demands and resources of the immediate *environment*.

A useful mechanism for studying problem solving is the individual's representation of the problem. In studying problems in which the goals and procedures for solving the problem are well defined, problem representation has focused largely on the individual's declarative knowledge and procedural knowledge. With regard to declarative knowledge, a consistent finding from several studies is that older adults engage in less extensive information searches than younger adults. Older adults also utilize fewer pieces of information in reaching a decision related to a problem. Interestingly, research on expertise also indicates that experts, compared to novices, engage in less extensive information searches, drawing instead on extensive, well-organized knowledge bases related to the domain of study. Likewise, experts are able to identify the few, most relevant pieces of information and utilize these in problem solution. Both the elderly and experts have been found to make a decision (reach a solution) faster and earlier in the problem-solving process, compared to the young and novices, respectively.

Researchers working in quite different fields (e.g., self-regulatory models of medical compliance, postformal reasoning) have suggested that two forms of knowledge or modes of thinking should be considered in studying problem solving and reasoning in later adulthood. Labouvie-Vief contrasted two modes of thought as formalistic, abstract, and objectified versus pragmatic, concrete, and subjective. Leventhal and colleagues in research on medical compliance have contrasted objective knowledge regarding one's health condition and treatment versus personalized knowledge acquired through the adult's experience in prior illness situations. Labouvie-Vief argues that developmental shifts in adult thought involve more balance in the use of these two modes of thought in middle age and old age. Leventhal proposed that there may be conflict between the two forms of knowledge in health-related problem solving; the more personalized episodic knowledge

may be particularly critical in medical compliance.

The procedural strategies of the old may more often be characterized as top-down processing. The elderly increasingly utilize prior experiential knowledge and well-honed procedural strategies to solve problems of daily living. They are less likely to engage in bottom-up processing requiring extensive information searches and inductive reasoning strategies. A major challenge for the elderly appears to be determining the appropriate balance between the two modes of thought and evaluating the utility of top-down versus bottom-up processing strategies. When there appears on the surface to be considerable familiarity with prior problem-solving situations, the elderly often inappropriately apply personalized knowledge and top-down processing procedures in a routinized manner.

The seeming efficiency of the elderly's problem-solving approach (limited information search, utilization of fewer pieces of information, emphasis on personalized knowledge, top-down processing) may represent a coping strategy based on their increased need to conserve physical and emotional resources. Quicker decision making in health situations may be based on the elderly being strongly motivated to detect and avoid threat as soon as possible, to reduce anxiety and tension, and to minimize ambiguity.

The above discussion has suggested *age-related* differences in approaches to problem solving. However, the wide variability in problem-solving competence in the elderly suggests that characteristics other than age are necessary to explain the phenomenon described. The lack of longitudinal studies of everyday problem solving precludes an examination of cohort differences. Moreover, individual-difference variables such as education and domains of expertise need further consideration.

Finally, it is argued that everyday problem solving does not occur in a vacuum. Competence in everyday problem solving represents the congruence of the abilities of the problem solver and the demands of the environment. Competence does not reside solely in either the individual or the environment. Hence, the role of the social and physical context in facilitating or hindering problem solving is an essential component in the study of everyday problem solving.

The study of everyday problem solving represents an exciting addition to the field of cognitive aging. Salient characteristics of research in this area include a focus on personalized knowledge bases, noncognitive factors, and the importance of the context. Given these characteristics, research on everyday problem solving will need to involve not only those with expertise in cognitive aging, but also our colleagues involved in social, emotional, and environmental studies. Psychogerontology and the elderly have much to gain from these interdisciplinary efforts.

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