



The role of cognitive abilities in decisions from experience: Age differences emerge as a function of choice set size



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ABSTRACT

People seldom enjoy access to summarized information about risky options before making a decision. Instead, they may search for information and learn about environmental contingencies—thus making decisions from experience. Aging is associated with notable deficits in learning and memory—but do these translate into poorer decisions from experience? We report three studies that used a sampling paradigm to investigate younger ($M = 24$ years) and older ($M = 71$ years) adults' decisions from experience. In Study 1 ($N = 121$) participants made 12 decisions between pairs of payoff distributions in the lab. Study 2 ($N = 70$) implemented the same paradigm using portable devices, collecting 84 decisions per individual over a week. Study 3 ($N = 84$) extended the sampling paradigm by asking participants to make 12 decisions between two, four, and eight payoff distributions (in the lab). Overall, the behavioral results suggest that younger and older adults are relatively similar in how they search and what they choose when facing two payoff distributions (Studies 1 and 2). With an increasing number of payoff distributions, however, age differences emerged (Study 3). A modeling analysis on the level of individual participants showed that a simple delta-learning rule model best described the learning processes of most participants. To the extent that ongoing updating processes unfold relatively automatically and effortlessly, older adults may be liberated from the detrimental consequences of cognitive aging in the case of decisions from experience with few decision options. We discuss implications for research on decisions from experience and choice performance over the lifespan.

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1. Introduction

Who runs the world? The average age of the 72 people in Forbes' 2013 ranking of the *World's Most Powerful People* is 61 years (Howard, 2013). Relatively old individuals thus wield enormous political and economic power worldwide. As populations across the globe age, the selection of older individuals into such powerful roles may be further

intensified. For instance, the average age of members of U.S. Congress has risen almost steadily since the 1980s in tandem with demographic aging (“The capitol's age pyramid: A graying congress,” 2010). Given that aging is associated with decline in many cognitive abilities (Li et al., 2004; Nilsson et al., 2004; Schaie, 2012), the question arises: How does older adults' decision making fare relative to that of younger adults?

There is not yet a conclusive answer. Some have argued that, despite cognitive decline and loss in computational power, the aging brain becomes more effective in its ability to recognize patterns (“wisdom”; Goldberg, 1970), but others have observed that “just as elders show profound

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declines in cognitive function, they also show profound declines in choice rationality” (Tymula, Rosenberg Belmaker, Ruderman, Glimcher, & Levy, 2013, p. 1; see also Denburg, Tranel, & Bechara, 2005). Still others have concluded that the decision-making performance of older and younger people is comparable (e.g., Kovalchik, Camerer, Grether, Plott, & Allman, 2005) and that older people are sometimes even “less biased than the younger individuals” (p. 79). As various researchers have pointed out, the trite truth seems to be that more research is required (Kovalchik et al., 2005; Mata, Josef, Samanez-Larkin, & Hertwig, 2011; Tymula et al., 2013). More importantly, and as we argue below, researchers have to go beyond blanket statements concerning the role of aging in decision making and instead consider the role of the properties and demands of the choice environment in determining the successes or failures of older adults’ decision making. In other words, the task ahead is to investigate whether and how particular task characteristics lead to age differences in decision making.

One crucial issue with regard to the decision-making faculties of older people is their ability to deal with risk and uncertainty—a ubiquitous challenge in the process of making decisions. Information about the probabilistic structure of choice options can be acquired in at least two ways. In some contexts, people can rely on summary descriptions of risky prospects. For example, weather forecasts explicitly state a probability of rain, snowfall, or hurricane landfall at a given location; likewise, drug package inserts describe the risks and side effects of the medication in plain terms. Equipped with such quantified risk information, people can make *decisions from description* (Hertwig, Barron, Weber, & Erev, 2004). Such information is, however, restricted to those domains in which tabulated risks exist. More often, people have to navigate the perils and opportunities of the modern world without transparent and convenient descriptions of risks. Many consequential decisions—including health care choices, intergenerational transfers (e.g., Coall & Hertwig, 2010), personal spending, and everyday risks (e.g., driving in bad weather; crossing a busy street)—are made without full knowledge of the possible outcomes and their probabilities. In this twilight of uncertainty, people may explore the current environment to determine its risks and opportunities. Equipped with such experiences of risks, people can make *decisions from experience* (Hertwig et al., 2004).

1.1. Decisions from experience and cognitive aging

A fundamental building block of decisions from experience is information search. *Ceteris paribus*, the more a person searches (explores), the better her estimate of an option’s value (Hertwig & Pleskac, 2010). Reliance on small samples can prompt systematically higher or lower levels of risk taking relative to those observed in decisions from description (in which outcomes and probabilities are explicitly presented, as in the traditional gambling tasks ubiquitously investigated by psychologists and economists). One reason is that small samples may not include rare but highly consequential events and, if they do, they may underrepresent them. Depending on whether these

rare events are desirable or undesirable, experienced-based choice will involve either more or less risk aversion relative to description-based choice (see Fig. 2 in Hertwig and Erev (2009)).

To date, little is known about the cognitive demands people face when they explore and learn about decision options—and the extent to which these processes are affected by cognitive aging. Arguably, the mind’s most notable transformation across the life span is a substantial decline in fluid cognitive abilities (e.g., Park et al., 2002). This inevitable decline hampers older adults’ processing speed and working memory capacity, as well as their short-term memory capacity—all components potentially involved in search and learning processes. Indeed, a recent meta-analysis on age differences in risky choice reported small to medium effect sizes in various experience-based tasks (but not in most description-based tasks; Mata et al., 2011), suggesting that age-related differences in risk taking might be a function of decreased learning performance (see also Eppinger, Hämmerer, & Li, 2011; Marschner et al., 2005; Zamarian, Sinz, Bonatti, Gamboz, & Delazer, 2008). Specifically, the direction of the age differences varied across experience-based tasks: In tasks that required decision makers to learn to take less risk (in order to make better decisions), older adults proved to be more risk taking than younger adults; conversely, in tasks that required decision makers to learn that they should take more risks, older adults were less prone to risk taking than their younger counterparts.

Relatedly, a meta-analysis on predecisional information search suggests that older adults tend to look up less information before making a decision and this decrease is particularly evident when many pieces of information are presented (Mata & Nunes, 2010; see also Mata, Schooler, & Rieskamp, 2007). Similarly, Spaniol and Wegier (2012) asked younger and older adults to make decisions from experience using a sampling paradigm and found that older adults sampled slightly less from the payoff distribution than did younger adults. Although Spaniol and Wegier did not explore the extent to which sampling or information integration were related to individual differences in cognitive ability or other variables, two other investigations of decisions from experience involving younger adults observed small correlations ($r \approx .2$) between search effort and measures of fluid cognitive abilities (Rakow, Demes, & Newell, 2008; Rakow, Newell, & Zougkou, 2010).

Some studies on multi-attribute decision making suggest that older adults tend to use simplifying strategies in the process of integrating information (Mata et al., 2007), sometimes even in the absence of significant age differences in search effort (Mata, von Helversen, & Rieskamp, 2010). For example, ongoing updating processes (of frequencies of occurrences or of sample means) seem to unfold relatively automatically and effortlessly (Hasher & Zacks, 1984). That is, under the assumption that people can make use of simplifying strategies, one might not expect decisions from experience between only a few decision options to be cognitively taxing. Consequently, age differences in decisions from experience may not be observed across the board. Rather, older adults’ declining fluid abilities may only lead to differences in search and

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