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Age Differences in Decision Making: To Take a Risk or Not?

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Abstract
A controlled laboratory experiment was used to assess the efficacy of the cognitive processes that underlie risk taking decision making in young and elderly people. Thirty-six participants took part in the study; half the subjects were elderly (mean age of 74) and the other half were young adults (mean age of 19). The elderly participants made equivalent decisions to those of the control young adults. Both age-groups of participants systematically and comparably changed their behavior as a function of risk levels. Furthermore, the elderly participants, relative to young adults, did not exhibit any slowing down in the speed of processing the information involved in making risk taking decisions, reflecting that healthy elderly people are cognitively apt to making risk taking decisions. Both age-groups took comparably less time on the easy trials (trials with either low or high levels of risk) and comparably more time on the difficult trials (trials with medium levels of risk).

Introduction

Many decisions we make involve uncertainty. Some decision making involves uncertainties that are completely unknown to us, in which case we are forced to gamble blindly. However, in most cases the uncertainties encompass known or estimated probabilities, enabling us to make calculated decisions. Risk taking in decision making contains an element of uncertainty; judgment and skill can produce high-quality decisions in the face of uncertainty. In this case, the calculated risk taking in decision making will effectively curve the outcome to one's benefit [1].

Elderly people may differ from young adults in how they perceive risk taking in decision making. Elderly adults may be less likely than younger adults to risk an incorrect response [2]. Such differences may result from fear of being perceived as incompetent in case of failure, or from the fact that elderly people are (or perceive themselves as being) closer to the end of their life span. They may be worried that they will not be able to deal with the possible negative outcome of their risk taking as efficiently as young people, and hence choose to be more cautious [2–4]. Alternately, elderly people may take greater risks. For example, they may adopt a 'what do I have to lose' mentality to promote risk taking behavior.

In both cases, elderly people may differ from young adults in their decision making when faced with risk as a result of external factors. Elderly people may also have degraded ability to make risk taking decisions because they experience higher anxiety [5], lower concentration [6], and are more likely to be distracted by irrelevant

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information [7–9] than younger people. However, elderly people also develop ways to cope and compensate for the changes that occur with aging [10–13].

Making decisions that involve risk taking relies on various internal cognitive processes. Estimating probability, weighing alternatives, judging outcomes, are all cognitive information processes that are used in such decisions. Research has shown that aging selectively affects some cognitive mechanisms but not others. For example, Dror and Kosslyn [14] found that age selectively affects mental imagery; specifically, aging degrades the ability to mentally transform images, but does not affect the ability to mentally scan images.

In the research reported here, we examined internal factors – the cognitive mechanism – involved in risk taking decision making. We were interested to see if elderly people differed in performance from young adults as a result of differences in underlying cognitive processing. Using a laboratory experiment, we isolated the cognitive mechanisms from external factors and examined the efficacy in processing information in risk taking decisions. Our task was similar to the game of blackjack; participants were required to decide whether or not to take an additional card. The participants attempted to obtain hands of cards with the highest sum, but were not to go over 21. Different levels of risk were associated with different sets of hands, depending on the probability that an additional card would cause the participant to lose the entire hand by going over 21.

Method

Participants

Thirty-six participants took part in the study. Eighteen were elderly participants who were recruited from a senior citizen's center. Based on self-reports, all the elderly participants were living an active life, were self-sufficient, and were healthy. Their ages ranged from 59 to 91, with a mean age of 74. Eleven elderly participants were female and 7 were male, and all had at least a high school education. The other 18 participants were university undergraduate students who participated in the study for extra credit in psychology courses. Their ages ranged from 18 to 22 with a mean age of 19. As in the elderly group of participants, the young adult group of participants consisted of 11 females and 7 males. Furthermore, the participants in both age-groups had comparable experience in playing blackjack.

Apparatus

In each trial, 3 cards were presented on the computer screen, 2 at the upper half of the screen below a label 'Your cards are as follows:', and 1 card at the bottom half of the screen below a label 'My card is as follows:'. Participants were required to decide whether or not they wanted to take another card (in addition to the 2 cards that were already given to them) so as to obtain the largest sum, but without going over 21. Only cards with values 2 through 10 were used in the task (aces were not used to avoid additional complexity of deciding if an ace was 1 or 11; jacks, queens, and kings were not used to avoid differences in perceptual recognition of the cards). All the cards were 3.2 × 5.0 cm. Each card consisted of a black rectangular frame, with its value (2–10) appearing once in the center of the frame (Geneva font, 36 point size).

One hundred and fifty-three trials were constructed. There were 17 groups of trials, each group contained trials that had the same total sum for the 2 cards that were given to the participant (i.e., in one group all trials had a sum of 20, the maximum sum possible, the next group of trials had a sum of 19, the next a sum of 18, and so on, until the last group which had trials with a sum of 4 – the minimum sum possible). In each group, the participant's 2 cards were completely counterbalanced (for instance, the group of trials that had a sum of 15 had all possible combinations of 2 cards that summed 15, i.e., 10 + 5, 9 + 6, 8 + 7, 7 + 8, 6 + 9, and 5 + 10). Within each group of trials that was constructed according to the sum of the cards of the participant, we systematically matched them to different cards of the opponent; one trial was matched to a '10' card for the opponent of the participant, one trial was matched to a '9' card, one to a '8', and so on, until a card of '2'. For administering the task, the 153 trials were then organized in a sequence of 9 blocks, each consisting of 17 trials. Each block contained all possible sums of cards, and the order of the trials within the blocks was randomized.

The trials were classified according to the level of risk associated with taking an additional card. At the very low end were the trials that had a sum of 11 or less, in which there was *no* risk in taking an additional card (regardless of the value of the additional card, participants could not go over 21). Then there were trials with *low* risk (trials with sums of 12 and 13), trials with *medium* risk (trials with sums of 14 and 15), trials with *high* risk (trials with sums of 16 and 17), trials with *very high* risk (trials with sums of 18 and 19), and trials with *infinite* risk (trials with a sum of 20, in which it is wrong to take an additional card because participants would always go over 21 and lose their entire hand).

Procedure

Each participant was tested individually. The task was administered on a Macintosh Powerbook 5300C with an active matrix screen, using SuperLab 1.68 (Cedrus Corporation). A research assistant remained present (out of the participant's direct line of vision) to answer questions. The participants read the instructions from the computer screen and then were given three practice trials. Throughout the instruction and practice trials, participants were encouraged to ask questions, and clarifications were given. However, no talking was allowed during the actual experiment.

After the practice trials, participants were tested on the 153 experimental trials. Each trial began with an exclamation mark on the screen. To initiate a trial, participants had to press the spacebar using their nondominant hand. The cards then appeared on the computer screen, and the participants were required to decide, as quickly as possible, whether or not they wanted to receive an additional card. Participants responded by using two fingers of their dominant hand to press the 'b' key (which was labeled 'yes') and the 'n' key (which was labeled 'no'). Then a new exclamation mark appeared, signaling the beginning of another trial.

Participants did not receive any feedback or additional information. They did not see what additional card they received, what additional cards the opponent received, or who won the hand. After com-

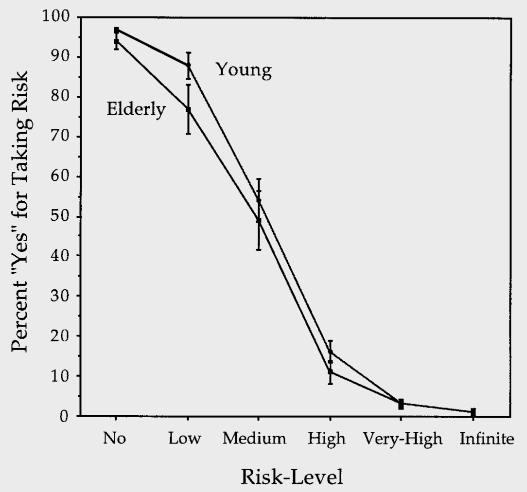

Fig. 1. The decision of whether to take an additional card as a function of level of risk. Elderly and young participants, alike, were systematically more and more reluctant to take an additional card as the risk level increased.

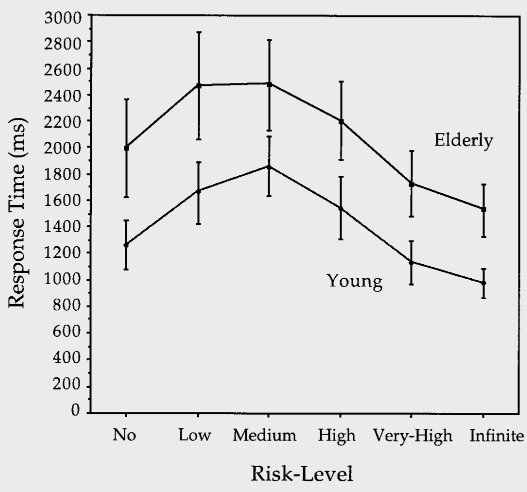

Fig. 2. The response time needed to make the decisions as a function of the level of risk. Elderly and young participants, alike, required less time for the easy trials (trials with either low or high levels of risk), and more time for the difficult trials (trials with medium levels of risk). The increase in response time with the difficult trials was comparable for the young and elderly participants, keeping the response time differences betweeen the young and elderly constant. Hence, the main effect of age and the lack of interaction reflect that the elderly's cognitive modules that are involved in risk taking decisions per se process information with the same efficacy as that of the young participant. The slower overall response times were due to other factors (e.g., motor speed, and encoding the stimulus).

pleting the task, the participants completed a questionnaire containing items about age, educational level, how often they played blackjack, and items about their performance on the task. All participants completed the entire procedure within approximately half an hour.

Results

The data were examined using analysis of variance (ANOVA), with Age as a between factor and Risk Levels as a within factor. First, we examined the decisions made (whether an additional card was requested or not); second, the response times for making the decisions were considered. The data of 1 participant was discarded because of failure to follow instructions; the participant did not respond either 'yes' or 'no' in 23% of the trials.

The decisions varied with the different levels of risk; participants were more and more reluctant to take an additional card as the Risk Level increased, $F(5,165) = 353.53$, $MS_e = 60,554$, $p < 0.01$. As illustrated in figure 1, elderly participants made comparable decisions to those made by the control young adults, $F(1,33) = 1.87$, $MS_e = 838$, $p = 1.9$, for a main effect of Age, and $F < 1$, for the interaction of Age × Risk Level.

The response time varied with the different levels of risk. As illustrated in figure 2, participants took less time for the easy trials (trials with either low or high Risk Levels), and took more time for the difficult trials (trials with medium Risk Levels), $F(5,165) = 27.97$, $MS_e = 4,520,650$, $p < 0.01$. Although there was a trend for a main effect of age, $F(1,33) = 3.61$, $MS_e = 23,025,461$, $p = 0.07$, differences in overall response time reflect overall factors (such as motor speed, encoding the stimulus, and general familiarity with completing tasks on computers) and not the specific processes that are examined. The lack of interaction between Age × Risk Levels, $F < 1$, shows that the differences between the young and elderly remained the same across the different levels of difficulty of the trials. Hence, there were no differences in the specific processes of risk taking decision making between the young and elderly participants.

Discussion

Young and elderly people make everyday decisions that involve risk taking. The research reported here examined whether there are age differences in the internal cognitive factors that govern the processes that underlie risk taking decision making. The young and elderly participants used skill and judgment in their decisions, as witnessed by their response on whether to take a risk or not. Both groups of participants took calculated risks, as reflected by a systematic decrease in risk taking when the risk levels increased. A main interest of this research is that both age-groups of participants made comparable risk taking decisions. Hence, the cognitive mechanisms used by elderly people in risk taking decision making produced comparable decisions as those used by young adults.

In addition to the actual decisions made by the elderly and young participants, our data further showed that elderly participants did not require more time to make the decisions. Our task included trials with different levels of difficulty, and hence enables us to selectively encumber the specific cognitive mechanisms involved in risk taking decisions. Given that the risk levels varied between trials and that all else was equal, the changes in response times between the levels of risk reflect the efficacy of the specific mechanism used in making risk taking decisions. The lack of interaction between Age × Risk Levels reflects that elderly people can cognitively process information related to risk taking decision making as well as young people. The overall time differences between the age-groups reflect differences not related to risk taking decisions (such as encoding the stimuli, pressing the response key, and so on). This logic is a variant of the 'additive factors' methodology [15] and has been used to assess cognitive information processing abilities of elderly people [14].

In decision making, as in many tasks, there is a tradeoff between speed and quality. Johnson [16] reports that although young and elderly participants complete their tasks in similar amounts of time, young participants consider more options in that time frame and therefore make higher quality decisions. The data reported in this study shows that aging does not degrade either the quality or the speed of making risk taking decisions. This does not necessarily mean that aging does not affect these cognitive mechanisms; however, it shows that if such as decline does occur, then other changes can compensate for it.

Although our study demonstrates that elderly people possess cognitive abilities that enable them to make sound risk taking decisions (i.e., comparable to young people), our study is limited by the subject population and experimental task we used. All our elderly participants were very healthy and active. Elderly people have a high variability on cognitive abilities, and activity may preserve cognitive ability with aging. For example, Buell and Coleman [17] found more dendritic connections in the aging brain than in brains of young adults; such additional dendritic connections can computationally compensate for neuronal loss in the aging brain, allowing it to continue to efficiently use a variety of cognitive mechanisms [13]. Hence, our study may have tapped onto the abilities of a certain group of highly capable elderly people, and may not apply to other groups of elderly people.

The study reported here examined risk taking in laboratory conditions, eliminating many other factors that may selectively affect elderly people in making such decisions. The strength of this approach lies in its ability to isolate and examine specific cognitive mechanisms, detached from the influence of external factors. The fact that we found that those internal mechanisms do not degrade with age does not necessarily mean that elderly people can make sound risk taking decisions in real, everyday, situations; they may have trouble with the noncognitive and external factors involved in such decisions. Our findings can help assess the factors that affect the way elderly people make decisions. By eliminating the internal cognitive factors as an explanation to why elderly people cannot make well-calculated decisions, one can try to attribute their possibly faulty decisions to other factors.

Further research is needed to examine additional internal and external factors involved in the process of decision making. For example, negative feedback may selectively affect elderly people (i.e., elderly people may respond differently than young adults when faced with negative feedback); pragmatic factors in 'real'-world decisions and situations can affect the elderly's willingness to take risks. The research reported here, along with additional research, has far-reaching implications to the new role elderly people can (and should) have in our society.

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