Theoretical Models of Cognitive Aging and Implications for Translational Research in Medicine

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**Purpose:** We provide an overview of theoretical models of cognitive aging and present empirical research that uses these models to explain older patients’ medical behaviors and to develop interventions for improving the delivery of health information and services to older adults. **Design and Methods:** Theoretical accounts of age and cognition are summarized and are related to key research findings, including age differences in comprehension of medical information, adherence, and use of medical technologies. The implications of cognitive aging theories for designing optimal medical environments and enhancing adherence are discussed. **Results:** Age declines in basic cognitive abilities such as working memory capacity limit older adults’ ability to comprehend and recall several types of novel medical information. In contrast, automatic processes and environmental cues can benefit older adults, as shown by age increases in compliance for practiced or mentally imaged health behaviors, but can also be dangerous, as shown by older adults’ greater belief in false but familiar health statements. Last, cognitive aging is shown to be a useful model for investigating cognitive disorders. **Implications:** Cognitive aging theories are important for understanding older patient behaviors and suggest age-related declines as well as gains in performance in medical domains. In addition, models of cognitive aging are useful in guiding the development of interventions that improve health care in older patients and in furthering our understanding of cognitive dysfunction in populations other than older adults.

**Key Words:** Cognitive aging, Medical information, Adherence, Medical devices

As primary users of health services, older adults must confront a range of cognitively demanding tasks, such as learning about new health conditions, making medical decisions, and remembering protocols for use of medications or home medical devices. At the same time, older adults experience age-related cognitive changes that affect the processing of medical information, medical compliance, and, ultimately, medical outcomes. For example, age-related declines in basic cognitive abilities such as online working memory capacity (Park et al., 1996) may limit older patients’ ability to acquire new medical information and use medical services. On the other hand, older adults also have substantial knowledge and experience with illnesses that they may bring to bear in certain health situations (Park, 1999). However, health professionals and clinicians have rarely addressed the issue of age-related cognitive changes when delivering information and services to older patients (Halter, 1999). Research on more effective delivery of medical information to older adults that takes into account their cognitive functioning should therefore result in better treatment compliance, better informed decisions, and fewer hospitalizations. In this article, we outline theoretical models of cognitive aging and examine how these models have been used to understand age-related differences in the processing of medical information and performance of medical behaviors (see Appendix, Note 1). We summarize key findings on the impacts of age and cognition on comprehension of medical information, adherence, and the design and use of medical devices and Web sites. We
then discuss how automatic processes and environmental cues can be recruited to enhance older adults' compliance with medical regimens, while at the same time cautioning that automatic processes in memory can also mislead older adults toward mistaken beliefs about health statements. In addition, we show how models of cognitive aging can be used to understand cognitive impairments in populations other than older adults, such as in individuals with the puzzling rheumatologic disorder fibromyalgia. We conclude by discussing the implications of this work for dissemination of medical information, technologies, and interventions for older patients.

Theoretical Models of Aging and Cognition

Although a substantial literature has shown that older adults evidence declines on standard laboratory measures of cognition as compared with younger adults, other work has suggested that normal elderly people can and do maintain intact or even superior performance on a number of everyday tasks (see Park, 2000, and Park & Hall Gutches, 2000, for reviews). An important theoretical distinction that may inform our understanding of why older adults do well on some cognitive tasks but not others involves the distinction between effortful and automatic processes (Park, 1999). Effortful or controlled processing requires substantial mental resources and occurs in situations where the individual must deliberately search for information from memory, actively manipulate information, or consciously attempt to solve a problem. In contrast, automatic processing requires little or no mental capacity to perform and may develop as a result of repeated experience (e.g., driving a car). The classic pattern of findings with regard to age and cognition is one of age declines in tasks requiring effortful processing versus age invariance in tasks relying predominantly on automatic processes, with growth occurring across the life span in knowledge structures such as vocabulary and world knowledge (Craik & Jennings, 1992; Light, 1992).

There are pronounced age declines in effortful processing, which largely reflects the fact that older adults have fewer cognitive resources available for such processing as compared with younger adults. Several indices of effortful processing resource have been proposed, and the best index is still of some debate in the cognitive aging literature (see Park, 2000, for a review). For example, older adults generally process information more slowly than younger adults, and this reduced rate of processing is posited to be a fundamental cause of age differences in cognitive performance (Salthouse, 1996). Speed of processing is measured in the laboratory by how many perceptual judgments a person can make in a specified time frame (e.g., deciding whether two letter strings are the same).

Another proposed index of processing resource is working memory capacity, or the amount of information a person can simultaneously process and store in consciousness. Working memory, or one’s "mental desktop," also declines with age (Park et al., 1996) and is measured by tasks in which participants answer questions about material presented while simultaneously having to remember aspects of this material (Salthouse & Babcock, 1991). Finally, other workers have argued that there are age declines in inhibition, or the ability to direct attention away from irrelevant information, and that this inhibitory deficit accounts for the decreased cognitive performance of older adults (Hasher & Zacks, 1988; Zacks & Hasher, 1997).

Basic abilities such as speed of processing, working memory, and inhibition can be thought of as building blocks of cognition because they are fundamental for understanding individual differences, and age differences, in many cognitive tasks. Decreases in speed of processing and working memory place limits on long-term episodic memory, or retention of information beyond a few minutes (Park et al., 1996), as well as other important mental activities such as comprehension, reasoning, and problem solving (Kemper, 1992; Salthouse, 1992). As a result of age declines in basic cognitive resources, older adults show deficits on types of memory that are effortful, such as recall tasks, which require the individual to remember information with minimal cues in the environment to support retrieval operations (Craik & McDowd, 1987; Park et al., 1996). In addition, explicitly remembering source information, or the specific context in which information was presented, is a resource-intensive activity that also evidences age declines (Frieske & Park, 1999; Spencer & Raz, 1995).

Figure 1 summarizes the life-span relationships between age and cognition described thus far. Figure 1 shows regular, linear declines across the life span in speed of processing, working memory, and long-term memory tasks (adapted from Park & Hedden, 2002). However, at the same time, there are slight age gains in world knowledge, which is represented here by vocabulary, but which also includes domain-specific expertise. This pattern of findings suggests that the typical older adult may be somewhat slow to take in new information but has considerably more stored knowledge and experience as compared with a younger adult (but see Schaie, 1996, 2000, for somewhat different age change patterns for different abilities).

Similar to the findings of age sparing of knowledge structures, age differences are typically small or nonexistent on tasks requiring primarily automatic processes. For example, picture recognition is considered relatively automatic because it provides environmental supports or rich external cues for remembering (Craik, 1986) and thus does not require much in the way of deliberate retrieval. Hence,
picture recognition does not show large age differences, as compared with recall tasks (Park, Puglisi, & Smith, 1986). Another automatic type of task is an implicit or indirect memory task, which does not deliberately refer back to a prior study episode but nonetheless assesses previous learning through improvements in performance. An example of implicit memory, also known as “priming,” is an increased probability of completing the word stem *REC* with the word *RECALL* (as opposed to other possible completions such as *RECORD*) after seeing references to recall tasks earlier in this article. Implicit memory tasks show small or no age differences as compared with traditional, “explicit” memory tasks (LaVoie & Light, 1994; Park & Shaw, 1992). In a similar vein, some researchers have suggested that there is age invariance in familiarity or perceptual fluency for previously occurring information (Jacoby, Jennings, & Hay, 1996). Familiarity may be described as a feeling of *déjà vu* or a vague sense that information has been presented before (Mandler, 1980) and is contrasted with recollection, which includes the clear contextual details surrounding information acquisition and which shows age declines (Jacoby et al., 1996). Jacoby and colleagues have suggested that memory performance reflects a combination of familiarity (automatic) or recollection (effortful) components, and these researchers have devised a technique for estimating these two components from a single recall protocol.

Finally, social psychologists have developed a broader conceptualization of automatic processes, one that may be particularly pertinent to the study of medical behaviors. Social psychologists define automatic processes as unconscious mental states, which when combined with the appropriate set of environmental conditions, trigger the behavior that is predicted by the unconscious state (e.g., Bargh, 1994). Real-life examples of subtle automatically driven behaviors include forming the self-evaluation that you lack willpower to stay on your diet when your seeing a frail elderly woman board a bus or deciding that you are too tired to attend your exercise class after dinner companions order tempting desserts. Jacoby and associates (1996) have identified familiarity as the mechanism underlying the type of automatic everyday behaviors described by Bargh, and this type of mechanism may be particularly important for understanding older patients’ behaviors. That is, in the relative absence of controlled processes, older adults may have a greater tendency to fall back on automatic or habitual modes of responding.

Thus, cognitive aging theories and mechanisms are relatively well specified and suggest particular hypotheses regarding the pattern of age differences in a number of health behaviors. For instance, we might expect older adults to show superior performance on medical behaviors that are familiar or are driven by external cues in the environment, such as taking the same dosage of a medication for several years or deciding among treatment options for a commonly experienced medical condition. In contrast, older adults should have difficulty on medical tasks requiring substantial cognitive resources such as using a medical device that requires the individual to retain several steps in mind at once or recollecting whether a medical claim they remember came from a physician or a supermarket tabloid. Thus, we applied theoretical models of cognitive aging to the study of several medical behaviors, including the comprehension of medical information, the process of making medical decisions, and adherence to treatment instructions.

**Impacts of Age-Related Cognitive Changes on Patient Health and Behaviors**

**Comprehension of Medical Information**

Age declines in basic cognitive resources could adversely impact older adults’ ability to comprehend several types of medical information, including medication instructions. For example, Morrell, Park, and Poon (1989, 1990) found that older adults incorrectly comprehended up to 21% of the information on prescription drug labels when they were asked to use this information to develop a specific medication schedule. A follow-up study by Park, Morrell, Frieske, Blackburn, and Birchmore (1991) showed that arthritis patients made errors in loading memory aids designed to improve their comprehension, except for 7-day organizers that had compartments for different times of the day. The authors hypothesized that the structure of the organizers decreased comprehension errors because they presented an appropriate structure for organizing medication plans across the week. Later, Park,
Morrell, Frieske, and Kincaid (1992) showed that the use of these organizers actually facilitated accurate pill-taking in very old adults when they were used in the field. Other work has suggested ways of structuring medication instructions in order to support age-related cognitive declines—for example, using a well-structured list format that is organized around patients’ existing schemas or knowledge structures for taking medicine (Morrow & Leirer, 1999; Park & Jones, 1996).

Park and colleagues (Park, Eaton, Larson, & Palmer, 1994; Zwahr, Park, Eaton, & Larson, 1997) have also examined the implications of age declines in cognitive resource for implementation of the Patient Self-Determination Act (PSDA), a law passed by Congress in 1990 that requires all health facilities receiving Medicare or Medicaid to offer patients, at the time of admission, information on advance medical directives and durable power of attorney for health care. Park and collaborators (Park et al., 1994; Zwahr et al., 1997) surveyed hospital and nursing home administrators in the state of Georgia to assess their experiences with the PSDA and found that the biggest perceived problem with the law was patients’ difficulty in comprehending the information. In follow-up work, Zwahr and colleagues (1997) examined the impacts of various informational formats on patients’ understanding of advance directive materials. Interestingly, a simple pictorial pamphlet with minimal text was just as effective as a complex document in helping patients to learn the key points necessary for understanding advance medical directives but failed to eliminate age differences in comprehension of the material.

A related line of research by Rogers and colleagues (e.g., Rogers, Rousseau, & Lamson, 1999) concerns age differences in the comprehension of medical warnings. In a thorough review of the literature on aging and warning perception, Rogers and colleagues (1999) concluded that older adults have particular difficulty in understanding warnings that are complex or that require making inferences, which is a resource-intensive process (Kemper, 1992). In further work, Hancock, Rogers, and Fisk (2001) conducted a large-scale survey assessing age differences in people’s likelihood of attending to warning information for household products and over-the-counter medications, as well as their actual comprehension of 12 common warning symbols. Although older adults reported attending to warning information more often than did younger adults, their comprehension of 50% of the symbols was poorer than that of the younger adults.

**Improving Use of Medical Devices and Technologies**

Rogers and colleagues have explored the implications of decreased comprehension abilities with age for the design and use of medical devices and technologies (see, e.g., Fisk & Rogers, 2002, for a review). They adopt a user-centered or human factors approach to the study of technology, one whose fundamental tenet is not to blame the user for errors when systems and instructions are designed without taking into account the cognitive system. There is evidence that some systems and technologies place unreasonable demands on even the most sophisticated user. For example, Rogers, Mykityshyn, Campbell, and Fisk (2001) examined the steps involved in using a blood glucose meter, a device used by patients to self-monitor glucose levels in the blood. A detailed task analysis of one blood glucose meter revealed, contrary to the manufacturer’s claim that it was “as easy to use as 1, 2, 3,” that there were over 50 discrete substeps involved in calibrating the meter. Thus, without receiving any feedback to reflect mistakes, users of this device have multiple opportunities to make errors. Rogers et al. also examined the manufacturer’s instructional video for this blood glucose meter and found that it failed to summarize main steps, omitted critical substeps, and switched back and forth between views of a person and close-up views of the meter, which created difficulties for older users due to age declines in working memory (Park et al., 1996), comprehension (Kemper, 1992), and inhibition (Hasher & Zacks, 1988). Thus, Mykityshyn, Fisk, and Rogers (in press) developed an improved video training system that provided environmental support by explicitly demonstrating and reviewing the task sequence, including all of the specific substeps. This redesigned system improved the accuracy of both younger and older adults to approximately 90%. This work underscores the need for developers of medical systems and technologies to be aware of design-induced errors and to use designs to minimize errors, as well as developing instructional materials with numbered steps, warnings, and structured reviews. Other work by Rogers and colleagues (Mead, Lamson, & Rogers, 2002) has considered the implications of cognitive aging theories for older adults’ use of health Web sites, as well as the use of telemedicine technologies, which electronically transmit health information between a health care provider and a patient (Fisk & Rogers, 2001).

**Aging and Medical Decision Making**

Another critical medical behavior where one might expect cognitive aging to play an important role is medical decision making. Are normal older adults disadvantaged in making important medical decisions as a result of age-related declines in effortful cognitive processes such as comprehension and recall (see, e.g., Marson & Harrell, 1999)? Zwahr, Park, and Shifren (1999) asked 102 women, ages 20 to 80, to read materials on the pros and cons
of estrogen replacement therapy and then to decide whether a hypothetical patient should use the therapy to treat her menopausal symptoms. These authors reported that, due to age declines in basic processing resources, the older women considered fewer treatment options, made fewer comparative judgments among choices, and had an overall lower quality of rationale for their decisions, as compared with younger women. However, despite showing age differences in decision-making processes, the two age groups made similar types of medical decisions in the end. Moreover, the older women in this study were more likely to reach an immediate decision as compared with the younger women. This result is reminiscent of Meyer, Russo, and Talbot’s (1995) finding that older and younger women made similar decisions when presented with hypothetical treatments for breast cancer (e.g., lumpectomy, mastectomy), despite the fact that the older women requested less information and offered less complete rationales for their decisions. The results by Zwahr and colleagues (1999) and by Meyer and associates (1995) suggest that older adults may rely heavily on intact knowledge structures and automatic processes when making medical decisions, at least for relatively familiar medical conditions. A compatible view is that older adults may recognize limits on their information-processing capacity, even for a familiar medical topic, and thus seek out less new information on that topic (see, e.g., Brown & Park, 2002). It is possible that older adults may arrive at systematically poorer decisions when medical situations are less familiar or are more immediately life threatening than the scenarios studied by Zwahr and colleagues and by Meyer and associates. However, this view must be tempered by the fact that older adults often rely on decision-making proxies (e.g., physicians and family members), which may be somewhat adaptive, given their declining cognitive resources. Finally, it should be noted that the tendency of older adults to seek less information (explore fewer available options) before reaching a decision is not specific to medical decision making. The same has been shown for such diverse activities as choosing apartments or automobiles (Johnson, 1990, 1993) and for choosing chess moves (Charness, 1981). Thus, how older and younger adults make decisions differs, in part, due to age-related cognitive changes.

Medication Adherence: Is Older Wiser?

Taking medication is a crucial medical behavior that many older adults perform on a daily basis. For example, a recent report from the Centers for Disease Control and Prevention (2002) noted that, within a 1-month time frame, 74% of adults age 65 and older have taken one or more prescription medications. However, relatively little work has investigated the impacts of age-related cognitive changes on older patients’ adherence behavior. Medication adherence is an interesting everyday memory behavior to study because it involves multiple cognitive processes, including working memory (integrating individual prescriptions to form a medication plan), long-term memory (remembering the plan), and prospective memory (remembering to implement the plan). Age-related declines in these effortful processes would therefore appear to leave older adults at a disadvantage for managing these tasks correctly. However, medication taking is also a real-world behavior that occurs in a wide range of settings (e.g., home, work, school), with varying degrees of practice, and in the context of varying symptoms and goals (see Park & Jones, 1996, and Park & Mayhorn, 1996, for reviews). Thus, automatic processes and environmental cues may play a significant role so that older adults are less disadvantaged than one might expect.

Park and colleagues (1999) studied the medication adherence behaviors of 121 rheumatoid arthritis patients, age 34 to 84, over a 4-week period. These authors used electronic bottle caps to record the date and time each medicine bottle was opened in order to ensure accurate but unobtrusive monitoring of medication usage. In addition to measuring adherence, Park et al. also assessed patients’ cognitive function, as well as their medication beliefs, emotional state, health, and a self-report measure of busyness and environmental demands (Martin & Park, 2002). Park and colleagues obtained the following result: Despite showing clear evidence for age-related cognitive declines, older adults were the most adherent of any age group, a finding that was reported previously (Morrell, Park, Kidder, & Martin, 1997; Park et al., 1992). In addition, the single best predictor of medication adherence was perceived environmental demands: People who reported leading chaotic, unpredictable lives (who tended to be middle-aged adults) made significantly more errors than did people who reported more routine, predictable environments (who tended to be older adults). This finding was significant because it suggested that context (i.e., an orderly environment) predicted remembering better than did laboratory measures of cognitive function, including speed of processing and working memory. Moreover, this result points to the role of automatic processes in controlling everyday behaviors. Park and colleagues (1999) argued that older adults often structure their schedules around their medication taking rather than the other way around, so that the same routine events (e.g., taking medicine with one’s morning coffee) will serve to automatically trigger their medication-taking behavior in the future. For example, individuals will reach for medications as soon as they drink their coffee. This finding is consistent with Jacoby and associates’ (1996) view that, with age, automatic or habitual processes
remind intact, whereas effortful or controlled processes show age declines. Thus, with age, an increasing proportion of behaviors may be controlled by contextual cues.

However, we do not mean to imply that medication nonadherence is never a problem for older adults. Although Park and colleagues (e.g., Park et al., 1992, 1999; Morrell et al., 1997) have conducted several studies showing high rates of adherence in older adults, these same studies have suggested that a particular subset of very old adults, termed the old-old (i.e., age 75 and up), may be at greater risk for medication errors as a result of the more severe cognitive impairments associated with advanced old age. For example, Park and colleagues (1992) demonstrated that a sample of old-old adults (age 78–92 in this sample) made substantially more medication errors than did young-old adults (age 60–77) when these individuals were in a no-treatment control condition that provided no cognitive aids. However, when the old-old participants were provided with cognitive aids that supported working memory function (i.e., an organizational chart plus a weekly medication organizer), the incidence of errors in this age group decreased significantly.

**Improving Compliance by Strengthening Automatic Processes**

Gollwitzer and colleagues (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997) have provided intriguing evidence that the formation of an implementation intention about a future behavior increases the likelihood of completing the behavior as a result of processes that are automatically activated. Forming an implementation intention involves imagining a detailed plan for completing a desired behavior, such as “When I finish my dinner, I will test my blood glucose level.” Both the act of imagining the completion of a behavior and the linking of the initiation of the behavior to cues in the environment automatically increase the likelihood that the behavior will be initiated when these cues are encountered in the future. Thus, in the above example, when the association between finishing dinner and performing the blood glucose test is imagined in great detail (e.g., picturing dirty dinner plates), subsequently seeing the after-dinner plates will become a reminder to the individual to perform the blood test. On the basis of findings of age invariance in automatic processes (e.g., Jacoby et al., 1996), this type of intervention should be particularly effective for older adults.

In the first demonstration of this technique in older adults, Chasteen, Park, and Schwarz (2001) showed that forming implementation intentions could be an effective strategy for improving older adults’ performance on a laboratory task of prospective memory. Subsequent work by Liu and Park (2002) investigated the use of implementation intentions in order to improve older adults’ compliance with a real-world medical behavior: self-monitoring of blood glucose. Older and younger adults, none of whom were diabetes patients, were instructed in the use of a blood glucose meter in the laboratory and were then asked to monitor their own blood glucose at home, at four specified times per day, for 3 weeks. Participants were then given one of three strategies to assist their memory for the intention: instructions to imagine implementing an intention to comply with the task instructions, rehearsing the intentions out loud, or deliberating the pros and cons of complying. At the end of 3 weeks, participants returned to the lab with their blood glucose meters and the data detailing the dates and times of tests performed were uploaded from the blood glucose meters to a computer. A “correct” reading was defined as one taken within a 30-min window around the target testing time. The main findings were as follows: Older adults who learned to form implementation intentions executed 25% more tests than older adults who received alternative instructions and 30% more tests than younger adults in the implementation intentions condition. Moreover, older adults who imagined implementing their intentions completed over 95% of their blood tests within 30 min of each targeted test time. Furthermore, these beneficial effects were maintained over a 3-week period based only on one short training session. Liu and Park’s (2002) finding that older adults benefited more from implementation instructions than did younger adults is reminiscent of Park and colleagues’ (1999) finding that older adults, who had more consistent environmental cues to automatically prompt their health behaviors, were the most adherent age group. In summary, our success in teaching older adults to form implementation intentions suggests that this technique can be a powerful and inexpensive way to improve patient compliance with medical regimens and hence lower the cost of health care by decreasing the incidence of unnecessary doctor’s visits.

**False Medical Claims Gain an Illusion of Truth**

Although we have shown that automatic processes can be successfully recruited to improve older adults’ compliance with a medical regimen, we caution that automatic processes in memory can also be dangerous for older adults by misleading them toward mistaken beliefs in health statements. More specifically, Skurnik, Park, and Schwarz (2000) have examined age differences in the “illusion of truth,” a memory distortion in which sheer repetition of statements causes people to believe the statements are true (e.g., Begg, Anas, & Farinacci, 1992). This illusion appears to occur when people think they have heard a piece of information before...
(i.e., it feels vaguely familiar to them), but they cannot remember the specific source of the information (i.e., who said it or where it was learned). In the absence of this detailed contextual information, people may use the heuristic or rule of thumb that, if they think they have heard the information before, it is probably true. Thus, the illusion of truth is dangerous because it can make false information seem true. The threat of this type of memory distortion looms particularly large for older adults, given their greater consumption of medical products and services as well as their high level of exposure to a variety of medical claims, some of which are complex and unreliable, from the popular press, as well as the Internet, television, radio, friends, and family members.

Previous work has suggested that older adults are more susceptible to this memory distortion than are younger adults (e.g., Law, Hawkins, & Craik, 1998) and that this age-related increase in the illusion occurs due to preserved familiarity or automatic processes with age (e.g., Jacoby et al., 1996) but impaired recollection or memory for detailed source information (e.g., Spencer & Raz, 1995). That is, memories tend to become “decontextualized” in old age. However, Skurnik and associates (2000) also showed that older adults are vulnerable to a paradoxical “rebound” effect whereby repeated warnings that information is false can backfire and make the information seem all the more true later on. Skurnik and colleagues presented older and younger adults with health statements such as “Corn chips have twice as many calories per cup as potato chips” that were labeled either true or false and that were presented either once or three times. (For ethical reasons, all of the statements were actually true.) Then, after a delay, participants saw the statements again and had to decide whether they were true. For older adults, presenting false information three times made it less likely to seem true immediately (i.e., repeated warnings initially helped older adults avoid the illusion of truth effect). However, after 3 days, the benefits of repetition backfired: Increased warnings that information was false (e.g., “It is not true that shark cartilage alleviates arthritis!”) paradoxically increased the likelihood of older adults’ remembering the information as true, even if they understood at the time of study that the claim was false. In contrast, for younger adults, presenting false information three times reduced the likelihood of this information seeming true, both immediately and at 3 days. Thus, the advantage of repetition stayed with younger adults for several days—that is, they were less likely to mistakenly remember a false statement as true after repeated warnings. But after several days for older adults, the initially beneficial effect of repeated warnings backfired and made repeated false information seem all the more true. An important implication of this line of research is that those who interact with older adults should state their instructions in positive terms rather than warning against negative results (e.g., “Take this medicine in the morning” rather than “Don’t take this medicine before bedtime”) in order to avoid memory distortions such as the illusion of truth. A further suggestion is to provide older adults with contextual supports, such as reading materials for future reference, that can increase source memory for information and hence minimize the potential for paradoxical memory illusions.

Age Increase in Gullibility

Similar to the age increase in the illusion of truth that was demonstrated by Skurnik and colleagues (2000), we have also considered that age declines in effortful cognitive processing may make older adults more susceptible to quackery and deceptive medical advertising by unscrupulous individuals. Age changes in cognitive abilities could make older adults less capable of being skeptical or socially vigilant when evaluating the intentions and abilities of physicians and salespeople. In an initial test of this hypothesis, Ybarra, Chan, and Park (2001) examined how sensitive older and younger adults were to information related to a person’s morality or competence. In these initial studies, older and younger adults completed a lexical decision task in which they were presented with a series of letter strings and had to respond quickly as to whether or not the strings formed words. In this task, the ability to identify certain words more quickly than others indicates an increased cognitive sensitivity to those words. When morality and competence cues were presented in the lexical decision task, older adults were generally slower in recognizing personality cues (categorizing them as words versus nonwords), which was consistent with age-related slowing. However, the pattern of sensitivities was equivalent for both age groups: All persons regardless of age were most sensitive to morality-related cues than to competence-related cues (i.e., responded faster to them). The authors suggested that a greater sensitivity to morality is generally adaptive in the social environment because it tends to signal more threats posed by the individual.

Despite the apparent age equivalence in sensitivity to isolated social cues in the studies by Ybarra and colleagues (2001), subsequent work by Ybarra and Park (2002) suggested that, under certain circumstances, older adults may be less skeptical when updating their existing impressions of other individuals. The authors hypothesized that social vigilance may be cognitively demanding, so that older adults are less able to revise their impressions of people once they are formed. In a series of studies, older and younger adults were initially given positive or negative information on a prospective physician and were then given new information that either
confirmed or disconfirmed the initial impression. When older and younger adults were given unlimited time to revise their impression of the individual, both age groups were equally likely to be cognitively skeptical. That is, both old and young could emphasize negative information about an individual that contradicted their initially positive expectancies of this person. However, under a time limit, which is closer to real-life conditions, an age difference emerged in which older adults were no longer able to be cognitively skeptical, whereas younger adults could still be skeptical. Thus, under cognitively stressful or time-limited conditions, older adults appear to have difficulty altering an initially positive view of an individual when available information suggests that the person has enacted immoral or incompetent behaviors.

Older adults’ greater gullibility and susceptibility to memory distortions such as the illusion of truth under conditions of cognitive load suggests that older adults may experience cognitive stress when learning about new medical products and services from physicians, salespeople, or the World Wide Web. In addition, older adults should be advised to take their time when evaluating the claims made by salespeople or vendors on the World Wide Web. Thus, under cognitively stressful or time-limited conditions, older adults appear to have difficulty altering an initially positive view of an individual when available information suggests that the person has enacted immoral or incompetent behaviors.

Cognitive Aging as a Model for Cognitive Disorders

In other work, we have used cognitive aging theories as an organizing heuristic for studying cognitive dysfunction in populations other than older adults. One population of particular interest in our laboratory has been the puzzling rheumatologic disorder fibromyalgia. Individuals with this disorder report chronic pain and fatigue of an unknown etiology (Wolfe et al., 1990), as well as difficulties in concentrating and remembering information. However, patients’ cognitive complaints are often dismissed by physicians as reflecting an underlying psychiatric syndrome such as depression.

At the same time, there is evidence that fibromyalgia patients experience alterations in hypothalamic-pituitary-adrenal functioning in a manner similar to that experienced by older adults (Crofford & Demitrack, 1996). Therefore, as a starting hypothesis, Park, Glass, Minear, and Crofford (2001) theorized that individuals with fibromyalgia may have cognitive function similar to that shown by older adults. Fibromyalgia patients were administered a battery of cognitive tasks and their performance was compared with age-matched controls as well as controls who were 20 years older. The findings indicated that fibromyalgia patients resembled younger adults on speed of processing tasks but resembled older adults on measures of working memory and long-term memory. These findings suggest that fibromyalgia is characterized by diminished mental resources, in line with patients’ self-reports. However, the disorder does not completely resemble cognitive aging, as speed of processing is a fundamental deficit of older adults—a deficit not shown by our fibromyalgia patients. Interestingly, pain, but not depression, predicted cognitive dysfunction in this patient population. Park and colleagues are currently investigating the neurobiological basis for cognitive impairments in fibromyalgia patients, including determining whether these patients’ neural recruitment patterns during working memory and long-term memory tasks resemble those of younger adults or older adults. Other work from our laboratory has used cognitive aging as a model to understand the cognitive effects of arthritis pain (Brown, Glass, & Park, 2002) and long-term alcohol abuse (Glass, Park, & Zucker, 1999). In summary, theories and mechanisms of cognitive aging are relatively well understood and may provide fertile ground for investigating conditions characterized by cognitive impairments.

Summary and Conclusions

In this article, we have discussed how theoretical models of cognitive aging can inform our understanding of how older adults process medical information and perform medical behaviors, as well as how to better deliver health information and services to older patients. The work represented in this article has largely developed from our applied cognitive aging research center supported by the National Institute on Aging—the Roybal Center for Aging and Cognition: Health, Education, and Training (CACHET). Theoretical accounts of aging and cognition have enabled the CACHET Roybal Center to develop a research program that systematically examines the interface of cognitive function with older patient behaviors and allows us to explain why older patients do well in some medical situations but not others. For instance, age declines in basic processing resources such as working memory capacity limit older adults’ ability to perform effortful cognitive tasks, such as comprehension and recall of warning symbols (Hancock et al., 2001), materials on advance directives (Park et al., 1994; Zwahr et al., 1997), and instructions for using medications and home medical devices (Morrell et al., 1989, 1990; Rogers et al., 2001). On the other hand, age sparing of knowledge structures and automatic cognitive processes can enable older adults to maintain superior performance on familiar or well-practiced behaviors, such as deciding on a treatment for a common medical condition (Zwahr et al., 1999) or remembering to take a medication at the same time every day for several years (Park et al., 1999). Similarly, interventions that recruit automatic processes can be of benefit to older adults, such as the use of external reminders to take one’s...
medication (Park et al., 1992) or the mental imaging of intended behaviors (Liu & Park, 2002). However, we caution that automatic processes can also be dangerous, by misleading older adults toward mistaken beliefs in false or deceptive medical claims (Skurnik et al., 2000).

A further important point from our research is that context can sometimes be more important than cognition in understanding patient behaviors. For instance, Park and associates (1999) found that a self-reported measure of a hectic lifestyle, which was more common in middle-aged adults than in older adults, was the strongest predictor of forgetting medication in rheumatoid arthritis patients. In addition, other contextual variables such as mood states and beliefs about one’s illness and medications may be vitally important in understanding adherence and other real-world medical behaviors (Morrell et al., 1997; Park, 1994; Park & Mayhorn, 1996; Park et al., 1999).

Our findings on cognitive aging and patient function suggest several ways in which health professionals and manufacturers of medical technologies can improve the dissemination of health information and services to older adults. First, health professionals should provide older patients with clear and simple written information on their medical condition such as pamphlets that they can review after the office visit, as well as opportunities to call back and ask questions of a physician’s assistant (in order to conserve a physician’s time). In addition, we recommend providing patients with additional, reputable sources of information, such as books, Web sites, and training videotapes and sessions for medical devices, in order to reduce the likelihood that health care is jeopardized by difficulties in comprehension or recall of information or by memory distortions such as the illusion of truth (e.g., Skurnik et al., 2000). Although only a small proportion of older adults currently use the Internet, we believe that having a Web site recommendation for a given diagnosis (or prescription) will be a more realistic option in the future, given the rapidly increasing proportion of seniors who use the Internet (Hodes, 2001), as well as the fact that many online seniors have reported using the Internet to obtain health information. (Morrell, Mayhorn, & Bennett, 2000). Second, manufacturers should not assume that medical devices are easy for older adults to use without first ensuring that such technologies are designed to address older users’ unique capabilities and limitations. In particular, we recommend improving the design and instructions for medical technologies by simplifying tasks, providing environmental supports, and reducing working memory demands whenever possible (Fisk & Rogers, 2002). Moreover, manufacturers and health professionals should verify that patients are actually using these technologies properly by conducting usability tests in-house or by contracting out such testing to human factors consultants. Alternatively, the Food and Drug Administration could do the testing for usability of medical devices (in addition to safety and effectiveness testing), although this option is not likely to be implemented in the current antiregulatory climate. Third, health professionals should consider using interventions that automatically cue health behaviors in individuals who are at risk for nonadherence, including the old-old (age 75 and up) as well as busy middle-aged adults. Examples of this type of intervention include using external reminders such as a triathlon watch with preset alarms reminding one to take medicine (Park, Shifren, Morrell, Watkins, & Stuedemann, 1997) as well as teaching patients to form implementation intentions or detailed plans for intended behaviors (Gollwitzer, 1999; Liu & Park, 2002). Last, health professionals should recognize that symptoms such as chronic pain may impair patients’ cognitive functioning, over and above the effects of age (Brown et al., 2002; Park et al., 2001). In conclusion, we believe that cognitive aging theories have much to offer in terms of improving the health care of older patients, as well as identifying and ameliorating the cognitive impairments of populations other than older adults.

References


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**Appendix**

**Note**

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