RISK TAKING AS A FUNCTION OF AGE, MONETARY INCENTIVE, AND GAIN OR LOSS

A Dissertation

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In Partial Fulfillment

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Doctor of Philosophy

By

Miriam B. Robins

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ABSTRACT

The purpose of this investigation was to compare elderly and younger subjects (Ss) in a chance situation designed to test the effects of age on risk taking. Measures used were probability, amount bet, and payoff choices, their variability, and latency. The effects of monetary incentive and gain or loss were also investigated. Using a payoff matrix based on a fair dice game, Ss indicated their preferences between seven probabilities and four bets by placing a chip on a marker. On each of 30 trials, Ss obtained immediate feedback following their rotation of a Bingo cage, which was designed to eject a ball. The frequency with which numbers were marked on the balls conformed to numbers presented on the payoff matrix. In turn, these frequencies were associated with probabilities.

The Ss were 40 elderly males and females from recreational centers, and 40 college students of the same socioeconomic level. Half the Ss in each age group gambled with chips worth actual money, while the other half gambled with worthless chips having only token value. For each S, mean scores were separately computed for trials following a winning trial and for trials following a losing trial.

It was found that elderly Ss responded more cautiously on the probability measure than did the younger Ss in that they chose higher probabilities of success. Response

latency also showed an age level effect; longer latencies characterized the performance of elderly Ss in the decision making tasks. No effects of monetary incentive were found.

The amount bet failed to depict age differences. All Ss, regardless of age, bet similar amounts of money. If bet choices are interpreted in terms of confidence levels, this suggests that older Ss were no less confident than younger Ss. Further support was obtained for this interpretation in the finding that older Ss bet as much money on the riskier alternatives relative to safer ones as did the younger Ss. Bet choices also were significantly affected by gain and loss. Irrespective of age, all Ss bet more following win and less following loss.

Aging did not affect the ability to shift toward higher risk levels after gain, or to conserve by shifting toward lower risk levels after loss. There was thus no evidence that elderly Ss were less flexible or adaptable than were younger Ss. It was also found that latency changed in the direction of longer latencies after gain, and in the direction of shorter latencies after loss, irrespective of age.

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CHAPTER I

INTRODUCTION

Information regarding age differences in risk taking has been meager, despite growing evidence of a relationship between low risk taking and aging. Wallach and Kogan (1961) used a "Dilemmas of Choice" questionnaire consisting of problems of youth to assess risk taking behavior. When an elderly group was compared with a college sample, older people were observed to choose conservative alternatives by requiring significantly higher probabilities of success. Recently, Botwinick (1966) extended the Wallach-Kogan instrument to include dilemmas of elderly central characters. The Botwinick data confirmed that aged subjects were unwilling to sanction a risky course of action. Insofar as low risk taking is understood to reflect cautiousness, both of these investigations indicated that cautiousness was an aspect of the aging personality.

In these initial efforts, decision making under hypothetical conditions was analysed to explore the relevance of a risk taking construct with respect to aging. In only one study--not addressed to the problem of risk taking per se--was a performance skill employed to measure goal-setting behavior in the aged (Davis, 1967). Using the Rotter Aspiration Board (1942) procedure, Davis found that elderly people did not respond to "success" norms with a "push" to get ahead,

although "failure" norms induced them to raise their goals. The Davis results are interesting because of the possible relevance of goal setting for risk taking in a setting of success and failure. Goal setting procedures have been used by others to measure cautiousness with younger adults (e.g., Moss, 1961; Rotter, 1942). However, this variable, and its relationship to cautiousness, has not been explored under chance conditions with elderly people.

At the present time, there appears to be no chance situational aging study which taps explicit risk taking behavior. Furthermore, the past history of the problem with young adults suggests that when real gains and losses are involved, changes in risk taking attitudes have occurred. Where payoffs have been utilized across monetary situations, for example, change in behavior has been observed as a function of incentives.

Siegel and Goldstein (1959) have shown in a binary situation that monetary incentives and costs were important. When both costs and payoffs were involved under a "risk" condition, college students chose the "safer," more conservative strategy more frequently than when under "reward" only; reward conditions, in turn, elicited less risky choices than the "no payoff" condition. Juxtaposing the "Dilemmas of Choice" data with both goal setting procedures and binary choice findings, one may raise the question of whether differences might be found between older and younger adults in

actual risk taking tasks, with or without monetary incentives. Thus a more rigorous test of the problem is proposed, within a gambling paradigm, where responses to actual risks may be obtained. This procedure would imply rapprochement with decision theory.

The opportunity for advancing knowledge on an aspect of aging in the domain of decision theory seems to be promising. Since decision problems require that a choice be made between diverse alternatives, the strategy characteristic of the decision maker may shed some light on risk taking behavior.

A normative "rational" model, frequently employed for interpreting decisions is that an individual maximizes subjective expected utility (SEU); in sum, given a choice situation, people evaluate probabilities and payoffs, and rationally choose the alternative maximizing something which has subjective value for them. On the one hand, consistent findings have indicated that given the opportunity, people do maximize subjective utility (e.g., Davidson, Suppes, & Siegel, 1957; Suppes & Walsh, 1959). However, other investigators have reported that decision makers seldom pursue this strategy in strict fashion (e.g., Edwards, 1954a; Miller & Lanzetta, 1962; Scodel, Ratoosh, & Minas, 1959). Edwards and Slovic (1965) have suggested that, when subjects do not follow this strategy, they prefer either high probabilities of small gains or low probabilities of high gains. These investigators hypothesize that this behavior indicates "excessive

caution or excessive incaution," respectively.

Despite these observations, decision theorists in general have been concerned with the prediction of decision making behavior to test mathematically optimal strategies, such as the SEU model. In addition, their focus on the situation has usually been at variance with the notion of organismic risk taking, in terms of preferred levels of risk in transituational contexts.

Since different investigators, with different age groups, have focused on different issues, and have utilized different tasks with varying assessment techniques, no coherent picture of the cautiousness-risk dimension has been possible. A generalized tendency towards cautiousness among aged subjects, regardless of monetary rewards, would signify a personality disposition of some generality. Therefore, a risk taking approach appears defensible, and should clarify this aspect of aging--cautiousness manifested as choice behavior under chance conditions with, and without, monetary incentives.

In particular, the present study will attempt:

1. To examine explicit probability-bet-payoff preferences in terms of a risk-conservatism dimension, highlighting the element of cautiousness.
2. To examine risk taking in an aged, non-institutionalized sample, and to include comparisons with a younger sample.

3. To investigate the function of monetary incentive in relation to the risk-conservatism dimension.
4. To determine the effects of gain and loss on risk taking behavior.
5. To study the magnitude and direction of shift behavior after gain and loss.
6. To examine decision time in terms of response latency.
7. To assess interrelationships among the various measures.

CHAPTER II

REVIEW OF THE LITERATURE

Definitions

Economists and mathematicians have long been concerned with how people make gambling choices when the element of risk is present. However, it was Knight's (1921) work on profits which distinguished between the terms risk and uncertainty. Knight used the term risk to refer to "insurable consequences" of events, characterized by more certainty of outcome than "non-insurable" events. This notion has led to a modern conception of risk, in which the parameters of future events are fully known and can be computed mathematically (Luce & Raiffa, 1957). Although uncertainty characterizes "unknown" objective probabilities, lack of certainty, based on the prospect of loss or failure to obtain some desirable goal, also suggests cautiousness, or low risk taking (Kogan & Wallach, 1967).

Edwards and Slovic (1965) have provided a decision theory rationale for the risk-conservation dimension. These investigators compared the relation between the actual amount of information required for a decision task and an optimal amount specified by a mathematically-derived strategy. While other relatively "good" strategies occurred, the optimal strategy accounted for only 34% of the subjects' choices. Edwards and Slovic suggested that choices which did not

maximize expected value reflected preferences for high probabilities of small gains, indicating "excessive caution." On the other hand, preferences for low probabilities of high gains depicted "excessive incaution" (p. 197).

This rapprochement of decision theory with cautiousness, as an aspect of personality, stresses the quantification of probabilities, payoffs, gains, and losses. However, the mathematical models related to decision theory have in general not included a consideration of individual personality characteristics. Competent reviews of these models have been presented in Becker and McClintock (1967), Edwards (1954b), and Edwards (1961). A critical discussion of the major models has also appeared in Kogan and Wallach (1967). It is beyond the scope of the present investigation to pursue the discussion of these models. However, since the subjective expected utility (SEU) model seems to possess some relevance for a risk taking analysis, some discussion of this model will be presented in a brief resume.

The SEU model (like all mathematical theories of choice behavior) provides a deterministic view concerning the process of decision making. In effect, the SEU model reduces decision making to the parameters of utility and subjective probability.

The economic lines of the theory of utility can be traced to ancient Greece in the philosophy of hedonism. In the 19th century, the concept of utility gained support in

the writings of Jeremy Bentham and James Mill. Essentially, this philosophy denotes a theory of motivation which holds that the ultimate values of human action are to produce pleasure and to avoid pain. Pleasure is given by "positive utility" and pain by "negative utility" (Edwards, 1954b). The essence of the utility theory of choice is thus the choice of the alternative which leads to the greatest degree of positive utility while averting negative utility.

Savage (1954) has presented the historical descent of the concepts of utility and probability in mathematics. These concepts gained meaning from the 18th century writings of Bernoulli, who established that people do not choose among money gambles, but merely on the basis of expected money returns. The Bernoulli notion, in turn, gave rise to the theory that an individual maximizes expected utility. Edwards (1955) added to the Bernoulli theory the concept of subjective probability, in his proposal of the SEU model.

The notion of subjective probability reflects the decision maker's state of knowledge about the structure of the world. It refers to the subjective expectation of the occurrence of each outcome in situations characterizing an event at the time of choice (Luce, 1967). The mathematical nature of the SEU model has been stressed by Luce:

> It holds that, in addition to utility assignments to all alternatives--risky as well as sure--one can also assign numbers to events. The numbers are interpreted as the subject's evaluation of the likelihood of the event's occurring; they are

> called "subjective probabilities." Like ordinary objective ones, they lie between 0 and 1. These two numerical scales are interlocked in the following way: the utility of a risky alternative is the sum of the utilities of its component outcomes, each weighted according to the subjective probability of its occurring (p. 336).

In essence, the SEU model proposes that an individual who is faced with a choice decision evaluates the probability and the amount of the payoff and then "rationally" selects the alternative which maximizes something of value for him. If this is done, it is said that the person behaves "optimally relative to his utility scale (Luce, p. 336)."

A serious shortcoming of the SEU model centers around variance preferences which cannot be reduced to utility and subjective probability functions (Coombs & Pruitt, 1960). Choices aimed at high variance bets over low variance bets reflect the attractiveness of gambling for larger rewards and costs. Kogan and Wallach (1967) point out that such preferences imply individual personality characteristics and "can be psychologically interpreted as a utility for risk (p. 119)."

Attempts to interpret the consistency of a risk taking behavior in aged persons becomes hazardous when the bulk of empirical data has been pertinent to young adults. An examination of the degree of risk taking in young adults has also been made more difficult when risks have been presented as either implicit or explicit, or when outcomes have been either contingent on performance or beyond Ss' control. While the literature on decision making is diffuse, some

organization may be imposed by examining risk across a variety of these situations. Three rather broad categories have emerged: (1) Young adult studies which point to the effects of hypothetical vs. real influences on risk taking (2) Young adult studies which review chance vs. skill contexts (3) Aging studies, where an interpretation of cautiousness has been based on comparisons of elderly and younger Ss.

Young Adult Studies: Hypothetical vs. Real Risk Taking

In many studies concerned with decisions in hypothetical situations, apparently it has been assumed that these contexts represent actual risk taking behavior. Thus, Slovic (1962) administered a battery of tests described in the literature as risk taking tasks (Cronbach, 1946). Included in the procedures used with male college students were tests of speed vs. accuracy, inclusiveness or category width, questionnaires, and simulated gambling measures. Slovic failed to find convergent validity with these procedures, and expressed doubt of the existence of a generalized risk taking trait. However, the question might be raised regarding the adequacy of these procedures for measuring such a trait. The roles of gain and costs with their attendant consequences were not determined, since no money changed hands.

The same criticism might apply to the Wallach-Kogan (1959) investigation of sex differences in hypothetical risk taking tasks. College students of both sexes were administered a battery of questionnaires. One procedure was the

"Choice Dilemmas" task, which consists of twelve hypothetical decisions requiring a choice between two courses of action for a central character. One alternative posed a higher reward but greater risk as compared with the other. The S's task was to advise the central character by deciding what probability of success he needed to warrant choosing the riskier course of action. In a second procedure, the S estimated the probability of a wide range of events, and indicated how certain he was of his opinion. Women were found to be more cautious than men when uncertain of their decisions, but took more risks when they perceived a situation to be highly certain. Women were also bolder than men when an area of typical feminine fulfillment (e.g., marriage) was examined. On the other hand, women were more cautious than men in other content areas (e.g., income loss and death). Within the limits of hypothetical decision tasks, this experiment seemed to explode the myth of feminine conservatism as a general personality trait.

Another effort to simulate risk utilized an imaginary gambling paradigm (Suydam & Myers, 1962). Undergraduate males were administered a 50 page booklet consisting of pairs of bets, and a rating scale for estimating the difficulty of choices. Ss were required to choose between accepting a gamble with a 50-50 chance of winning and a relatively sure thing. The Ss were observed to weight more heavily potential costs than potential gains. These results suggest that an

avoidance of possible loss contributes to a conservative trend in decision making, under hypothetical conditions.

Katz (1962), working directly with the question of gains and losses, provided information on the effects of monetary incentives in a male undergraduate population. Ss had a choice between "standing pat" with a known payoff, by accepting a gain or loss indicated on a card, or by "gambling" with an unknown payoff, by drawing another card. In one condition, 18 Ss were provided with chips only, and in another condition, a similar number of Ss were staked to $10.00 worth of chips, with a value of five cents each. In apparent agreement with the Suydam-Myers finding, Ss seemed to avoid losses by "gambling" significantly more when the alternative to gambling was a known loss, than when it was a known gain. Monetary incentives had little effect on this overall pattern of results.

In contrast, Edwards (1953) found that monetary incentives differentially influenced risk taking when Ss gambled with their own money; at the conclusion of the experiment, Edwards arranged for losses to be made up. Ss were required to choose between pairs of bets. Each alternative of the respective pair had the same expected value. All Ss served as their own controls, proceeding from an "imaginary" condition, to playing for "worthless chips," to the final condition of gambling with their own "real money." Greater risks were taken when Ss played for "real money." This was

indicated by a greater willingness to bet on "long shots" with their own funds than in either the "worthless chip" condition or "imaginary" situation. It is difficult to evaluate these results, since a greater tendency towards risk taking could have occurred from more confidence as a result of practice effects, rather than monetary influences. An obvious way to determine this is the method of separate groups, the approach utilized by both Goodnow (1955) and Siegel and Goldstein (1959).

Goodnow (1955) used a "gambling" and a problem solving "light guessing" technique in a binary uncertain outcome situation. The "gambling" group received chips which could be exchanged for a penny each. The "light guessing" group received no monetary incentives. Random sequences of light illumination were arranged across 120 trials, with the two lights occurring with fixed but unequal probabilities, with respect to the more frequent and less frequent events. When the last 20 trials were analyzed, in contrast with the Edwards (1953) results, the introduction of money yielded a significantly greater prediction of the more frequent event. Although the Goodnow approach was oriented around utility theory, in terms of probability matching, her results might be construed as evidence for a low risk taking strategy, consonant with a preference for the safer, more frequent event.

Siegel and Goldstein (1959) used the Goodnow experimental situation, but systematically varied monetary incentives.

Male college students were randomized into "No Payoff," "Reward," and "Risk" groups. The "No Payoff" group merely observed whether predictions were correct or not. The "Reward" group received a nickel for a confirmed prediction, and lost nothing for an incorrect prediction. The "Risk" group won a nickel for a correct prediction, and lost a nickle for an incorrect prediction. The more frequent event was a light which illuminated on 75% of the trials, while the less frequent light illuminated for the remaining 25% of the trials. Results confirmed the Goodnow (1955) effect, in terms of greater reluctance towards risk taking within the monied groups. On the final 20 trials, the "No Payoff" group correctly predicted 75% of the trials (perfect probability matching), as compared with 86% for the "Reward" group, and 95% for the "Risk" group. Probability prediction appeared to reflect greater conservatism (overestimation of frequency) when gains and losses were involved. The interpretation was offered that correctly predicting the rarer event may be related to the utility of satisfaction derived from "playing a game" with the machine. On the other hand, dissatisfaction or monotony may result from always predicting the more frequent event, when monetary rewards and losses are absent. Another important aspect of the Siegel-Goldstein experiment, from a risk taking point of view, is that cautiousness seems to take the form of a greater willingness to endure a larger number of errors. This interpretation was examined in some

detail by the Kogan and Wallach (1964) study, which will be reviewed in a later section.

The studies just reviewed point to the controversial effects of hypothetical vs. monetary inducements for risk taking. The weight of the evidence seems to suggest that variations in risk taking occur as a function of shifts in value, which take the form of less risk taking with real money. Under hypothetical conditions, conservatism was clearly not sex-related, but appeared to be situation-specific. However, parallel studies with monetary effects might have added validity to this finding. There was the implication, in both hypothetical and explicit risk taking with monetary reinforcements, that an approach-avoidance conflict underscored more cautious behavior. Less clear evidence tended to support the notion that cautious young adults tend to avoid loss more than they tend to approach gain.

The results of chance and skill studies may shed some light on these findings. The chance vs. skill context raises the question of situational and personality influences on decisions. The extent to which variations in the structure of the task influence risk behavior will therefore be examined in the following section.

Young Adult Studies: Chance vs. Skill Contexts

Utility for money in a chance context was studied by

Mosteller and Nogee (1967) who compared national guardsmen with college students. Ss played a poker-dice game against an experimenter, whose poker "hand" consisted of previously prepared stimulus cards. Ss were provided with chips which were later exchanged for money. The decision task was a choice of whether to bet a nickel in an attempt to beat the experimenter's hand, or to abstain from betting on each roll of the dice. Results indicated significantly more conservative utility curves for money in the college population.

Scodel, Ratoosh, and Minas (1959) also compared risk taking in military men (Air Force personnel) with male college students. Ss were staked to $10.00, and were required to bet either 15 cents or 30 cents on the outcomes of a dice game. For each roll of the dice, Ss chose one bet from a nine-alternative matrix with varying known odds. The experimenters also introduced other procedures: the TAT, which was scored for need achievement, and a series of questionnaires, whose purpose was to uncover other needs and values. The college group displayed significantly greater conservatism by selecting the low payoff, high probability bets, suggesting a greater utility for frequency of wins than the military group. Conservatism was also related to theoretical and aesthetic values, higher need achievement, and fear of failure.

The Scodel et al. (1959) study had two interesting consequences for further research. First, the finding that high need achievers exceeded low need achievers in a preference

for intermediate levels of risk was in partial agreement with the Atkinson (1957) formulation of need achievement. Secondly, the Scodel et al. investigation appears to have been an important influence in directing attention toward possible relationships between personality variables and formal models of decision making.

Earlier, McClelland, Atkinson, Clark, and Lowell (1953) had proposed that risk taking was related to achievement motivation. According to Atkinson (1957), subjects in whom the motive to achieve success exceeded the motive to avoid failure were expected to be drawn to tasks of intermediate difficulty. On the other hand, when the motive to avoid failure was greater than the motive for success, then individuals were expected to prefer either extreme risk or extreme conservatism.

Atkinson, Bastian, Earl, and Litwin (1960) tested the Atkinson model by examining the relationship between a skill-type task and an imaginary chance game. Ss performed a shuffleboard task in which they were required to state their distance preferences from the target. In the chance situation, Ss had the chance either to gain or lose 50 cents, or the chance to win or lose $300.00. Ss with high motivation for success (measured by the French Test of Insight) chose intermediate distances from the target. The high need achievers also preferred moderate levels of risk in the chance situation, but only with the 50 cent condition. On

the other hand, low need achievers preferred either extremely high or extremely low bets in both monetary conditions.

The Atkinson et al. (1960) study seemed to suggest a stronger relationship between need achievement and risk taking when risks concerned performance of a skill rather than a chance task. This finding tends to support the idea that risk behavior in skill and chance situations might be antithetical.

Recently, in studies on the internal-external "locus of control" dimension, related to Rotter's (1954) social learning theory, another rationale has been presented for the view that skill and chance decisions are psychologically different. Liverant and Scodel (1960) incorporated the concept of personal power into a chance task, by utilizing a forced-choice scale of control. Internal control was defined as a general belief in the power to order one's own fate. The investigators reasoned that the internally controlled Ss would behave cautiously and attempt control by avoiding high risk alternatives. Externally controlled Ss, believing in environmental control, were expected to play hunches, or to commit the gambler's fallacy of choosing bets on the outcomes of previous trials. Ss were white male college students who chose bets from a seven-alternative payoff matrix in a dice game. There were no significant differences between the groups in the choice of high probability bets, and no significant differences in the total amount of money wagered. However,

internally controlled Ss selected more intermediate probability bets, while externally controlled Ss chose more low probability bets. In addition, internal control was related to more money wagered on lower risk bets, and less variability in shift behavior in the selection of probabilities.

While the Liverant-Scodel findings suggested that white college students differed among themselves in risk taking on the "control" dimension in a chance context, studies of racial differences have pointed to contrasting effects in skill and chance situations. Lefcourt and Ladwig (1965) examined risk taking in a skill context in a population of Negro and white prisoners. Using Rotter's (1942) level of aspiration procedures, and a power scale, these investigators observed significant differences in the two groups. The Negroes scored higher on powerlessness, implying a greater belief in external control than the white Ss. There were also significantly greater increases in level of aspiration following failure for Negroes, and decreases in level of aspiration after success. A widely accepted generalization on level of aspiration has been that successful performance leads to an increased level of aspiration, while failure reduces the aspiration level (Lewin, Dembo, Festinger, & Sears, 1944). The apparently "irrational" pattern of the Negroes in level of aspiration connotes their lack of belief in personal power to control the success or failure of performance tasks.

Contrary to the Lefcourt-Ladwig findings for a task demanding skill, Lefcourt (1965) indicated that Negroes reflected an internally controlled orientation in a gambling task. Lefcourt equated white and Negro male prisoners for intelligence and social class. His Ss participated individually in a dice game which consisted of four different bets, with seven payoff alternatives. Negroes chose significantly fewer low probability (high risk) bets, and shifted less frequently from one betting category to another than the white prisoners. Lefcourt concluded that Negroes approached chance tasks in a more cautious manner than white Ss, reversing the findings of the Lefcourt-Ladwig (1965) study of skill-type tasks. In addition, Negroes seemed to be more highly motivated by success than by failure, as reflected by attempts to maximize frequency of winnings. The present findings were considered to result from the Ss' different view of the tasks, with the inference made that "Negroes as compared to whites believe that achievement in self-evaluative, skill-demanding tasks is less instrumental to success than in externally controlled situations where determinants are largely luck or fate (Lefcourt, 1965, p. 769)."

Kogan and Wallach (1964) focused directly on the issue of generality by arranging separate chance and skill tasks. Results with white college students indicated very little generality across tasks, and lack of consistency in preferred risks from task to task. Intermediate strategies were

preferred within a shuffleboard task situation, while a chance context led to either extremely risky or conservative strategies. However, when the investigators analyzed "motivational disturbance," pervasive generality emerged. "Motivational disturbance" was a term reflecting the combination of motives to avoid failure (high test anxiety) and high defensiveness (need for social approval). Ss high in motivational disturbance were consistently higher in either risky or conservative outlook across decision tasks. On the other hand, those who exhibited lower levels of motivational disturbance were described as less consistent from task to task, more flexible, and more responsive to environmental contingencies. In essence, individuals low in defensiveness were capable of modulating risk taking by adapting in an appropriate or "rational" way to the task at hand.

One interesting comparison involved the relationship to risk taking and categorization. The Wallach-Kogan (1964) study indicated that broad categorizers reflected greater conservatism, and narrow categorizers were greater risk takers. These results seem to be analogous to the Siegel-Goldstein (1959) study in which cautiousness implied the ability to endure a larger number of errors. However, they contrast with those of the Slovic (1962) study in which broad categorizers were considered high risk-takers.

Tentative conclusions from the studies reviewed above on chance and skill tasks seem to point to the dissimilarity of these two procedures for risk taking. While the weight of

the evidence points to conservatism of college students in gambling tasks, generality across tasks does not emerge, unless Ss are insensible to environmental differences, or have become defensive and anxious. There was a strong indication that conservatism was related to fear of failure. The various studies indicate that a risk taking interpretation may be tenable. The convergence of recent personality studies with those of decision making suggests that the problem is of wide importance. There seems to be clearer evidence on the type of risks preferred in skill tasks than in gambling tasks, in so far as the cautious-risk dimension is concerned. At the present time, without age-related studies, there is no way of knowing whether cautiousness is an aspect of aging.

Aging Studies

The effect of the normal aging process on increased latency of response has been well-documented (e.g., psychomotor skills, Birren, 1956; Welford, 1951, 1958; verbal association, Birren, Riegel, & Morrison, 1962; nonverbal intelligence, Chown, 1961; reaction time, Talland, 1965; and others).

Botwinick (1959) has offered two hypotheses for the characteristic slowing with age: (1) The consequence hypotheses, which assumes that slowness is a neurally controlled response which permits review, and therefore leads to increased accuracy. (2) The motivational hypotheses, which assumes that, in order to obtain accuracy, slowing down is a

purposeful response. As Botwinick (1964) points out, these hypotheses are not necessarily incompatible, since both predict a relationship between slowness of response and increased accuracy. However, the motivational hypothesis implies a change in the value system of aged people, which promotes carefulness in order to reduce the tendency to make errors. The present review will be limited to investigations consonant with the motivational approach, in respect to suggestions in the literature that older people seem to value cautiousness as a purposeful response.

The relationship between speed and accuracy suggests one area of rapprochement between learning and personality studies. The speed factor was examined by Botwinick, Brinley, and Robbin (1959), who questioned whether the aged could be as adaptive as younger adults when the task was speed of writing. Male volunteers were divided into two groups--34 younger men, aged 18-32; and 29 older men, aged 65-81. All subjects were instructed to write the phrase, "New Jersey Chamber of Commerce" in the following sequence and rates of speed: normal-slow-fast-slow. Significant age differences emerged. The younger group performed at a pace consistent with instructions, whether fast or slow. On the other hand, the older group reduced their speed under "fast" conditions and increased their speed under "slow" conditions. Both kinds of errors were considered a form of "monitory" behavior. The investigators reasoned that the narrow range of response

speeds with which older Ss modulated their responses had "safety or protective features (p. 142)."

A more detailed analysis involving the disposition to reduce errors was presented by Korchin and Basowitz (1957) in the context of paired-associate verbal learning. The authors compared an older and a younger group of Ss whose mean ages were 78.1 and 26.8 years, respectively. During the course of learning, younger Ss were observed to make responses, whether correct or not, while older Ss risked fewer failures by less frequent attempts to respond. Korchin and Basowitz suggested that aged persons preferred the "error of omission to that of commission." They concluded that omission errors reflected a "more profound personality defense in the aged through which the recognition of inadequacy is avoided (p. 78)."

A variety of learning studies with older Ss have indicated that errors of omission contribute extensively to the total errors in performance (Botwinick, 1964). In brief reviews of these studies, Botwinick (1964, 1967) has directed attention to the formulation of basic cautiousness to account for omission errors.

A recent study which has some bearing on the issue of omission errors is the Eisdorfer (1965) investigation of serial rote learning. Eisdorfer tachistoscopically presented eight lists of words to 15 white males over 60 years of age. Various combinations of stimulus exposure durations and interstimulus intervals from other experiments were compared

with the present experimental data. Results indicated that more rapid pacing of the stimuli led to significantly more errors of omission. On the other hand, more time to respond resulted in a reduction of omission errors. No change was observed in commission errors with varying exposure conditions. Eisdorfer offered an "anxiety-withdrawal" hypothesis to account for omission errors at the faster exposure speed. He also suggested that the external stress compounded under task difficulty and more rapid pacing.

While Eisdorfer made no comparison with a younger group, Silverman (1963) confirmed the Eisdorfer findings by comparing data from the two age groups. All Ss were presented with tachistoscopic word lists, and instructed in one condition to call out the word when they were sure they recognized it, and in a second condition, to guess if they were not certain. Elderly Ss required significantly higher levels of confidence before responding than did younger Ss.

The notion that lack of confidence and uncertainty are typical of the aged led Basowitz and Korchin (1957) and Korchin and Basowitz (1956) to examine this phenomenon. The Basowitz-Korchin (1957) study involved analyzing responses to perceptual tasks related to organization and resistance to closure. Sixty persons from two widely separate age groups were compared. The older group was described as "healthy" residents of a home for the aged. The younger population was drawn from the staff of resident doctors and nurses. Groups

were chosen so as to be roughly equated for intelligence. The finding that older Ss produced significantly more failures in responding led the authors to hypothesize an interaction between decreased cognitive ability and excessive caution. Caution was hypothesized as a need for a high level of certainty, and served as a defense against feelings of "inadequacy" (p. 96).

In their related study with the same population of Ss, Korchin and Basowitz (1956) explored judgments of ambiguous stimuli as an index of cognitive functioning. A series of 13 line drawings were presented to older and younger Ss, whose task was to tell whether each picture resembled a cat or a dog. The first picture in the series was clearly a cat, which became modified gradually, until later in the series it resembled a dog. The most ambiguous pictures were thus in the middle of the series. Younger Ss gave the "cat" response through the early part of the series, and then abruptly shifted to "dog" in the middle of the series. On the other hand, elderly Ss "vacillated" between cat and dog in the middle of the series, with the final shift to "dog" occurring later in the series. The vacillation was interpreted as cautiousness arising from the uncertainty of a novel situation.

In the Korchin-Basowitz study, decision time was expected to be greater in the ambiguous situation, as a second measure of uncertainty or conflict. That is, decision time for the elderly was expected to be maximal at the point where "cat"

and "dog" cues were nearly balanced. Although the elderly were significantly slower than the younger group, their decision time was higher earlier in the series with less of a rise on the ambiguous cards.

The general findings suggested that it would be premature to conclude that older people responded cautiously in novel situations. A test of behavior in less ambiguous situations was needed. In addition, the unexpected finding that younger Ss were more extreme than older Ss required further study.

Botwinick (1962) shed some light on the performance of elderly Ss under more nearly structured conditions. Botwinick cleverly emphasized the set to shift, by using the Basowitz-Korchin (1956) pictures in a different order. He introduced the final pictures of the series at the beginning of the procedure, and then ended the procedure after the shift. Results indicated that Ss shifted earlier in the series when the pictures were clearly either a dog or a cat. Botwinick suggested that when he had reduced uncertainty elderly Ss were capable of more flexibility.

The earlier Korchin-Basowitz (1956) study still presented some confusing results. The unexpected finding that older people expressed less extreme judgments than younger people suggested to Wallach and Kogan (1961) that a separation of confidence from extremity would lead to a different

pattern of results. They attempted to resolve the problem by relating confidence and extremity to risk taking variables. An older group of 154 Ss with a mean age of 70 was selected from a gerontological center. They were non-institutionalized and physically healthy. A comparison was made with a younger group of 357 college students, who were roughly matched for educational level with the older people. Both sexes were represented in the sample. The risk taking task was the hypothetical "Choice Dilemmas" task, which was compared with both a measure of extremity of judgment, and a motor skill task, which was designed to uncover subjective probability of failure. When the procedures were analyzed separately, the hypothetical task revealed that older Ss were significantly more conservative than the college students. The decline of risk taking with age was more gradual for women than for men, suggesting to the authors that retirement was more anxiety provoking for men.

The finding that older Ss were less extreme in their judgments than were younger Ss, even in situations where they were "very sure" of success, indicated that "One of the important consequences of aging appears to be a greater unwillingness to 'go out on a limb,' even though very certain of one's judgment (Wallach & Kogan, 1961, p. 29)." These results helped to clarify the Korchin-Basowitz (1956) study.

No overall relationship was found between subjective probability of failure on the motor skill task and actual

performance for any age group. The research also failed to confirm that greater extremity of judgment would be related to lower subjective probability of failure and conservatism on the hypothetical task. Only one significant correlation emerged: subjective probability of failure was related to performance on the "Choice Dilemmas" task. While the general weight of evidence across procedures seemed to suggest a high degree of specificity with regard to level of risk, the presence of the single positive relationship provided the first empirical support for thinking in terms of caution as a dimension of aging. It was nevertheless evident that, with no payoffs involved, firm generalizations on this problem could not be made.

Botwinick's related study with the "Choice Dilemmas" procedure supported the Wallach-Kogan (1961) findings on age-related cautiousness, and also indicated that both sex and education were nonsignificant. By adding aged problems to the hypothetical procedure, Botwinick found, surprisingly, that both age groups were less cautious in handling problems of the aged than they were with young adult problems. This was interpreted as an acknowledgement that youth had more at stake with a longer life ahead.

There are some data to suggest, however, that older people are more conforming and bound to standards of their own age group than is true for young adults. Davis (1967) dealt with this problem in a level of aspiration study

providing a performance skill procedure with three groups: young, middle-aged, and old. Aspiration level was measured before and after the introduction of fictitious peer group norms of "success" and "failure." For the older group, success led to a decrease of aspiration level, while young men sought even higher goals than those of their peer group. The middle-aged group diverged from both these groups, with success having little effect upon their performance. Under failure, all groups converged toward their peer group norms, by setting significantly higher levels of achievement. Davis concluded that, although older people seemed to withdraw from former achievement goals, they tended to become as highly involved as younger people when they perceived they were doing more poorly than their peers.

The relationships among extremity, confidence, achievement, and risk taking are not clear-cut. The results of the aging studies reviewed above seem to suggest that aged persons lack confidence, take fewer risks, and may feel more anxious in ambiguous situations than younger people. Although the majority of studies suggest that older people are deterred by failure, not all studies point to this as a consistent trait, characteristic only of elderly people. While the concept of cautiousness may have helped to explain deficits in verbal learning and perceptual-cognitive tasks, these explanations have also had to compete with other explanations as

well. However, when the procedures have been such that the exercise of risk taking has been maximized, older people do seem to be at a disadvantage. In studies involving hypothetical risk procedures, caution as an age-related phenomenon has emerged. At the present time, no evidence has emerged on the problem of how elderly people would respond to the press of actual risk. On the other hand, research with young adults suggests that, in a chance context where actual risks may be incurred, real payoffs have yielded significantly greater cautiousness than have imaginary payoffs.

These various considerations suggest that an investigation of risk taking across both hypothetical and real payoff conditions would contribute to an understanding of the generality of cautiousness for aging. In addition, since explicit decision theory parameters representing the risk-conservatism dimension have been satisfactorily employed with young adults, these measures might result in firmer generalizations relating cautiousness and aging. This formulation would thus attempt to bridge the gap between areas of parallel research which appear to be conceptually linked.

The purpose of this investigation was to obtain clarification of risk taking as an aspect of aging, by comparing old and young adults within the context of a gambling situation. An important reason for utilizing the gambling context rather than a performance situation is that a skill-type performance task would have disadvantaged the older sample.

The assumption is that a risk-conservatism dimension of personality may be measured by three types of indices: risk taking measures, response latency, and shifts in risk taking. The primary risk taking measure, probability preference, will be examined in terms of its relationship to response latency. Responses to probability, bets, and payoffs will be examined in terms of their sensitivity to loss and gain, as well as for trial by trial shifts. The effects of loss and gain will also be examined in relation to latency changes. To the extent that the variables refer to a common dimension of risk-conservatism, it is expected that they will be related to each other. The central expectation is that there will be a positive relationship between cautiousness and aging, irrespective of monetary incentives.

The design of the task considered the possible agitation and controversy which might have surrounded the introduction of a dice game with elderly people. For this reason, a Bingo-type game was introduced, which appeared to provide some similarity to church-related social activities of the elderly. The apparatus provided for fluctuations of chance. It was also simple to operate and to understand. Comparability with Lefcourt's (1965) payoff matrix was achieved by utilizing the 36 possible events in the throwing of two dice.

Two major criteria in selection of the aging sample were community residence, as an index of the normal, aging adult,

and socioeconomic similarity. Socioeconomic level indicated a variety of variables, e.g., social class, education, and intelligence. Thus an attempt was made to avoid psychiatric populations and substantial differences in social status.

CHAPTER III

METHOD

Subjects

Subject samples consisted of 40 older persons, aged 60-91, with a mean age of 73, and 40 younger persons, aged 19-34, with a mean age of 22. Each age group was comprised of two subgroups of 20 Ss each, differing with respect to monetary incentives. The older sample was selected from Houston recreational centers to satisfy the requirements of a non-institutionalized, ambulatory, and retired group of Ss. In addition, the elderly group presented no readily apparent physical disabilities which might have influenced the task. Although it was difficult to adequately assess their educational level, because of the non-equivalence of their schooling to present day standards, the elderly group appeared to be a generally well-informed and intellectually average to superior group. Their average schooling was estimated to be from one to two years of High School. In general, the older sample represented a middle class socioeconomic group, as indicated by area of residence and former occupation.

The younger group comprised a sample of undergraduate students enrolled at the University of Houston. An effort was made to select a younger sample which would parallel the elderly sample in general socioeconomic level, by reference to parental occupation. Finally, although it was anticipated

that the experimental results of the task would not be affected by the sex of the Ss, an attempt was made to represent approximately equal proportions of male and female Ss in the two groups. All Ss were Caucasian, and previously had volunteered to participate as paid Ss in psychological experiments.

Procedure

The Ss were assigned at random to each of the following experimental groups: Monetary Incentive (MI) and No Monetary Incentive (NMI), with the stipulation that equal numbers of aged and younger adults were to be represented in each group. Ss were run individually by the same female experimenter in a single session lasting approximately one hour. The investigation was conducted at the University of Houston for the young adults, and at the recreational centers for the older group. A quiet, private setting prevailed in all cases.

The risk taking task was introduced as a study in decision processes. Ss were seated beside the experimenter, and in front of a table which held the experimental apparatus. All Ss received an initial instruction period, during which they were familiarized with the nature of the stimuli and the experimental task. Instructions were read by the experimenter as follows:

> You are going to play a kind of Bingo game. When you turn the cage, a Bingo ball will be released. But before you turn it each time, you will decide two things: The first is which one of seven

> groups of Bingo balls will be released, and that will be either A, B, C, D, E, F, or G. (At this point, Ss were shown the payoff matrix, shown in Table 1, which was in view during the entire experiment.) The Bingo balls are marked with the numbers which appear directly under each of the alphabetical groups. Here are the winning numbers for A, B, C, etc. (Experimenter alternately pointed: at first the numbers, then the letters.) The second thing you decide is how much you want to play for, and that will be for either $.10, .20, .30, or .40 chips. Each time you have made these selections, place the appropriate chip on either A, B, C, D, E, F, or G marker. (At this point, Ss were shown the marker.) Your chances of winning, and amounts you can win for each of the seven groups have been worked out. (A detailed explanation of the payoff matrix followed, which was explained in terms of the probabilities and payoffs for the four wagers.) Each time, a new play will begin when I have said, "Begin, new game." Then you will make your decisions and turn the cage. When the Bingo ball is released, please hand it to me.

For those Ss studied under the MI condition, additional instructions were read as follows:

> You have been provided with chips worth $10.00. When a winning ball has been ejected from the cage, you will receive a payoff in chips for the designated amount. If you lose, you will forfeit your chip. This is what you win at the end of the entire series of games: If you have $10.00 or less, you keep 10% of that amount. If you have more than $10.00 left, you will keep $1.00, plus half of everything over it. For example, if you end with $15.00, you will have $1.00 + $2.50 = $3.50 profit. Since you will be playing for a stake worth actual money, what you will make from your participation in this experiment, is whatever you happen to win.

For those Ss who participated in the NMI condition, the following modifications were made in the above instructions:

> Please play the game as if the chips have real value. For your participation in the experiment, you will be paid $2.50.

TABLE 1

PAYOFF MATRIX

Play:	A	B	C	D	E	F	G
Wins on Numbers:	5 6 7 8 9	2 4 6 8 10 12	8 9 10	5 6	7	3 11	2 12
.10 pays	.05	.10	.20	.30	.50	.80	1.70
.20 pays	.10	.20	.40	.60	1.00	1.60	3.40
.30 pays	.15	.30	.60	.90	1.50	2.40	5.10
.40 pays	.20	.40	.80	1.20	2.00	3.20	6.80
Chances To Win:	2 in 3 (.67)	1 in 2 (.50)	1 in 3 (.33)	1 in 4 (.25)	1 in 6 (.17)	1 in 9 (.11)	1 in 18 (.06)

Upon completion of the preliminary instructions and explanations, Ss were asked if they understood; and to explain in their own words what their task would be. A check list was marked by the examiner as an indication that Ss understood the procedure. Questions were answered and further explanations provided, when necessary, until Ss satisfied the requirements of the check list. Three practice gambles followed, during which Ss made their bets and played the modified Bingo game. Finally, Ss were briefly interviewed.

The experimental stimuli consisted of a modified version of the payoff matrix used by Lefcourt (1965) which was based on a fair dice game. This procedure made all pertinent decision making information readily available to Ss, in respect to probabilities, amounts wagered, and expected payoffs. The payoff matrix was presented on a placard, with letters and numbers of sufficient size to be readily seen (see Table 1). The experimental task consisted of choosing between seven levels of probability and four wagers, totaling 28 combinations of payoffs. In contrast to Lefcourt's dice-throwing procedure, the present study utilized a Bingo cage which, when rotated by the S, ejected one of 36 well-mixed balls. By weighting the proportions of digits appearing on the 36 balls, the S achieved correspondence with the chance events of two fair dice. The cage contained 36 balls of the following description:

1 ball marked with the digit 2
2 balls marked with the digit 3

3 balls marked with the digit 4
4 balls marked with the digit 5
5 balls marked with the digit 6
6 balls marked with the digit 7
5 balls marked with the digit 8
4 balls marked with the digit 9
3 balls marked with the digit 10
2 balls marked with the digit 11
1 ball marked with the digit 12

The addition theorem in the mathematical approach to probability was applied in the case of grouped combinations representing the seven alternatives. For example, the probability of winning on the D group was given as either a 5 or a 6. Since there are 4 ways of obtaining a ball marked 5 (or 4 chances in 36), and 5 ways of obtaining a ball marked 6 (or 5 chances in 36), then 4/36 + 5/36 = 9/36, or 1/4, which is the probability level given in the payoff matrix. All probabilities were figured in terms of replacing the ball in the cage for each trial.

Apparatus

A circular wire Bingo cage contained 36 numbered wooden balls. The cage was equipped with a handle; when the S turned the handle, the cage revolved and ejected a single ball. Each ball fell into an automatic selector cup, and then was deposited in a chute. The S removed this ball from the chute, and then handed it to the experimenter, who returned the ball to the cage. This procedure was followed for 31 trials. The first trial was omitted from statistical analysis.

Latency of decision time was recorded by means of a clock with a unit value of .01 sec. The clock was started, stopped, and reset manually by the experimenter at inter-trial intervals.

Stimuli were presented via a payoff matrix, which was printed on poster board. The payoff matrix was designed to be a visual aid in making gambling choices; it remained in view during the entire experiment. The marker provided a designated circular space directly beneath each alphabetical category. These categories were associated with the probabilities shown on the payoff matrix. Thus, the categories A to G correspondingly indicated the range from higher to lower probabilities of success.

In order to simplify the response of placing chips on the marker, chips were both color-keyed and clearly labeled with the associated money value of the bets. Thus, blue, red, yellow, and white chips represented the $.40, .30, .20, and .10 bets, respectively. Each S initially received ten chips of each color, representing $10.00 worth of chips. A plastic box was provided for the chips.

CHAPTER V

DISCUSSION

Risk Taking Analyses

Probability. It was hypothesized that elderly people would differ from young adults in the degree of risk taking. This prediction was confirmed for the probability measure. The results demonstrated that risk taking was related to aging; when faced with the choice between relatively safer options and riskier courses of action, the elderly Ss, as compared to the young adults, showed a preference for the safer alternatives. These data on actual risk taking in a chance setting confirm studies of age-related cautiousness in hypothetical settings (Botwinick, 1966; Wallach & Kogan, 1961).

It should be noted that the aged selected more of the alternatives which, on an objective basis, were expected to occur more frequently, even though their objectively greater occurrence was offset by their association with a proportionately smaller payoff. It would thus appear that the aged were attempting to maximize the number of wins. On the other hand, the young adults appeared more chance-oriented, in terms of selecting a greater number of "long shots." The performance of the aged may be interpreted as belief in their own ability to control events, or disbelief in luck. This behavior contrasts with the performance of the young adults,

means to obtain the group means, the experimenter obtained equal N's for the outcome data.

Further analyses were also performed on each measure by combining the total mean scores, irrespective of win-loss outcome. However, since the functions of age and monetary incentive in these analyses were identical to those obtained in the win-loss analyses, only the latter findings will be reported.

Each of the analyses to be reported was a mixed factorial model, comprising an analysis of variance design with two between group factors (Age and Monetary Incentive) and one within group factor (Win-Loss trials). Since the design was a balanced factorial design with 20 Ss in each of four groups, an averaging procedure was defensible (Blommers & Lindquist, 1960). Relations between some of the measures were examined by computing Pearson product-moment correlation coefficients. Results will be commented upon only when significance attains the level of .05 or better.

Risk Taking Measures

Probability. In the first analysis, the dependent variable was the S's probability scores. These scores were derived from each S's mean choices of the seven alternative probabilities, or chances of winning for the series of 30 trials. Table 2 presents a summary of the analysis of variance for the probability measure as a function of Age, MI,

TABLE 2

ANALYSIS OF VARIANCE OF A PROBABILITY MEASURE OF RISK TAKING AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.12045	4.11*
MI (B)	1	0.02003	< 1.00
A x B	1	0.02328	< 1.00
Error (b)	76	0.02933	
Within Ss	80		
Win-Loss (C)	1	0.00431	1.20
A x C	1	0.00390	1.08
B x C	1	0.00588	1.63
A x B x C	1	0.01073	2.98
Error (W)	76	0.00380	
Total	159		

*$p < .05$

and Win-Loss. Only the main effect of Age was found to be significant ($F = 4.11$, df 1, 36, $p < .05$). Table 3 presents the means and standard deviations for the Elderly and Young Adult MI and NMI groups, respectively. As indicated in this table, the Elderly groups chose significantly higher probabilities of success in respect to risk taking than the Young Adult groups (Elderly Groups: $\bar{X} = .43$, Young Adult Groups: $\bar{X} = .38$). The MI variable was not significant. No interactions emerged between Age and MI. The Win-Loss variable also did not reach significance. No interactions between Win-Loss and Age or MI were observed.

Table 4 presents the comparison between the number of Win trials for the Elderly and Young Adult groups. As can be seen, the percentage of Win trials for the Elderly groups was significantly greater than for the younger groups (Mann-Whitney U Test, $z = 2.24$, $p < .025$, two-tailed). These data tend to confirm the fact that the older Ss, who chose the odds with the higher probabilities of success, experienced a greater number of wins than the younger Ss.

Bet. The bet measure involved the mean of each S's amount wagered ($.10 to $.40) across the 30 trials, regardless of the probability chosen. Table 5 presents the analysis for the bet measure. Inspection of this table indicates that the main effects of Age and MI were not significant, and no interaction for these variables emerged. However, the main effect for the Win-Loss variable was significant

TABLE 3

MEANS AND STANDARD DEVIATIONS OF PROBABILITY AND BET MEASURES

	Probability						Bet					
Groups:	Win		Loss		Total		Win		Loss		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Elderly-MI	0.42	0.12	0.44	0.13	0.43	0.12	0.28	0.08	0.26	0.08	0.27	0.08
Elderly-NMI	0.42	0.15	0.44	0.14	0.43	0.14	0.30	0.06	0.28	0.06	0.29	0.05
Young-MI	0.41	0.13	0.38	0.13	0.39	0.12	0.30	0.07	0.26	0.07	0.28	0.06
Young-NMI	0.34	0.12	0.37	0.11	0.36	0.10	0.27	0.07	0.26	0.07	0.26	0.06

TABLE 4

NUMBER, MEAN, STANDARD DEVIATION, AND PERCENTAGE OF WIN TRIALS

	Elderly			Young		
	MI	NMI	Total	MI	NMI	Total
Number of Win Trials	247	268	515	228	195	423
Mean	12.35	13.40	12.88	11.40	9.75	10.58
SD	3.64	4.91	4.33	3.78	4.02	4.01
%	41	45	43*	38	32	35*

*p = <.025, two-tailed test

TABLE 5

ANALYSIS OF VARIANCE OF A BET MEASURE OF RISK TAKING AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.00462	< 1.00
MI (B)	1	0.00030	< 1.00
A x B	1	0.01024	1.26
Error (b)	76	0.00812	
Within Ss	80		
Win-Loss (C)	1	0.02256	15.78*
A x C	1	0.00144	< 1.00
B x C	1	0.00196	1.37
A x B x C	1	0.00090	< 1.00
Error (w)	76	0.00143	
Total	159		

*$p < .001$

(F = 15.78, df 1, 76, $p < .001$). The means and standard deviations for the bet measure are presented in Table 3. When results for the MI and NMI groups are collapsed, it can be seen that all Ss, regardless of age, bet more after winning, and less after losing (Elderly Win: $\bar{X}$ = .29; Young Adult Win: $\bar{X}$ = .29; Elderly Loss: $\bar{X}$ = .27; Young Adult Loss: $\bar{X}$ = .26).

Inspection of the data revealed that a comparable amount of money was wagered by the two age groups (Elderly $\bar{X}$ = .28, Young Adult $\bar{X}$ = .27). Lower risk taking in elderly groups had emerged in terms of the probabilities chosen, as compared with the young adult groups. These findings suggested the possibility that the elderly, as compared with the young adults, might have wagered more money on the safer probabilities relative to the riskier ones. This consideration led to a within subjects analysis of the differing amounts of money bet on the safer probabilities (.67, .50, .33) as compared with the riskier probabilities (.17, .11, .06). In accord with Liverant and Scodel's (1960) procedures, a difference score was obtained for each S by subtracting the mean amount bet on the safer alternative probabilities from the mean amount bet on the riskier ones. The elderly wagered on the average $4.92 more on the safer alternative probabilities than on the riskier ones. The young adults wagered $4.14 more on the safer categories relative to the riskier alternatives. A Mann-Whitney U test based on the rankings of these

difference scores was not significant between the age groups (Elderly $\bar{X}$ rank = .39, Young Adult $\bar{X}$ rank = .41; z = .27, $p<1.00$) indicating no differential age effects for the amount of money wagered on risky alternatives.

Payoff. The payoff measure was comprised of the odds x the amount bet. The results of the payoff analysis appear in Table 6. Inspection of this table reveals that none of the main effects or interaction variables attained significance. The means for the payoff analysis can be found in Table 7. This analysis fails to confirm Lefcourt's (1965) major measure of risk taking. Since the payoff measure is the product of both the probability-odds and bet, certain combinations of results in these two indices can preclude significant findings with a payoff measure.

Response Latency

The latency score comprised the mean latency of decision time taken to respond by choosing one of the alternative probability categories and by making a bet. A decision was considered to have occurred when the S was observed to place a single chip on the marker directly beneath the designated category of choice, following the experimenter's signal to begin a new trial.

A summary of the analysis for response latency is presented in Table 8. Inspection of this table indicates that the main effect of Age was highly significant (F = 11.45,

TABLE 6

ANALYSIS OF VARIANCE OF A PAYOFF MEASURE OF RISK TAKING AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.04624	< 1.00
MI (B)	1	0.00930	< 1.00
A x B	1	0.02070	< 1.00
Error (b)	76	1.22836	
Within Ss	80		
Win-Loss (C)	1	0.09506	< 1.00
A x C	1	0.23562	1.63
B x C	1	0.28224	1.87
A x B x C	1	0.13924	< 1.00
Error (w)	76	0.15058	
Total	159		

TABLE 7

MEANS AND STANDARD DEVIATIONS OF LATENCY AND PAYOFF MEASURES

	Latency						Payoff					
Groups:	Win		Loss		Total		Win		Loss		Total	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Elderly-MI	5.19	3.57	4.83	2.37	4.98	2.66	0.90	0.67	0.80	0.75	0.85	0.71
Elderly-NMI	4.78	2.84	4.18	2.04	4.44	2.37	0.96	1.32	0.81	0.75	0.83	0.83
Young-MI	2.97	2.02	2.93	1.64	2.94	1.78	0.82	0.70	0.99	0.83	0.95	0.77
Young-NMI	3.44	1.47	3.18	1.40	3.26	1.38	0.96	0.79	0.84	0.62	0.87	0.59

TABLE 8

ANALYSIS OF VARIANCE OF A RESPONSE LATENCY MEASURE AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	104.70073	11.45*
MI (B)	1	0.28308	< 1.00
A x B	1	8.05060	< 1.00
Error (b)	76	9.14273	
Within Ss	80		
Win-Loss (C)	1	4.02907	3.36
A x C	1	1.08079	< 1.00
B x C	1	0.52785	< 1.00
A x B x C	1	0.00006	< 1.00
Error (w)	76	1.19975	
Total	159		

*$p < .005$

df 1, p .005). Table 7 reveals that the Elderly group means were higher than Young Adult group means (Elderly MI: $\bar{X}$ = 4.98, Elderly NMI: $\bar{X}$ = 4.44; Young Adult MI: $\bar{X}$ = 2.94, Young Adult NMI: $\bar{X}$ = 3.26), confirming an aging effect in respect to lengthy decision time. No other significant effects emerged in this analysis.

Variability

Probability shifts. The dependent variable was the S's trial-by-trial difference scores derived from the changes or shifts between his choices of the seven alternative probabilities across the series of trials. The differences between the probability chosen and the preceding choice were summed algebraically. A mean for each S was computed separately after winning and after losing trials. The amount of the difference indicated the magnitude of the shift. Signs affixed to the scores indicated the direction of the shift (+, -). The results of the trial-by-trial differences in probability shifts appear in Table 9. Inspection of the analysis reveals that only the main effects of the Win-Loss variable attained significance (F = 106.52, df 1, 76, p .001). Table 10 contains the means and standard deviations for the probability shifts. When results for the MI and NMI groups are collapsed, it is evident that both age groups had similar patterns of differences (Combined Elderly groups, Win: $\bar{X}$ = -.09; Combined Elderly groups, Loss:

TABLE 9

ANALYSIS OF VARIANCE OF TRIAL BY TRIAL SHIFTS IN PROBABILITY SELECTIONS AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.00121	< 1.00
MI (B)	1	0.00020	< 1.00
A x B	1	0.00361	2.23
Error (b)	76	0.00162	
Within Ss	80		
Win-Loss (C)	1	0.78400	106.52*
A x C	1	0.00042	< 1.00
B x C	1	0.00441	< 1.00
A x B x C	1	0.00600	< 1.00
Error (w)	76	0.00736	
Total	159		

*$p < .001$

TABLE 10

MEANS AND STANDARD DEVIATIONS OF SHIFTS IN PROBABILITY AND BET MEASURES

	Probability				Bet			
Groups:	Win		Loss		Win		Loss	
	M	SD	M	SD	M	SD	M	SD
Elderly MI	-0.10	0.08	0.06	0.04	0.01	0.04	-0.01	0.02
Elderly NMI	-0.07	0.07	0.05	0.04	0.00	0.04	0.00	0.03
Young MI	-0.09	0.08	0.05	0.06	0.00	0.03	-0.01	0.02
Young NMI	-0.10	0.10	0.05	0.05	0.01	0.06	0.01	0.02

$\bar{X}$ = .06; Combined Young Adult groups, Win: $\bar{X}$ = -.10; Combined Young Adult groups, Loss: $\bar{X}$ = .05). All four groups of Ss differentially shifted the choice of probability level depending on the outcome of the preceding trial. Following a win, Ss lowered the probability chosen, thereby increasing the risk, whereas following loss, Ss increased the probability, thereby decreasing the risk taken. Neither age nor monetary incentive had a bearing on their behavior.

Betting shifts. The changes in betting from trial to trial were summed in the same fashion as the probability shifts. Each S's algebraic difference score was computed separately after win and after loss. The analysis for betting changes is presented in Table 11. The means for this analysis can be found in Table 10. It is evident from the results that none of the main effects or interactions between Age, MI, and Win-Loss attained significance.

Payoff shifts. Analogous computations applied to the probability and bet shift scores were derived for the payoff shifts. Table 12 contains the analysis of variance for the payoff shifts. The results of this analysis indicate that only the main effects of the Win-Loss variable were significant (F = 56.70, df 1, 76, $p < .001$). Table 13 presents the means and standard deviations for these data. It is evident that all groups, regardless of Age or MI, shifted up in direction and magnitude of payoff after winning, and down in direction and magnitude after losing (Wins: Elderly MI:

TABLE 11

ANALYSIS OF VARIANCE OF TRIAL BY TRIAL SHIFTS IN BET SELECTIONS AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.00006	< 1.00
MI (B)	1	0.00036	< 1.00
A x B	1	0.00121	2.90
Error (b)	76	0.00042	
Within Ss	80		
Win-Loss (C)	1	0.00484	2.22
A x C	1	0.00081	< 1.00
B x C	1	0.00090	< 1.00
A x B x C	1	0.00020	< 1.00
Error (w)	76	0.00218	
Total	159		

TABLE 12

ANALYSIS OF VARIANCE OF ALGEBRAIC TRIAL BY TRIAL SHIFTS IN PAYOFF AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.00518	< 1.00
MI (B)	1	0.00086	< 1.00
A x B	1	0.03221	< 1.00
Error	76	0.08073	
Within Ss	80		
Win-Loss (C)	1	16.68617	56.70*
A x C	1	0.18975	< 1.00
B x C	1	0.09555	< 1.00
A x B x C	1	0.10972	< 1.00
Error (w)	76	0.29413	
Total	159		

*$p < .001$

TABLE 13

MEANS AND STANDARD DEVIATIONS OF SHIFTS IN LATENCY AND PAYOFF MEASURES

	Latency				Payoff			
Groups:	Win		Loss		Win		Loss	
	M	SD	M	SD	M	SD	M	SD
Elderly-MI	0.28	1.66	-0.22	1.11	0.54	0.54	-0.28	0.27
Elderly-NMI	0.37	0.83	-0.46	0.87	0.41	0.72	-0.20	0.30
Young-MI	0.11	0.38	-0.15	0.26	0.38	0.45	-0.20	0.29
Young-NMI	0.27	0.57	-0.15	0.26	0.42	0.46	-0.17	0.17

$\bar{X}$ = .54, Elderly NMI: $\bar{X}$ = .41; Young Adult MI: $\bar{X}$ = .38, Young Adult NMI: $\bar{X}$ = .42; Losses: Elderly MI: $\bar{X}$ = -.28, Elderly NMI: $\bar{X}$ = -.20; Young Adult MI: $\bar{X}$ = -.20, Young Adult NMI: $\bar{X}$ = -.17).

Latency changes. The dependent variable was the S's trial-by-trial difference scores obtained from changes in decision time across the series of trials. Parallel computations applied to the risk taking shift scores were derived for the response latency changes. Table 14 contains the analysis of variance for the response latency changes. The results of this analysis indicate that only the main effects of the Win-Loss variable were significant ($F = 7.48$, df 1, 76, $p < .01$). Table 13 contains the means and standard deviations for these data. As indicated in the table, all groups, regardless of Age or MI, responded differentially with changes in decision time after winning or losing. As can be seen, the difference scores differed significantly between win-loss trials (Wins: Elderly MI, $\bar{X}$ = .28, Elderly NMI, $\bar{X}$ = .37; Young Adult MI, $\bar{X}$ = .11, Young Adult NMI, $\bar{X}$ = .27; Losses: Elderly MI, $\bar{X}$ = -.22, Elderly NMI, $\bar{X}$ = -.46; Young Adult MI, $\bar{X}$ = -.15, Young Adult NMI, $\bar{X}$ = -.15). The positive difference scores after win indicated that latency on the trial following win increased, whereas the negative difference scores after loss indicated that the latency value was less than that of the previous trial following loss.

TABLE 14

ANALYSIS OF VARIANCE OF TRIAL BY TRIAL CHANGES IN LATENCY AS A FUNCTION OF AGE, MI, AND WIN-LOSS

Source	df	M.S.	F
Between Ss	79		
Age (A)	1	0.02730	< 1.00
MI (B)	1	0.00018	< 1.00
A x B	1	0.24780	1.54
Error (b)	76	0.16112	
Within Ss	80		
Win-Loss (C)	1	10.07514	7.48*
A x C	1	1.05138	< 1.00
B x C	1	0.58443	< 1.00
A x B x C	1	0.07439	< 1.00
Error (w)	76	1.34765	
Total	159		

*$p < .01$

Correlations

In order to determine whether the probability and bet measures were related, correlations were computed for these measures. Because of significant differences in effects of winning and losing on the bet measure, the probabilities and bets chosen following win and following loss trials were computed separately. The first correlation to be described represents the degree of association between the probability and bet measures for all 80 Ss. The overall correlation value between these variables indicated a nonsignificant negative relationship for win ($r = -.10$, $p > .05$) and a significant, but low negative correlation for loss ($r = -.26$, $p < .05$). While there is thus a slight tendency for bets and probability to have an inverse relationship, such low correlations also indicate relative independence of the probability and bet measures. The question arose as to whether a differential age effect was contributing to this phenomenon. Therefore, separate correlations for each age group were computed on these variables. The results indicated a similar low nonsignificant negative correlation following win between the bet and probability measures for both age groups (Young Adult Groups: $r = -.12$, $p > .05$; Elderly Groups: $r = -.09$, $p > .05$). Following loss, these variables were associated at a significant low (negative) level for young adults ($r = -.36$, $p < .05$), and a nonsignificant (negative) level for the elderly ($r = -.26$, $p > .05$). These additional correlations computed

for each age group indicated that no differential age effects prevailed. With respect to the fact that age group differences were found in the mean probability levels chosen, the present data indicate that, regardless of the probability levels chosen, independence between the bet and probability measures was evident. Finally, the degree of inverse relationship appeared somewhat higher after loss.

Since separate analyses had indicated that both the probability chosen and the response latency of decision time were functions of age, it seemed worthwhile to explore for a relationship between these measures. Therefore, correlations were computed for these two variables. These correlation values proved to be nonsignificant for both age groups (Elderly: $r = -.10$, $p > .05$; Young Adults: $r = .00$); thus, there was no evidence of a relationship between the probability risk taking measure and response latency of decision.

Consideration of the win-loss effects, in terms of the shifts in probability following winning and losing for both age groups, relative to such effects on response latency, led to an additional examination of correlations between these variables. For all 80 Ss, relationship between shifts in probability and changes in response latency was negative, and just barely significant ($r = -.23$, $p < .05$). A significant negative correlation value of similar magnitude was obtained between these variables after losing trials

(r = -.28, $p < .02$). These correlations suggest that there is a tendency for Ss who make larger shifts towards taking greater risks to also change in the direction of requiring more decision time.

CHAPTER V

DISCUSSION

Risk Taking Analyses

Probability. It was hypothesized that elderly people would differ from young adults in the degree of risk taking. This prediction was confirmed for the probability measure. The results demonstrated that risk taking was related to aging; when faced with the choice between relatively safer options and riskier courses of action, the elderly Ss, as compared to the young adults, showed a preference for the safer alternatives. These data on actual risk taking in a chance setting confirm studies of age-related cautiousness in hypothetical settings (Botwinick, 1966; Wallach & Kogan, 1961).

It should be noted that the aged selected more of the alternatives which, on an objective basis, were expected to occur more frequently, even though their objectively greater occurrence was offset by their association with a proportionately smaller payoff. It would thus appear that the aged were attempting to maximize the number of wins. On the other hand, the young adults appeared more chance-oriented, in terms of selecting a greater number of "long shots." The performance of the aged may be interpreted as belief in their own ability to control events, or disbelief in luck. This behavior contrasts with the performance of the young adults,

who ignored the objective probabilities of winning more than did the elderly. It is relevant to point out that the selection of higher probabilities did, in fact, lead to being right the greater number of times, as reflected by the higher proportion of winning trials achieved by the elderly, as compared to the young adults.

A need for achieving correctness of response has been attributed to cautiousness in the aged in various studies (e.g., Eisdorfer, 1965, Korchin & Basowitz, 1957). However, this presumed aging effect has generally been reported in the context of speed and accuracy in learning. The present experiment presents additional evidence for an age-related emphasis on correctness of response in terms of cautiousness in a gambling situation.

In general, the probability data confirm cautiousness as an aging phenomenon. However, the results of the bet measure, as a second index of choice in risk taking, cast doubt on the existence of any simple relationship obtaining between risk taking and aging.

Bet. It may be noted that instructions in the present experiment emphasized that Ss must make two choices: the probability of obtaining a Bingo ball, and the amount to be wagered. In contrast to the aging effect in probability preferences, there were no differences between the age groups on the bet measure. These rather paradoxical findings for the two risk taking measures are comparable to results

obtained with similar matrices in the dice throwing experiments with young adult Ss (Lefcourt, 1965; Liverant & Scodel, 1960).

Lefcourt accounted for the failure of the betting measure to depict risk taking by implying that the $.10, .20, .30, and .40 bets contained a "restricted range of choices offered (p. 768)." However, Liverant and Scodel (1960) inferred that the amount bet reflected the degree of confidence in decision making. These investigators later reanalyzed the bet data by comparing the amount of money wagered on safer categories relative to the riskier alternatives. In the present experiment, this further analysis was made for the bet measure. Results indicated that the aged bet as much money on the riskier alternatives as the younger adults. The fact that the bets varied markedly depending on whether a bet was preceded by a winning or losing trial affirms the utility of the bet measure.

Insofar as the amount bet is assumed to reflect confidence in risk taking, there was thus no evidence that the elderly were less confident in their general approach to risk taking than were younger people. The present results thus suggest that probability preferences in risk taking and confidence in these choices may be fairly independent of one another, as was indicated by the low correlation between the bet and probability chosen. This conclusion was also implied by the Wallach and Kogan (1961) findings that risk taking and

confidence of judgment are unrelated for both elderly and young adult groups. These authors have commented that "the trend toward conceptual convergence of the domains of judgment and decision making is without empirical basis for the particular measures employed in the present study (p. 35)."

With regard to success and failure, it is of interest that Wallach and Kogan's index of deterrence of failure reflects not only deterrence of failure but also desirability of success. It is clear that dimensions of both success and failure enter into the formulation of the index, and these dimensions are of considerable conceptual significance. It would therefore be instructive to examine risk taking behavior under conditions that are differentiated by effects of either success or failure. Although their paper and pencil procedure did not permit this, the present gambling procedure allowed an examination of risk taking behavior following either winning or losing trials. All age groups evidenced comparable win-loss effects on the bet measure, betting more after winning and less after losing. However, it should be recalled from the results of the probability measure that there were no win-loss effects on it. In addition, low negative correlations were obtained between the bet and probability measures for both elderly and younger groups, irrespective of success and failure.

It would thus seem likely that success and failure have little or no aging effects on risk taking per se, but do

exert influence on the level of confidence. Age, apparently, does not affect the tendency to respond with greater confidence after success and lesser confidence after failure. As Kogan and Wallach (1964) have implied, paper and pencil tests and subjective judgment encompass a restricted set of decision making variables, as compared with payoff consequences.

In terms of the present results, it can be seen that the use of hypothetical risk taking procedures may lead to some questionable conclusions about the elderly. Because Wallach and Kogan (1961) label a risk taking index "deterrence of failure," there is the possibility that it will be mistakenly assumed that the lower risk taking level in the elderly is somehow related to failure. The present findings contraindicate such an impression. It is important to note that choice of probability, the index most directly reflecting risk taking, was not sensitive to success and failure, whereas magnitude of bets, an index of confidence, was.

Monetary Incentives

Of principal interest was the finding that monetary incentives had no effect on risk taking. While this was in accord with expectations for the aged group, it was anticipated that the influence of monetary incentives would be most prominently displayed by greater risk taking in the young adult group, which received no monetary incentives, as compared with the young adult group which did receive monetary

incentives. None of the risk taking measures was significant for the monetary incentive variable. Why this variable did not differentially affect risk taking in young adults is not immediately apparent. The bulk of the literature with undergraduate Ss suggests that a conservative trend results from the influence of monetary reinforcements in a chance situation. However, there have been conflicting findings on this point.

The present results are consistent with the Katz (1962) findings for young adults. Katz has provided compelling evidence that, when costs and gains are manipulated in both a monied chip condition and a worthless chip condition, a conservative trend results in both conditions. One explanation of the negative results in the present experiment is that the incentive value of the chips without money was similar to that for the chips with money. Another explanation for the failure of the monetary incentive variable may be related to various methodological differences. The present results were not in accord with those of Goldstein and Siegel (1959), who reported that monetary reinforcement produced greater conservatism in their college groups than did a condition of no monetary reinforcement. In their experiment, costs and gains were not manipulated. Ss won or lost five cents depending on the outcome of their predictions in a light guessing task. It should also be noted that the 300 trials of their experiment, as compared with the 31 trials of the present study,

may have produced boredom for Ss in the no monetary reinforcement condition. Boredom has been associated with greater risk taking (Slovic, Lichtenstein, & Edwards, 1965). Finally, in the present study, there were no cash rewards until the conclusion of the experiment, and thus the particular value of monetary payoff as an incentive might have been attenuated. This consideration might also have bearing on the fact that no significant payoff differences were found. The instructions to the groups which received no monetary incentives to "play the game as if the chips have real value" may have had some influence on the Ss' set. Although the expected similarity in risk taking with and without monetary incentives among the elderly was found, methodological questions render this finding ambiguous.

Latency

The analysis of decision time indicated that longer latencies occurred for the aged than for the young adult groups. This finding may be interpreted as an effect of the normal aging process, which has been described as a general slowing down, with more time required to make decisions. Birren, Riegel, and Morrison (1962) have concluded that this reduction of speed factor emerges with age. With increasing age, people tend to show a characteristic slowness of response, regardless of the nature of the task. The importance of the present data for aging would thus seem to be that in decision time, as with other tasks, elderly people

show this characteristic reduction in speed. These data also seem to confirm Chown's (1961) theoretical view that the limitations of speed with age involve both association time and the time to select the appropriate response.

It may be recalled that other investigators suggested that the aged tended to delay response in order to avoid the possible effects of error (Eisdorfer, 1965; Korchin & Basowitz, 1957). In general, they have concluded that age differences in confidence and uncertainty are reflected by the tendency to withhold response. The present data on latency apparently uncover a different aspect of this problem. As revealed by the bet data, elderly people do seem to reach the same level of confidence as younger Ss, and therefore show no evidence of greater uncertainty. However, the probability data would indicate that they have a greater need for positive outcomes. Rotter and Mulry (1965) have noted that the person "with more involvement in being correct would spend more time comparing the alternatives (p. 599)." The present findings suggest that it is safe to assume that the elderly people were not more uncertain than the young adults. Older people did take longer to decide but, once having concluded the decision making process, they were as certain as younger people. Therefore, uncertainty may reside in the period of reaching a decision, but not in the decision itself.

The basic assumption underlying the use of response latency measure is that response times are a faithful

reflection of decision times. If this is true, older people may require more time to rehearse and review the materials before attaining the same level of certainty as that of younger people.

Variability

It was expected that elderly people would differ from young adults in shift behavior. For both payoff and probability shifts, this expectation was not confirmed. In contrast with the Davis (1967) findings--that with a performance task elderly people, as compared with young adults, decreased their goals after success--the present research did not confirm such an aging effect in a chance setting. Furthermore, both age groups evidenced similar patterns after either winning or losing. The shifts of probability in both age groups were downwards toward the higher risk alternatives after winning, and upwards in the direction of lower risk taking after losing. These results suggest that age does not affect susceptibility and adaptability to success-failure cues which provide information or feedback for future risk taking behavior.

It should be recalled from the probability data that elderly Ss were more conservative than younger Ss. The win-loss effects on probability shifts provide clarification of the boundaries of this conservatism. These data suggest that, within the elderly S's characteristic conservative

behavior, there is flexibility, and this flexibility is comparable to that encountered in younger, less conservative Ss. The present study would thus indicate that, contrary to popular belief, elderly people are not necessarily rigid in their approach to some aspects of the external situation. They were found to be as capable of shifting as were the younger people. These results are compatible with Botwinick's (1962) findings with respect to perceptual shift phenomena. He found that, under structured conditions, elderly Ss were capable of flexibility. Insofar as winning and losing provide unambiguous knowledge of the results of decision making, the present chance setting demonstrated that older people could monitor their behavior in the same fashion as that of younger people. While Chown (1961) did find evidence of rigidity in her large-scale study of older people, she emphasized that rigidity was more closely related to intelligence than to chronological age.

That betting shifts were not significant appeared to be the product of Ss' reluctance to alter bets. Although success and failure did affect bet levels, a bet level, once established, tended to be retained for several trials, whether the S won or lost. In addition, it was noted impressionistically that Ss occasionally shifted both extremely and paradoxically. Modifications in bet levels were evidently less systematic and more infrequent than probability and payoff shifts.

Changes in latency parallel those obtained on probability and payoff shifts. All Ss, irrespective of age, changed decision time by extending it after winning, and reducing it after losing. Once again, the aged Ss adapted in a manner no different from that of younger Ss. It is also of interest to note that overall latencies of older Ss were longer than those of younger Ss. Despite this difference, latency change behavior did not differ between the groups. The aged individuals in this study did show a general slowing, but it was also indicated that they were able to vary the latency in accord with environmental events. An additional point may be made of the consistency of the relationship between shifts in probability and changes in latency. Despite the marked effects of success and failure on both of these measures, under either the influence of success or failure, a relationship was obtained between the measures. For Ss who shifted probabilities more, either toward greater or lesser risk, the latency changes were correspondingly toward greater or lesser decision times.

The findings that probability preferences were differentially affected by age differences on a risk-conservatism dimension provides partial support for the internal control orientation conceptualized in Rotter's Social Learning Theory (1954). Internal control has been related to a cautious selection of probabilities in young adult gambling studies (Lefcourt, 1965; Liverant & Scodel, 1960). On the internal

control basis, it might be contended that the aged ordered a chance-determined situation into one involving some elements of skill. This possibility might account for their attempts to make correct predictions by maximizing wins.

It is interesting to note, however, that the occurrence of "unusual shifts" predicted by a high risk, external orientation (Lefcourt, 1965) did not differentiate the age groups. Both the elderly and the young adults conformed more to the "internal" orientation by a predominance of the "usual shift" pattern of selecting higher risk levels after winning and lower risk levels after losing. In this regard, interpretation of the present data in terms of the internal-external control dimension remains ambiguous.

The chance setting contributed valuable insights concerning risk taking and the effects of aging. It would appear that future studies of risk taking with aging people might profit more from use of the chance situation than of the hypothetical situation. Additional variables relevant to risk taking, such as cognitive-judgmental aspects, simplicity-complexity, and various personality dimensions might also be studied. Further investigations of the effects of monetary incentives are also necessary. Comparisons of risk taking over the entire adult life span would be valuable in terms of specifying a developmental age function for risk taking.

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