Judgment and Decision Making as a Skill

Learning, Development and Evolution

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Aging and decision skills

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Introduction
In this chapter we examine decision-making skills across the adult lifespan. Older adults (usually defined as ages 55 or 65 years and older) are a growing segment of the world population, and they make many personal, health, and financial decisions important to their quality of life. They also make some of society’s most consequential decisions as physicians, politicians, and Supreme Court justices. Of course, some older adults need considerable decision-making assistance, particularly in later life. As a result, understanding the effects of aging on the maintenance and facilitation of independent decision making is critical. Yet, age differences in decision making have been understudied, with decision research being conducted largely with samples of university students. Decision-making skills, however, are likely not static across the lifespan, and findings with younger adults (usually defined in the range of 18–39 years) may not generalize to middle-aged (often defined in the range of 35–64 years) or older-adult populations. In fact, research conducted to date demonstrates a series of age-related changes in skills that are expected to be relevant to decision making. These changes include declines in deliberative efficiency and motivated selectivity in the use of deliberative capacity, possible improvements in the use of affective information and in the acquisition of experience. Thus, across the adult lifespan, skills are acquired
and attenuated in ways that likely influence older adults’ judgments and decisions. The aim of this chapter is to examine existing evidence for age-related changes in information processing and decision-making skills, as well as to provide suggestions for interventions and decision support tools that may facilitate the decisions of older adults.

**Dual modes of thinking in decision making**

Information appears to be processed using two different modes of thinking: affective/experiential and deliberative (Epstein, 1994; Loewenstein et al., 2001; Reyna, 2004; Slovic et al., 2002). These modes are sometimes called System 1 and 2, respectively (Kahneman, 2003; Stanovich and West, 2002). The affective/experiential mode produces thoughts and feelings in a relatively effortless and spontaneous manner. The operations of this mode are implicit, intuitive, automatic, associative, and fast. According to some researchers, processing in this mode is based primarily on affective feelings, although some disagreement exists on this point (e.g. Sloman, 1996, does not consider the role of affect in his dual-process theory). The deliberative mode, in contrast, is conscious, analytical, reason-based, verbal, and relatively slow, and it may provide effortful control over spontaneous experiential processes. Kahneman (2003), for example, suggested that one of the functions of the deliberative mode is to monitor the quality of the affective/experiential mode’s information processing and its impact on behavior. Both modes of thought are important to forming decisions, and some researchers believe that good choices are most likely to emerge when both modes work in concert, with decision makers thinking as well as feeling their way through judgments and decisions (e.g. Damasio, 1994).

In this chapter, we review research on age-related changes in judgment and decision making, and how they may be explained by age-related changes in the two modes of thinking. We also discuss whether age-difference research supports their existence as two interdependent processes or as a single process (with lesser deliberative ability, for example, resulting in greater affective influence).

**Age-related changes in dual deliberative and affective/experiential processes**

In this section, we examine age differences in deliberative and affective/experiential information processes. We then continue with age-related

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1 We use the term *affect* in a general sense, to mean a valenced (good/bad) reaction, an arousal (activated/deactivated) reaction, or a discrete emotion such as anger or fear.
differences in decision making that may be attributable to lifespan changes in these processes.

Age-related declines in deliberative processes

Robust evidence demonstrates age-related declines in the efficiency of deliberative processes such as working memory—also referred to as fluid cognitive abilities (e.g. Park et al., 2002). Older adults, for example, process information more slowly than younger adults, potentially reducing the amount of information that they process and use (Salthouse, 1996). Age-related shrinkage in the prefrontal cortex (e.g. Amieva, Phillips and Della Sala, 2003; Raz et al., 2004) has also been related to older-adult deficits in explicit memory and learning (Cohen, 1996; Kausler, 1990; Salthouse, McGuthry and Hambrick, 1999). In addition, older adults tend to be less numerate than their younger counterparts (i.e. they understand basic numerical and probabilistic information less well; Peters, Väståll and Mertz, 2008). Such differences in processing speed, memory, and numeracy may be due, in part, to cohort differences, but declines have also been shown longitudinally (Schaie and Zanjani, 2006). Because decisions often involve complex trade-offs between multiple options varying on different attributes (e.g. Edwards, 1954; Raiffa, 1968), these age-related declines in deliberative processes will likely have a negative impact on at least some decisions.

Age-related changes in affective/experiential processes

Age-related changes in affective/experiential processing have not been documented as well as the robust declines in deliberative processing. As people get older, they tend to develop crystallized abilities, including knowledge and strategies that are increasingly specialized and dependent on personal experiences (Salthouse, 1990, 2004). In general, studies also support an age-related increase in reliance on affect, which appears to be mostly adaptive. For example, older adults demonstrate a more sophisticated understanding of emotion states compared to younger adults (Labouvie-Vief, DeVoe and Bulka, 1989). According to Carstensen’s (1993) socioemotional selectivity theory (SST), younger adults are more motivated to seek information about the world, whereas older adults are more motivated to focus on emotional goals and optimize positive affective experience. Tests of SST have demonstrated that, compared to younger adults, older adults remember affectively meaningful information relatively better than nonaffective information (e.g. Carstensen and Turk-Charles, 1994; Fung and Carstensen, 2003; Mather and Carstensen, 2005).
SST also predicts a specific age-related focus on positive relative to negative information in later life as older adults seek to optimize affective experience. Several behavioral studies of memory support this expectation. For example, Charles, Mather and Carstensen (2003) found that overall picture recall declined with age, but that older adults recalled a greater proportion of positive images than negative images, whereas young and middle-aged adults recalled similar amounts of each. Mather and Carstensen (2003) found that, relative to younger adults, older adults exhibited disproportionate attentional and memory biases in favor of faces depicting positive emotions over those depicting negative emotions. Older adults also demonstrated greater recognition memory for positive than for negative information (Spaniol, Voss and Grady, 2008). It is unclear, however, whether this age-related positivity effect results from increases in the processing of positive information or from decreases in the processing of negative information. A recent study using functional magnetic resonance imaging demonstrated that neural responses to the anticipation of monetary gains were relatively stable across younger and older adults, whereas responses to loss anticipation decreased with increasing age (Samanez-Larkin et al., 2007; see Kisley, Wood and Burrows, 2007, for similar results using event-related potentials). These results provide some basis for hypothesizing an age difference in decisions involving losses, with loss sensitivity diminishing with age, and no age difference in decisions involving gains.

In each of the studies conducted, however, arousal was not held constant across the positive and negative stimuli. In general, negative stimuli tend to be more arousing than positive stimuli (Sims and Tsai, 2007; Wurm et al., 2004). As a result, the reported findings could be due to the energy-consuming influence of arousal, with the energy consumption required by arousing events making little difference to younger adults with abundant resources, but taxing older adults' more limited resources (Charles and Carstensen, 2007). Additional research is needed to tease apart the exact mechanisms for this age-related difference, and further replication is needed concerning age changes in responses to positive and negative stimuli. Because decisions often involve affective and arousing information, such possible age-related changes will likely have an impact on decision making. As explained later, whether such changes have a positive or negative impact will depend on the situation.

**Age-related changes in decision making**

Research that has begun to examine adult age differences in decision making suggests that some decision-making skills decline with age,
whereas others improve with age. The reported results seem to reflect age changes in dual deliberative and affective/experiential processes thought important to decision making (for recent reviews, see Hanoch, Wood and Rice, 2007; Peters, Hess et al., 2007). Thus, we take a dual-process approach to organize the remainder of this chapter. We first discuss age-related declines in decision-making skills that seem to be deliberative in nature. Next, we present age-related improvements in decision-making skills that appear to rely more on affective/experiential processes. Finally, we discuss experience that is acquired with age, and how it may be related to age-related improvements in decision making.

**Age-related declines in deliberative decision-making skills**

As discussed above, deliberative processes generally decline with age. Perhaps not surprisingly, then, the decision-making skills that decline with age appear to be ones that rely on deliberative processes. In a recent study, adults aged 18–88 were asked to complete six decision-making tasks measuring adult decision-making competence (ADMC) (Bruine de Bruin, Parker and Fischhoff, 2007; in press). Participants scoring higher on the measure were more likely to avoid self-reported negative life decision outcomes (such as developing type 2 diabetes and going bankrupt), even after controlling for existing measures of cognitive ability (Bruine de Bruin, Parker and Fischhoff, 2007). On two of these decision-making tasks (described in the following paragraphs), older adults performed more poorly than younger adults. Meditational analyses suggested that the age-related declines observed in both skills were explained by age-related declines in fluid cognitive ability (Bruine de Bruin, Parker and Fischhoff, in press).

First, older adults were less likely than younger adults to correctly apply decision rules (Bruine de Bruin, Parker and Fischhoff, 2007, in press). In hypothetical choice tasks, they were asked to follow ten different decision rules preferred by ten different decision makers. For example, one item asked them to follow a so-called lexicographical rule (e.g. “Sally first selects the DVD players with the best Sound Quality. From the selected DVD players, she then selects the best on Picture Quality. Then, if there is still more than one left to choose from, she selects the one best on Programming Options”). Other commonly used decision rules (see Payne, Bettman and Johnson, 1993) were described in the remaining items. On average, the percentage of correctly applied decision rules was lower for older adults than for younger adults. These results seem consistent with prior research demonstrating that, when selecting their own choice strategies, older adults are more likely than younger adults to use
noncompensatory ones. These noncompensatory strategies require fewer comparisons — thereby reducing cognitive effort, but also potentially decreasing decision quality (Johnson, 1990). As discussed later, however, age increases in experience may moderate whether heuristic strategies are used and, when used, whether they are helpful or harmful to decision quality.

In the second ADMC task to show age-related declines, older adults were also more likely to be swayed by changes in the framing of decision problems (Bruine de Bruin, Parker and Fischhoff, 2007, in press), such as whether ground beef is described as 20% fat or 80% lean (Levin and Gaeth, 1988). Fourteen item pairs on the ADMC Resistance to Framing component similarly varied the description of various decision problems. Across these items, older adults showed more response inconsistency (larger framing effects) than younger adults. In Bruine de Bruin, Parker and Fischhoff's study (in press), similar results were demonstrated for risky-choice and attribute-framing problems (see Levin, Schneider and Gaeth, 1998, for a description of different types of framing problems). However, studies of risky-choice framing across laboratories show mixed results, with some studies showing similar results to Bruine de Bruin, Parker and Fischhoff (2007), and others showing the opposite or no age effect (Kim et al., 2005; Mayhorn, Fisk and Whittle, 2002; Mikesels and Reed, 2009; Rönnlund et al., 2005; Weller, Levin and Denburg, in press).

The conflicting results may be due to the cognitive demands of the specific methodology used. Traditionally, judgment and decision-making researchers have used between-subjects designs and, thus, group comparisons. Studies of individual differences, however, typically present participants with both frames so that participants may recognize similarities between the frames and alter responses to be consistent. Recognition of related item pairs is reduced when they are separated by distracting filler tasks or time (LeBoeuf and Shafir, 2003). However, doing so may disadvantage older adults compared to younger adults due to memory skills that may decline with age; older adults, therefore, may be less likely to remember the earlier problem and/or their response to it. This possibility cannot fully explain conflicting results in the literature, however, as conflicting findings exist across studies that use only between-subjects designs too. If resistance to framing declines with age, it may reflect findings that older adults are less consciously aware than younger adults about factors that influence their judgments and decisions (Lopatto et al., 1998), are less able to control the impact of automatic processing on judgment (Hess, Waters and Bolstad, 2000), and rely more on affective input.
Four other component measures of the ADMC scale were also deliberative in nature, as seen by significant positive correlations with measures of fluid cognitive ability (Bruine de Bruin, Parker and Fischhoff, 2007). Yet, older adults’ performance on these decision-making tasks was not worse – and sometimes better – than that of younger adults (Bruine de Bruin, Parker and Fischhoff, in press). Two tasks showed no relationship with age, after controlling for demographic differences. For example, no age differences were detected in the ability to consistently judge risks across five different situations (i.e. such that the judged probability of dying in a terrorist attack is lower than or equal to the judged probability of dying from any cause). Because these risk perception questions appeared together, recognizing the need to give consistent responses across questions should not depend on memory skills, which would have made the task more difficult for older adults. Moreover, older adults may have developed experience-based abilities that helped them to recognize the need to judge risks consistently, without overburdening other fluid cognitive abilities. Another task that showed no age differences was Recognizing Age-group Social Norms, which asked younger and older adults to judge the probability of people their age who would agree that it is sometimes OK to engage in various negative behaviors, such as stealing. An individual’s overall score reflected the Spearman rank correlation between the judged and observed percentage of people their age who endorsed these behaviors. Possibly, experience-based knowledge of one’s peers may help to reduce the burden on fluid cognitive abilities, when judging these social norms. Performance on the remaining two measures improved with age, after controlling for age-related demographic differences. Older adults were better than younger adults at discontinuing unprofitable investments (i.e. they showed less of a sunk-cost effect). They also had more appropriate confidence in their knowledge. Although performance on these tasks may require some fluid cognitive ability, it may be that age-related improvements in other skills buffered, or even counteracted, the age-related declines in fluid cognitive ability (Peters, Hess et al., 2007). These other skills may include affective/experiential processes that improve with age. For example, older adults may have learned from experience when and how to adhere to sunk-cost rules and have appropriate confidence in their knowledge. Indeed, understanding when and how to apply such normative rules may reduce reliance on fluid cognitive ability when making decisions (Stanovich and West, 2008).

Other deliberative decision-making skills may not benefit from age-related improvements in affective/experiential abilities – and may decrease as adults age. Perhaps most notably, comprehension and use of numeric information in decision making appears to decline with age. Such a
decline is important, because numerical information is ubiquitous in the
decisions that people make throughout their lives, and less numerate
individuals fare less well in important medical and financial decisions
involving numeric information (Banks and Oldfield, 2007; Estrada
et al., 2004). Age-related declines in numeracy, therefore, will likely result
in lower comprehension and worse decisions being made by older adults
especially when unfamiliar numeric information is presented (e.g. health-
insurance choices; Hibbard et al., 2001).

Age-related declines in numeracy are also likely to have an effect on
decisions beyond simple comprehension of numbers. Recent research has
begun to examine the role of numeracy in risk perception and decision
processes. For example, Peters, Lipkus and Diefenbach (2006) pitted
intuition against rational analysis in a university student population by
making an objectively worse choice more tempting. Participants were
offered a prize if they drew a colored jellybean from a bowl. Bowl A
contained 9 colored and 91 white beans (providing a 9% chance of win-
nig), and Bowl B contained 1 colored and 9 white beans (providing a 10%
chance of winning). Whereas highly numerate participants appeared to
perceive the probability of winning more clearly and select Bowl B, the
less numerate were drawn more to the number of winning beans than by the
objective probability. These results combined with those of other studies
imply that, compared to highly numerate decision makers, the preferences
expressed by the less numerate are likely to be more labile and influenced by
extraneous cues such as irrelevant sources of affect, and to be less influ-
enced by objective probabilities. Little related research has been conducted
with older adults (but see Peters, Västfjäll and Mertz, 2008).

It remains to be seen how much age differences in numeracy will
explain age differences in the quality of older adults’ decisions. Some
previous research has found strong age differences in decision tasks
related to health-insurance choices that require processing of numeric
information (e.g. Finucane et al., 2002; Hanoch et al., 2009; Hibbard
et al., 2001); numeracy was not measured in these studies. However,
Tanius et al. (2009) found no age differences in a task similar to a common
health-insurance choice in the United States (choice of a Medicare Part D
prescription plan), but did find that numeracy was a strong predictor of
task performance. Reasons for the lack of significant age effects in this
study versus significant age effects in a similar study by the same group
(Hanoch et al., 2009) are unclear. It may be that the current importance
of this task to older adults (see the section later in this chapter on selec-
tivity and motivated use of deliberative processes) and their experience
with this Medicare choice in the United States motivates older individuals
such that choices are equivalent in quality across age.
Age-related improvements in affective/experiential decision-making skills

Recent research has focused on the role of affect in decision making, including integral affect (i.e. feelings relevant to the decision), and incidental affect (i.e. feelings that are normatively independent of the decision). For example, if someone is deciding between health-care plans, integral affect may involve worries about going bankrupt as a result of health-care costs, and incidental affect may involve mood effects caused by the weather that are misattributed to feelings about a health-care plan. Both types of affect have been shown to predict a wide variety of judgments and decisions (Fischhoff et al., 2004; Kahneman, Schkade and Sunstein, 1998; Lerner and Keltner, 2000, 2001; Loewenstein et al., 2001; Schwarz and Clore, 1983; Slovic et al., 2002). The Affect Heuristic, for example, predicts that people will use their affect about an object, such as nuclear power, as information to guide perceptions of its risks and benefits and to make decisions (ibid.).

The conventional view of affect is that it undermines deliberative processes, and is often harmful to decision making. More recently, however, researchers have argued that affect may sometimes provide meaningful information and help to improve decision processes. For example, research has been conducted on patients with damage to the ventromedial prefrontal cortex, an area of the brain thought to be important to the integration of affect and emotion into decisions. These patients performed poorly in a risky decision context where affectively reacting to rewards and punishments aided learning and improved decisions (Bechara et al., 1994). However, in a context where not reacting affectively was beneficial (because the decision maker did not over-react), the patients performed better than matched controls (Shiv et al., 2005). Age-related changes in affective processes are therefore relevant to the study of older-adult decision making.

Age-related changes in affective and experiential processes predict that older adults will use affect more in choices relative to their younger counterparts so that their decisions are impacted more by affectively rich information (and especially positive information). As discussed above, this change may buffer the effects of declines in cognitive skills on decision making (Bruine de Bruin, Parker and Fischhoff, in press; Peters, Hess et al., 2007). Older adults, however, may also be more susceptible to scams and deceptive advertising that include information that is affectively memorable to them (Fung and Carstensen, 2003).

Most of the tested effects of the role of affect in decision making among older adults assume that affect is being used as valenced information about decision options, which is consistent with most recent research in
affect and decision making (e.g. Slovic et al., 2002). That is, at the moment of judgment or choice, decision makers consult their feelings about a target or option and ask “how do I feel about this?” (Schwarz and Clore, 2003). Although limited published decision studies exist currently, predictions can be made based on age differences in responses to affective information. For example, if older adults pay greater attention to and use affective information more than younger adults (Carstensen and Turk-Charles, 1994), then one might expect older adults to demonstrate greater effects of anecdotal information, mood states, and other sources of affect.

Evidence in favor of an age-related increase in use of affect as information comes from studies examining performance in the Iowa gambling task (IGT). This task offers choices between two “good” and two “bad” decks of cards (Damasio, 1994). Although performance on the IGT appears to depend on both memory ability and affective processes (Bechara et al., 1994; Hinson, Jameson and Whitney, 2002; Peters and Slovic, 2000), older adults tend to perform as well as younger adults on it (e.g. Kovalchik et al., 2005; MacPherson, Phillips and Della Sala, 2002; Wood et al., 2005; note that a subset of older adults may perform significantly worse, see Denburg, Tranel and Bechara, 2005). In IGT choices, younger adults appear to rely more on memory processes, whereas older adults rely more on an accurate representation of gains and losses, presumably formed from their affective reactions to feedback in the task (Wood et al., 2005).

Alternatively, if older adults are more motivated to seek positive than negative information (Mather and Carstensen, 2005), then one might expect a positivity bias or relative lack of a negativity bias among older adults compared to younger adults (see Wood et al., 2005 for some support). Results reported earlier in this chapter imply that decisions involving losses might be the ones that change across the lifespan, whereas those involving gains might remain stable. Indeed, neural responses to negative information decrease with age, whereas neural responses to positive information are unrelated to age (Kisley, Wood and Burrows, 2007; Samanez-Larkin et al., 2007). However, research results in decision making are mixed. Using an extreme-age-groups design, Mikels and Reed (2009) found that only younger adults showed risk-seeking in the loss frame, but that younger and older adults demonstrated similar risk-aversion in the gain frame. Although this result is consistent with the neural findings (e.g. Samanez-Larkin et al., 2007), Weller, Levin and Denburg (2010) found the opposite pattern in their research with younger and older adults. In particular, risk-seeking involving losses remained relatively stable with age, whereas risk-aversion involving gains showed linear increases across the lifespan (with increasing age, individuals were more likely to choose a sure gain rather than a risky gain).
Further research is required to understand how age-related changes in affective information processing will influence older-adult decisions. Affect may also have other functions in judgment and decision processes, but these functions have been sparsely studied among older adults (Peters 2006; Peters, Lipkus and Diefenbach, 2006). Affect can act as a spotlight focusing us on different information depending on the extent of our affect. For example, Lockenhoff and Carstensen (2007) found that older adults sought out relatively more positive than negative information in health-related choices compared to younger adults (whether they sought out more positive information or less negative information is unclear from their paper). The IGT results reviewed earlier are consistent with a third function of affect. Specifically, affect, when present, acts as a common currency allowing decision makers to compare apples to oranges more effectively than when it is absent. Finally, affect can motivate the decision maker to take action or do extra work. Given evidence of the importance of affect to decision making and to attempts to improve decisions in younger and older adult populations, more research is needed to understand the potentially changing roles of affect in decisions across the lifespan.

**Selectivity and motivated use of deliberative processes**

To adapt to age-related declines in deliberative efficiency, older adults may become increasingly selective about when they spend effort, allocating resources only when personal relevance is high (Hess, 2000). By contrast, younger adults (and perhaps particularly university students) might be willing to deliberate at greater length without regard to how relevant or meaningful a decision is. If so, fewer age differences should be observed in situations of greater relevance and meaningfulness to older adults.

In a test of this hypothesis, Hess et al. (2005) examined the extent to which attitudes toward proposed legislation were influenced by relevant thoughts about the legislation versus irrelevant affective information, such as the likeability of the lawmaker proposing the legislation. When personal relevance of the legislation was low, older adults focused more on irrelevant affective information, such as how much they liked the lawmaker. In contrast, younger adults seemed to ignore irrelevant affective information and reported attitudes consistent with processing information in more depth. When the legislation was high in personal relevance, neither the younger nor older adults were influenced by information about the likeability of the legislator, with both groups elaborating on information relevant to the legislation.
These results stress the need for studying older adults’ decision making in real-world contexts. Laboratory studies of decision making often involve hypothetical scenarios, require cognitive effort, and are not always designed to maximize the interest value or relevance to participants. As a result, older adults may be less motivated than younger adults to put effort into laboratory-based decisions, leading researchers to overestimate age-related declines in decision making. Indeed, age-related declines in deliberative skills may not be of much concern in everyday decisions that are personally relevant to older adults. However, when the personal relevance of the decision is misjudged by the older adult (e.g. an important change in a health-insurance rule is judged as being irrelevant) or is unclear, older adults may act as they do in some laboratory tasks by selecting not to expend cognitive effort and thereby to make worse decisions.

**Age-related changes in experience and their role in decision making**

Some decisions are made by description, in the sense that relevant information is explicitly described (e.g. decisions related to weather forecasts or health-care plans). Decisions by experience lack such summary information and require decision makers to rely on their own past experience (e.g. when deciding about collaborations and friendships). The previous section reviewed age-related differences in decisions from description (the IGT studies are a notable exception). Age-related improvements, or at least age stability, might be observed in choices that are learned from experience. Fisk and Rogers (2000), for example, reviewed evidence that decisions in well-learned environments (e.g. driving) are preserved with age.

Older adults’ knowledge and experience appear to benefit them in familiar life situations. When older adults are faced with decisions or judgments in contexts they frequently encounter, previous experience may enable them to avoid biased decisions. Perhaps as a result, they are less likely than younger adults to be influenced by irrelevant changes in the choice context, such as the presentation of dominated options. Studies with younger adults, for example, reveal an asymmetric-dominance effect. When faced with a tradeoff between option A which is better on quality, and option B which is better on price, younger adults are more likely to choose option A when a third option C is presented and dominated by A (e.g. A is better than C on quality and equal to it on price) and not B (e.g. option C is better than B on quality and worse than B on price; Shafir, Simonson and Tversky, 1993). Tentori et al. (2001) demonstrated that, in a grocery-store context, older adults were less likely than young adults to
be influenced by the addition of a dominated option. The older adults’ greater experience with the grocery-store context presumably helped them to discount irrelevant information (see also Kim and Hasher, 2005, for similar results). This greater experience with purchasing groceries and other items may also partly explain why their perceptions of inflation are more accurate than those of younger adults (Bryan and Venkatru, 2001).

In the domain of health, Meyer, Russo and Talbot (1995) found that compared to their younger counterparts, older women with breast cancer behaved more like experts by seeking out less information, making decisions faster, but arriving at decision outcomes equivalent to those of younger women. In a follow-up study, Meyer and Pollard (2004) found that this effect was due to the availability of specific information about breast cancer. In other words, consistent with an expertise-based explanation, the presence of relevant information in the problem domain facilitated decision making in older women.

Thus, these studies support older adults’ ability to use their expertise in making judgments and decisions. It is also important to acknowledge that this apparent expertise influence on performance could easily be misinterpreted in terms of aging-related deficits in deliberative functions, because shorter decision times and consideration of fewer pieces of information on the part of older adults could reflect worse processing resulting from reduced cognitive resources. However, older adults made better choices according to Tentori et al. (2001), and older women made choices equivalent to those of younger women according to Meyer, Russo and Talbot (1995). Thus, the results are more consistent with an expertise explanation and highlight the potential role of expertise in older-adult decisions as critical to an accurate portrayal of their decision-making skills.

**Separate dual processes or a single continuum?**

Research examining decision making across the lifespan ultimately may illuminate our understanding of the interplay between deliberative and affective processes. However, the scarcity of current research precludes conclusions at this time. Evidence thus far provides some support for separate dual processes, as well as some support for a single continuum—with deliberative and affective influences balancing one another. For example, Hess et al. (2005) found that with increased deliberation, older adults were less likely to be affected by an irrelevant affective source, supporting the single continuum. Indeed, a recent study, discussed above, suggests that both deliberative processes, which decline with age,
and affective/experiential processes, which may improve with age, contribute to ADMC (Bruine de Bruin, Parker and Fischhoff, in press). Hence, decision-making skills that decrease with age can be explained by age-related declines in cognitive ability, whereas those that do not may rely on both cognitive abilities as well as affective processes, suggestive of an affective buffering effect (see also Hansson et al., 2008; Strough et al., 2008). Such results are consistent with some research with younger adults, who demonstrate a greater influence of affect on risk/benefit perceptions and on choices with less deliberation (e.g. time pressure, Finucane et al., 2000; cognitive load, Shiv and Fedorikhin, 1999). Wood et al. (2005) found a similar result, with younger adults relying more on memory processes in choices, whereas older adults relied on more affective processes. These results are consistent with a relative preservation of affective processes in older adults, enabling them to compensate for losses in deliberative processes.

On the other hand, the fact that deliberative processes do show declines whereas affective and automatic processes appear to be preserved with age (see Peters, Hess et al., 2007 for a review) implies separable dual processes. In addition, according to recent research by Mather and Knight (2005), the increased affective influence of the positivity effect among older adults requires greater deliberative input and specifically is not a compensation for deliberative declines, supporting the existence of separable dual processes. This research implies that the relatively greater influence of positive than negative information on older-adult decisions will occur only for those older adults who have the resources necessary (due to ability, motivation, or time) to meet the motivational goals hypothesized in socioemotional selectivity theory. We are not aware of any published research on this issue.

To push the issue even further, the question of whether a single process or dual processes exist may not even be the right question. Research on the neural underpinnings of decision making has begun to point towards a wide range of neural networks, and potentially many multiple subsystems, working together to produce decisions (Sanfey et al., 2006). Focusing on a dual-process approach for now, however, provides a convenient organizing framework for the otherwise wide-ranging findings in the study of older-adult decision making.

Supporting and developing the decision-making skills of older adults
In a multitude of domains, interventions have been developed to improve specific decisions that are relevant to older adults. For example, educational efforts have aimed to teach older adults how to prevent falls (Chang et al., 2004), increase physical activity (van der Bij, Laurant and Wensing,
2002), improve nutrition (Sahyoun, Pratt and Anderson, 2004), perform a computer-based customer service task (Nair, Czaja and Sharit, 2007) – often with mixed results. The studies reviewed in this chapter suggest that the success of such interventions may be improved by taking into account the specific cognitive and decision-making skills of older adults, building on their strengths and addressing their weaknesses. For example, interventions may: (1) reduce the cognitive effort needed to understand and process information in a decision; (2) increase or preserve cognitive capacity; (3) try to motivate older adults to pay attention to meaningful factual information; (4) support the understanding of factual information with an affective manipulation; and (5) provide older adults with experience in a particular domain that they can use when faced with an actual decision. We discuss each of these options below.

First, one possibility for improving older adults’ decisions is by addressing age-related declines in deliberative ability. Thus, researchers have attempted to reduce the cognitive effort involved in processing information. Studies have demonstrated, for example, that how information is presented may matter as much as what information is presented (Peters, Dieckmann et al., 2007; Peters, Hibbard et al., 2007). Showing only the most important information (or highlighting it), making key points easier to evaluate (order, summarize, interpret information), and generally requiring less cognitive effort and fewer inferences (e.g. do the maths for them) can help older decision makers better understand and better use information.

In an important health application, medication instructions that are well organized, explicit and compatible with preexisting schemas about the decision task improve memory and are preferred over other formats, suggesting that they can improve medication adherence (Park et al., 1994). The use of external memory supports, such as organizational charts and medication organizers, have also been shown to be beneficial to older adults’ adherence to healthy behaviors (Park et al., 1991; Park and Kincaid, 1992). Indeed, older adults spontaneously use memory aids to summarize or check information at the end of information search, as if to verify forgotten information, whereas younger adults appear to use these same aids in the middle of a search, as if for planning rather than memory purposes (Johnson, 1997).

A second type of intervention is based on the idea that some of the deliberative processes linked with decision making can also be trained, thus building, and possibly preserving, cognitive capacity. For instance, a growing body of evidence suggests that cognitive training interventions – focusing on, for example, memory, reasoning skills, or speed of processing – may increase cognitive capacities of normal-functioning healthy
older adults, thus reversing the age-related decline that is typically observed (Ball et al., 2002; Derwinger et al., 2005; O’Hara et al., 2007; Rebok and Balcerak, 1989; Willis, 1987).

Numerical ability can also be trained, and possibly preserved, in older adulthood. In one study, Woloshin, Schwartz and Welch (2007) demonstrated that a health statistics primer (an educational booklet designed to teach people skills to understand health risks, e.g. understanding the absolute and relative magnitudes of risks) could be successfully used to improve individuals’ understanding of health risks. It may also be possible to train the intuitive sense of numbers that appears to underlie higher-level numeracy abilities (Halberda, Mazzocco and Feigenson, 2008; Peters, Västfjäll and Mertz, 2008). Indeed, training such intuitive number sense may accelerate learning of other numerical concepts (Wilson et al., 2006). Although a majority of cognitive- and numerical-training studies has been conducted in the laboratory, some of the cognitive-training interventions have also been shown to achieve long-term improvements in the execution of cognitively demanding real-world tasks involving, for example, household finances, health maintenance, and shopping (Ball, Edwards and Ross, 2007; Willis et al., 2006).

Whereas the above methods attempt to increase long-term deliberative capacity through training, other methods may work more short term by temporarily increasing flexibility in processing information in decisions. Individuals induced into more positive moods (compared to neutral moods) process information more systematically if it helps them maintain their positive mood (Isen, 2000). Positive mood inductions also tend to lead to more creative and efficient decisions (Forgas, 1995; Isen, 2000; Marino, 1992). Such methods have not been tested with older adults, however. As a result, we recently conducted a study with older adults (Carpenter et al., 2009). In the task, half of the participants received a gift of candy to induce a positive mood, whereas the remainder received no gift. All participants then completed a computer-based card task in which they won and lost money based on choices from four gain and four loss decks. In the computer background, positive-mood participants saw smiling suns; and neutral-mood participants saw control circles. Participants in the positive-mood condition made better choices from both gain and loss decks than neutral-mood participants. Concurrently, the positive-mood manipulation was associated with an increase in cognitive capacity (working memory; see also Yang and Isen, 2006). Understanding how affective processes influence cognitive flexibility and decision making may help researchers and policy makers improve how they present complex health, financial, and other important decisions to older adults.
Aging and decision skills

A third possible type of intervention comes directly from Tom Hess’s work on older adults’ selective use of their deliberative capacity (e.g., Hess et al., 2005). It may be possible to increase older adults’ motivation to use their limited capacity in unfamiliar decision situations by increasing the relevance and meaningfulness of the decision to the older adult (e.g., by increasing personal accountability; Chen, 2004). For example, an older adult made more personally accountable for a decision by asking him or her to justify beliefs, feelings, or actions to others may use more deliberative capacity in decisions and thereby decrease the use of less relevant sources of information. Evidence also exists that using other nontraditional approaches such as the formation of implementation intentions and increasing social and cognitive engagement may assist older adults in making better decisions (Park et al., 2007). Such successes may be due to increasing motivations on the part of older adults to use their cognitive capacity.

A fourth possibility is to increase the affective meaning of information. Peters, Slovic and Hibbard (2009) were interested in the processes by which decision makers bring meaning to dry, cold facts. They attempted to influence the interpretation and comprehension of information about health-plan attributes by providing information in a form that could be used easily to evaluate the overall goodness or badness of a health plan. For example, in one study older-adult participants were presented with attribute information (i.e., quality of care and member satisfaction) about two health plans. The information was presented in bar chart format, with the actual score displayed on the right of the bar chart. The information for half of the participants was supplemented by the addition of evaluative categories (i.e., the category lines plus labels that placed the health plans into categories of poor, fair, good, or excellent). The attribute information was designed such that Plan A was good on both attributes, while Plan B was good on quality of care but fair on member satisfaction. The specific scores for quality of care and member satisfaction were counterbalanced across subjects such that, for half of them, the average quality of care scores were higher; for the other half, average member satisfaction scores were higher. As predicted, evaluative categories influenced the choices. Specifically, older adults preferred health plan A more often when the categories were present (plan A was always in the good evaluative category when the categories were present).

Finally, it may be possible to develop an intervention building on older adults’ greater reliance on experiential processing in decisions by teaching them to automatically associate particular contextual cues with appropriate actions. For example, similar to recent studies with adolescents (Reyna, 2008), it may be possible to teach older adults automatic
responding to contextual cues that signal risk about scams and other problematic issues to which they are particularly vulnerable.

Decision making as a set of core skills separate from its deliberative and affective/experiential components, may be teachable as well (Baron and Brown, 1991). Correlational evidence demonstrates that people with better decision-making skills and those who have received formal training in decision making may obtain better life outcomes (Bruine de Bruin, Parker and Fischhoff, 2007; Larrick, Nisbett and Morgan, 1993; Parker and Fischhoff, 2005). If so, then teaching decision making may improve quality of life, especially among older adults who are at risk for cognitive declines. Moreover, interventions that aim to improve older adults' decision-making skills may bring the promise of prolonged independent living.

**Knowledge gaps and future directions**

Although age-related changes occur in some of the important information processes linked with decision making, a relatively small number of decision-making studies have been conducted with older adults. Limitations also exist in the research conducted thus far. To begin, age-difference research is often conducted with an extreme-groups design comparing much younger adults (in their 20s) with much older adults (in their 60s and 70s). Such an approach may miss important processes taking place in middle age. For example, declines in deliberative efficiency but increases in experience may result in the best decisions being made by individuals in late middle age or young older age. Indeed, Agarwal et al. (2008) find that middle-aged adults made better decisions in credit markets than younger or older adults, with fee and interest payments being minimized around age 53. Second, most research has not used longitudinal designs. As a result, differences between younger and older adults may reflect cohort effects rather than true age differences. Nevertheless, the longitudinal studies that have been conducted, measuring, for example, numeracy, working memory, speed of processing, and vocabulary do demonstrate true effects of aging (Park et al., 2002; Schaie and Zanjani, 2006).

A third limitation is the presence of conflicting findings across otherwise similar studies. We reviewed some studies earlier where the mechanisms involved seemed relatively clear (e.g. cognitive decline). It is not always clear, however, what the mechanism is and why age differences appear sometimes and not others. For example, older adults are less likely to exhibit the sunk-cost fallacy, as evidenced by continuing investments that are no longer paying off (Bruine de Bruin, Parker and Fischhoff, 2007, in press), possibly as a result of their decreased focus on negative information and losses (Strough et al., 2008). Results are mixed, however,
with regard to the appropriateness of older adults’ confidence in their knowledge, which some studies have shown to be better and other studies have shown to be worse than that of younger adults (Bruine de Bruin, Parker and Fischhoff, 2007; Crawford and Stankov, 1996; Kovalchik et al., 2005; Parker et al., 2008). Studies of framing and risky choices also show mixed results (Kim et al., 2005; Mayhorn, Fisk and Whittle, 2002; Mikels and Reed, 2009; Rönnlund et al., 2005; Weller, Levin and Denburg, 2010). Possibly, these results depend on the cognitive demands of the specific methodology used (Hansson et al., 2008). Finally, some decision-making skills, such as the ability to follow the rules of probability theory when judging risks, appear unrelated to adult age (Bruine de Bruin, Parker and Fischhoff, 2007; Fisk, 2005), whereas other findings such as framing and risk preferences demonstrate mixed age-difference results. The lack of consistency is problematic in the literature and is surprising, particularly in some of the numeric decision tasks, given age differences in numerical ability.

Currently, it is not clear whether age-related changes in such processes lead to changes in experienced outcomes from decisions. Indeed, most older adults appear to be leading productive lives and taking important positions in society (Carstensen, 2001; Salthouse, 1990). It may even be possible that the age-related differences shown in this chapter do not reflect deficiencies in older adults’ decisions, but rather in younger adults’ decisions. For example, research by Hess and others with respect to selective use of deliberative capacity by older adults could be interpreted as younger adults wasting a lot of effort and older adults making wiser decisions about their own use of energy and other resources. Thus, additional research is needed to examine how age-related changes in older adults’ decision-making skills influence their experienced life outcomes, especially on important decisions that are increasingly relevant to older adults, such as those related to health and retirement.

Finally, it is important to conduct intervention studies that target decision-making competence more broadly in older adults. Few cognitive training studies have been done outside of the laboratory, and specific health interventions that have been conducted outside the laboratory may not take into account what we know about how older adults make decisions. Such a theoretically based approach is likely to be more effective.

**Summary and conclusions**

Older adults are likely to process information in ways that are different from younger adults. Robust declines in deliberative capacity suggest that older adults will make worse decisions than younger adults in some situations.
Many older adults, however, function quite well in the world and even make many of the world's most important decisions. Deliberative decline is likely to be too simple a story for three reasons. First, older adults appear to selectively use their deliberative capacity. Second, accumulated experience may buffer, or even compensate for, age-related declines. Finally, affective focus appears to increase with age, possibly also counteracting cognitive declines. As a result, older adults may make better decisions than younger adults, at least in some situations. Older adults are faced with many decisions about vital health, financial, and other personal issues. In addition, their proportion of the consumer population is growing, but the world's resources are not necessarily growing with them. As a result, understanding ways to facilitate decisions of those who have attained more advanced ages may provide individual advantages for the older adult, and may ultimately prove beneficial to the population at large.

References


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