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Research Dialogue

# Limitations to the deficit attenuation hypothesis: Aging and decision making

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**Abstract**

The deficit attenuation hypothesis is the proposal that age related declines in basic cognitive functions often result in compensatory changes in decision making strategies. However, the patterns of cognitive changes across the adult life span are complex: Many cognitive abilities change across the adult life span while others do not. Some of the cognitive changes will be detrimental to decision making, others will have no impact and still others may actually improve decision making. We illustrate the complexity of the impact of cognition on aging and decision making with examples from working and long-term memory and use these to suggest boundary conditions for the deficit attenuation hypothesis.
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The goals of Yoon, Cole, and Lee (2009) are to highlight and organize existing knowledge of aging and cognitive changes with the aims of setting policy agendas to maximize the quality of decision making by older adults, and to minimize their victimization. To these ends, they provide a masterful overview of research in cognition and social psychology to illustrate the multiple determinants of decision making in healthy older adults. These determinants are organized around a model of 'fit', which wisely includes both fundamental cognitive factors as well as social (e.g., stereotype threat) and even biological (e.g., circadian rhythms) factors that interplay with cognitive functions to determine critical outcomes. The breadth and scope of the article is truly impressive and paints, in broad strokes, a clear picture of the effects of cognitive aging on decision making. A necessary consequence of such scope is that some complex issues cannot be fully explored. Here we wish to enrich the framework provided by Yoon et al. by highlighting several complex issues that we take to be critical for a full understanding of age, cognition, and decision making. In doing so, we stress that not all of the cognitive functions critical to decision making decline with age and further that some functions that do decline may actually result in spared or even improved decision making.

Older adults clearly have difficulties with many foundational cognitive functions including working memory (Hasher, Lustig, & Zacks, 2007; May, Hasher, & Kane, 1999), and explicit long-term memory (Grady & Craik, 2000; but see also Zacks & Hasher, 2006). Despite these disruptions to low level functions, it is clear that many aspects of decision making are preserved in normal aging (e.g., Kim, Healey, Goldstein, Hasher, & Wiprzycka, 2008; Kim & Hasher, 2005; see Peters, Hess, Västfjäll, & Auman, 2007; Mather, 2006; and Yoon et al., 2009 for reviews). This pattern of impaired "basic" cognitive functions and preserved decision making presents an apparent paradox: how do older adults maintain decision making proficiency despite having difficulty with cognitive functions that, on the surface, seem critical to making sound decisions? Yoon et al. highlight the contributions of factors such as whether or not time pressure is involved or whether or not the decision has personal or emotional meaningfulness. But like others (e.g., Peters et al. 2007; Mata, Schooler, & Rieskamp, 2007), Yoon et al. rely on what we term the deficit attenuation hypothesis: the notion that older adults compensate for declining resources by relying on decision strategies that are less cognitively demanding than those employed by younger adults. That is, preservation of decision making competence reflects the efficiency of the compensatory strategies older adults adopt. There are certainly cases in which cognitive aging has a negative impact

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on decision processes, however, we suggest that the deficit attenuation hypothesis has limitations, largely tied to cognitive processes that are invariant (or may even improve) with age, along with processes that decline but may have little impact on decision making and others that decline in such a way as to provide ironic advantages to decision making. In the following sections we explore these patterns in the context of working memory and long-term memory. In the final section, we briefly discuss the measurement of decision making ability and the comparison of decision quality across age groups.

## Working memory, mental capacity, and decision making

The idea of limited cognitive capacity plays a prominent role in many theories of decision making, yet surprisingly little is known about how individual differences in capacity among younger adults (let alone differences between age groups) actually affect decision making (Frederick, 2005). In the cognitive literature, the most commonly used measures of capacity are complex spans such as reading and operation span, which require people to remember target words while doing a demanding processing task (e.g., solving simple math problems). Complex span tasks have proved to be reasonably good predictors of fluid intelligence (Unsworth & Engle, 2005), and problem solving (Kyllonen & Christal, 1990), but in a search of over 300 articles using working memory span tasks over the past 8 years, we found none that examined the relationship between working memory measures and consumer type decisions (e.g., directly choosing between two concrete options). As Yoon et al. point out, there are many reasons to suspect that reduced working memory ability will lead to difficulty making decisions but empirical evidence is limited, and recent work indicates that working memory, as measured by operation span, is actually unrelated to preferences for a cognitively demanding versus undemanding decision strategy (Healey, Goldstein, Hasher, & Kim, 2008).

While little is known about the direct connection between consumer decision making and working memory, some work has linked working memory with judgments of probability and frequency. Such studies have found a modest correlation between working memory and accuracy of probability judgment, but little or no relationship with frequency judgment (Dougherty & Sprenger, 2006). The finding that probability but not frequency judgment is related to working memory is consistent with evidence that humans are especially sensitive to frequency and encode frequency information automatically (Zacks & Hasher, 2002). Because the ability to judge frequency is largely preserved into old age (Hasher & Zacks, 1988), these findings suggest that to the degree to which decision making relies heavily on frequency judgments, any declines in working memory might not be overly detrimental. This possibility is supported by arguments that frequency is the natural language of decision making (e.g., Hoffrage, Gigerenzer, Krauss, & Martignon, 2002) and evidence that presenting information in terms of frequency rather than probability enables people to avoid many classic mistakes (e.g., base rate neglect; Gigerenzer & Hoffrage, 1995). There is also evidence that, at least among younger adults, frequency information plays an important role in consumer decisions, often overshadowing other types of information (see Alba, 2002, for a review); if working memory is not involved in gathering such information then working memory declines may not interfere with decisions based on frequency.

Intriguingly, there is evidence that individuals with lower working memory spans are actually more accurate at detecting correlations between variables than are individuals with higher spans (Kareev, Liberman, & Lev, 1997; DeCaro, Thomas, & Beilock, 2008); the ability to detect correlations (e.g., between price and quality) is obviously valuable in decision making. Such findings point to the possibility that older adults' working memory capacity deficits will not necessarily impair decision making and in limited cases, such as correlation detection, may confer an advantage. These findings suggest that the deficit attenuation hypothesis may not be sufficient for a full understanding of the role of working memory in decision making.

## Explicit long-term memory and decision making

There is far more evidence about the role of long-term memory in decision making than is the case for working memory, but the complicated pattern of preserved and impaired memory processes exhibited by older adults makes it difficult to make clear predictions (Zacks & Hasher, 2006). As an example, in a real world decision task one of the most important roles of memory is retrieving options in order to generate a consideration set (Alba, Hutchinson, & Lynch, 1991), such as recalling the restaurants in an area when choosing where to go for dinner or remembering what you have in the pantry when choosing what to pickup at the market. How is age likely to impact construction of consideration sets? One prediction is that older adults might suffer because they will likely be less able to retrieve specific options from memory. But, there are many routes to recalling options from memory (Alba et al. 1991) and explicit retrieval may not capture all of the useful information that can be otherwise retrieved by older adults. Indeed, many aspects of memory—such as automatic recall based on contextual cues (Zacks & Hasher, 2006; e.g., the scenery of a neighborhood cueing the nearby restaurants), crystallized knowledge (Park et al., 2002; Verhaeghen, 2003), general or semantic level information (Craik, 2002; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; St Jacques & Levine, 2007), and implicit use of long-term memory (see Healey, Campbell, & Hasher, 2008, for a review)—generally do not decline, and may even improve, with age. These preserved aspects of memory may reduce the impact of impaired explicit recall of specific episodic details.[1] Of course, as Yoon et al. argue, in some situations failures of episodic memory (e.g., forgetting that information about a product came from a disreputable source) may impair decision making. From a policy perspective, it is critical to be aware that impaired episodic memory may leave

[1] For other roles of memory in decision making (e.g., the Query Theory account of the endowment effect; Johnson, Häubl, & Keinan, 2007; Weber et al. 2007), similar complications arise when trying to predict age effects.

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older adults vulnerable to fraud, but from the perspective of basic research, instances in which failures of source memory are catastrophic are likely to be the exception rather than the rule and may be offset by a large database of, mostly accurate, general knowledge accumulated over a lifetime.

As in the case of age-impaired working memory, it is not entirely clear that decreased retrieval of specific events is always detrimental to decision making. Gigerenzer and Goldstein (1996) argue that lack of knowledge can sometimes benefit heuristic processing (e.g., the less-is-more effect). Using simulations they demonstrate that the recognition heuristic actually works best with incomplete knowledge. In fact, there is evidence that in addition to *lack* of knowledge, some decision heuristics (e.g., the fluency heuristic) actually work best in a memory system with a fairly high level of *forgetting* (Schooler & Hertwig, 2005). In one particularly dramatic demonstration of how memory impairments can improve cognition, Frank, O'Reilly, and Curran (2006) showed that participants actually performed better on a version of the transitive inference problem if they had first been given a drug that inactivates the hippocampus causing profound, but temporary, amnesia. To be clear, memory is critical for decision making and deficits in memory will often lead to poorer decisions (e.g., Lynch, Marmorstein, & Weigold, 1988), but there is growing evidence that some decision processes, particularly heuristics, operate most efficiently with an optimum degree of forgetting and it remains to be determined whether older or younger adults' particular patterns of forgetting come closer to this optimum.

We note that that although the role of memory in decision making is indisputable, as the literature now stands it is not entirely clear which aspects of memory are most important for effective decision making. It thus remains to be seen whether an older adult's memory difficulties will lead to poor decisions or reduced fit.

## Age-invariant cognitive processes and decision making

The question of how limits on cognitive performance impact decision making is by no means unique to the performance of older adults. Indeed one of the primary driving forces in the psychological study of decision making and consumer behavior has been finding ways that human behavior departs from normative behavior of a perfectly rational being with unlimited resources. The work of Simon (1957) and Kahneman and Tversky (see Kahneman, 2003, for a review) and many others (e.g., Gigerenzer, & Goldstein, 1996) has made it abundantly clear that human decision makers, even the most gifted undergraduate research participants, do not behave as if they were perfectly rational. Such research provides further reason to question the assumption that older adults' cognitive difficulties will necessarily impair their decision making.

One answer to apparent limits in resources is that humans are equipped to make high quality (if not precisely optimal) decisions using a variety of "fast and frugal" heuristics (Gigerenzer, & Goldstein, 1996). In most situations, these heuristics produce a decision that closely resembles the prescriptions of normative theory but, critically, does so without placing heavy demands on the resources known to decline with age. Based on the established pattern of age related preserved and impaired cognitive functions, we see little reason (and nor do Yoon et al., 2009) to expect that older adults would be any less able than younger adults to successfully employ such heuristic strategies.

Dual system theories of decision making (and the mind in general) similarly suggest that many decision making processes do not rely on the sort of cognitive functions that decline with age (Bargh, & Morsella, 2008; Bargh, & Chartrand, 1999; Stanovich, & West, 2000). Dual system theories distinguish between conscious, effortful processes (system 1) and automatic, resource free processes (system 2). Many dual system theorists argue that much decision making relies primarily on system 2 and there is evidence that requiring younger adults to engage in system 1 types of processing can actually lead them to make poorer choices (Dijksterhuis & Nordgren, 2006; Wilson, Schooler, Hodges, Klaaren, & LaFleur, 1993, but see also Payne, Samper, Bettman, & Luce, in press; Crossley & Highhouse, 2005; Kmett, Arkes, & Jones, 1999). Given evidence that most age deficits occur in system 1 processes (e.g., Jacoby & Dallas, 1981) it is not clear from a dual system perspective that decision making should show large age effects.

## Beyond deficit attenuation: other sources of changes in decision making

There are actually some reasons to believe that older adults' decision processes actually become more effective overall, quite apart from any compensation for deficits. For example, Yoon et al. (2009) discussed the finding that, compared to younger adults, older adults often seek less information before making a decision (e.g., Johnson, 1990; Riggle & Johnson, 1996; Meyer, Russo, & Talbot, 1995; Berg, Meegan, & Klaczynski, 1999; Leventhal, Leventhal, Schaefer, & Easterling, 1993). Similarly, there is evidence that older adults attempt to eliminate options without considering all of the available information (Riggle & Johnson, 1996). One interpretation is that seeking less information and eliminating options reflects reduced processing capacity.[2] However, in light of evidence that too much choice can actually reduce decision satisfaction (Iyengar & Lepper, 2000), limiting the size of a choice set might actually be a productive strategy. Indeed, it is often more sensible to quickly eliminate undesirable options, and younger adults' desire to keep options open can lead them to irrational, suboptimal decisions (Shin & Ariely, 2004). Similarly, it is not clear that considering more information about the available alternatives is always beneficial since considering too much information increases the difficulty of distinguishing important from unimportant information (Payne, Bettman, & Schkade, 1999).

[2] Interpreting reductions in information seeking as a negative consequence of aging seems somewhat at odds with the fact that, in these studies, older adults often arrive at the same decisions as younger adults. In this light, an alternate interpretation is that older adults are more efficient, often making the same choice as younger adults without having to process as much information.

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Therefore, as Yoon et al. suggest, in some cases limited search and quick elimination of options may be a direct, and positive, result of changes in how older adults process information (e.g., paying greater attention to emotional cues).

The notion of constructed preferences (Payne, Bettman, & Johnson, 1993; see also Simonson, 2008, and commentaries) provides further reason, also touched upon by Yoon et al. (2009) to suspect that older adults may be able to make decisions more efficiently than younger adults. When an individual is faced with an unfamiliar type of decision (e.g., buying their 1st car), they lack a clearly established set of preferences, and so must construct them within the context of the decision scenario. When an individual has considerable experience with a particular type of decision (e.g., buying their 5th car) they likely have pre-constructed preferences, or "crystallized" values (Payne Bettman, & Schkade, 1999). From this perspective it is reasonable to expect that older adults have more stable preferences that have accumulated over time and that these pre-constructed preferences allow them to quickly identify critical information and eliminate undesirable options (or, as Yoon et al. put it, to develop efficient search strategies). Indeed, there is evidence that compared to younger adults, older adults focus on the positive attributes of options and consider fewer attributes overall yet are more satisfied with their final choice (Kim et al. 2008).

Finally, older adults tend to pay more attention than do younger adults to distracting information that is not relevant to their focal task (Rabbit, 1965). Recent work demonstrates that older adults actually retain much of this distracting information and are able to use it, at least implicitly, on later tasks when it becomes relevant (Healey et al. 2008; see Kim, Hasher, & Zacks, 2007; Rowe, Valderrama, Hasher, & Lenartowicz, 2006). In a decision making situation, knowledge of previously irrelevant information might actually be helpful. Many of the decision making heuristics employed by younger adults rely on a base of implicit and explicit knowledge about the environment such as the occurrence and co-occurrence of various events. For example, the extent to which the availability heuristic will produce valid conclusions depends on the strength of the correlation between the availability of a particular class of events in memory and the actual frequency of occurrence in the real world. If older adults have a wider focus of attention than younger adults, and as a result are gathering more details about the world around them, whether those details are currently relevant or not, it is possible that they actually have a more accurate implicit knowledge of the structure of the environment than do younger adults. To borrow the classic textbook example, if an older and younger adult are both watching a cable news story about a plane crash, the younger adult is likely to focus on the main story and filter out any non-relevant details, but the older adult may pay more attention to non-relevant distractions and might notice a story about a car crash in the text ticker at the bottom of the screen. When later asked about likely causes of death, only plane crashes will be highly accessible for the younger adult but both plane and car crashes will be available for the older adult.

We have highlighted reasons to expect some age related cognitive changes to lead to improved decision making in order to complement Yoon et al.'s (2009) account of ways in which other changes may impair decision making. Our aim is to illustrate that the relationships between age-sensitive cognitive processes and decision making are extremely complex and nuanced. Theoretical frameworks such as Yoon et al.'s may prove critical in guiding the field forward, but we caution that if theory stretches too far beyond existing empirical data (e.g., by assuming that most changes in decision strategies reflect deficit attenuation), we may miss important pieces of the puzzle of aging and decision making.

## What is a good decision?

Before closing, we raise a point about measuring the quality of decisions. In much of the literature the quality of a decision is measured against some objective standard external to the decision maker, for example, maximizing utility while minimizing cost (Bettman, Luce, & Payne, 1998). Defining an objectively perfect decision and then quantifying the deviation of actual decisions from this standard can be quite effective and precise if all of the decision makers share the same preferences, goals, and motivations. However, in many situations, differences between individuals make it extremely difficult to identify objective standards for decision quality. Clearly decision making researchers are aware of such individual differences in preferences and know how to account for them when evaluating the quality of a decision, but the field seems much less aware of the possibility of similar (and even more fundamental) differences between age groups.

It is obviously true that older adults and younger adults have different preferences but it is likely there are also deeper differences, including the dimensions on which they prefer maximize value (e.g., emotional satisfaction versus knowledge acquisition; Carstensen, Isaacowitz, & Charles, 1999). If so, the appropriate metric of decision quality would be very different for older and younger adults. It may be possible to deal with these differences in an expected utility style calculation by weighting different attributes and dimensions differently for older and younger adults. But at this point what those dimensions and weights should be remains an unexplored question. Furthermore, objective measures of decision quality often neglect how the decision maker actually feels about the decision (Kim et al. 2008) and an objectively perfect choice is not always subjectively satisfying (Iyengar, Wells, & Schwartz, 2006). We do not suggest that objective measures be discounted altogether when assessing the quality of older adults' decisions (e.g., is a satisfying but financially catastrophic decision a good decision?); we simply highlight the need to carefully attend to age differences in preferences and goals, and to strike an appropriate balance between objective quality and subjective satisfaction.

Yoon et al. make the related point that older and younger adults find different types of decisions personally meaningful, have different motivations, and that older adults may use emotion as a guide in decision making more so than younger adults. Their position seems to be that if older adults' goals and motivations are compatible with the demands of the situation older adults will show high fit, but if they are

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incompatible older adults will show low fit (e.g., emotional motivations will improve fit if the situation demands emotional processing). We suggest, by contrast, that goals and motivations actually *determine* the demands of the situation, rather than being compatible/incompatible with the demands of the situation. For example, when choosing dinner companions, the demands of the situation depend on whether your goal is to strengthen existing relationships, in which case you should choose to eat with family and friends, or expand your social network, in which case you should choose to eat with new acquaintances (Carstensen, Isaacowitz, & Charles, 1999). In this light, it may not be necessary to view changes in older adults' decision strategies as a compensation for reduced fit.

## Conclusion

Yoon et al. (2009) have enriched our understanding of aging and decision making by providing a much needed and careful overview of how age-sensitive cognitive, social, and biological functions might impact decision making. Our goal in this commentary was to elaborate on the role of cognitive processes, particularly memory, in decision making and provide a more detailed snapshot of the potential consequences of age related changes in these processes. Taken together with older adults' changing knowledge, goals, values, and interests, the picture that emerges is complex and not entirely consistent with the deficit attention hypothesis. It is clear that age related changes in memory will impair decision making in some cases, but in others, changes may actually improve decisions or have no impact. From our perspective, Yoon and colleagues may overemphasize age related declines in decision making. Nonetheless, the fit framework is extremely useful: it generates many testable predictions that can help the field move forward, and the public policy recommendations have the potential to improve the lives of older adults.

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