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Individual differences in impulsiveness : a conceptual and empirical analysis.

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INDIVIDUAL DIFFERENCES IN IMPULSIVENESS:
A CONCEPTUAL AND EMPIRICAL ANALYSIS

A Dissertation Presented

by

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DEDICATION

To Rick, for reminding me of the large delayed reward of finishing this project, and for making sure I had the time to do it.

To Tom, my favorite small immediate reward, for taking long naps and being cheerful when awake, and to our newest family member, whose impending arrival ensured the completion of this project.

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ABSTRACT

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Impulsive behavior is a common theme in psychology, but human decision making, animal choice, foraging, and personality research define and measure impulsiveness differently. The first goal of this study was to determine how much agreement exists between impulsiveness measures based on these different perspectives.

A review of these literatures suggests that individual differences in sensitivity to rate of reward and punishment may be an important factor in impulsive decision-making. The second goal of the present study was to investigate this possibility.

College undergraduates (n = 159) responded to a four-part questionnaire. The first part was a series of duplex bets that assessed each subject's relative attention to four risk dimensions: amount to win, amount to lose, rate or probability of winning, and rate or probability of losing. The second part of the

questionnaire represented the common definitions of impulsiveness in decision theory with 20 items posing hypothetical choices between immediate and delayed rewards. The third part was the 42-item Eysenck Impulsivity Scale used in personality research. Finally, subjects responded to a single 7-point self-rating of impulsiveness, and gave examples of impulsive and unimpulsive behavior.

The decision theory items and personality measure of impulsiveness were very weakly related. The findings suggest that reliability and validity issues with regard to hypothetical choices of this type should be investigated carefully before using them in further research.

Regarding the suggestion that individual differences in sensitivity to rate account for impulsive behavior, the results of the study indicate that impulsive individuals may instead be particularly sensitive to punishment or cost. When unavoidable cost is explicitly associated with reward, as in the choices in the duplex bets and hypothetical choices in the questionnaire, impulsives weight that information heavily, but in many everyday decision situations, like those described in elicited examples, they may actively avoid cost considerations, which leads to rapid action, sometimes with objectively negative outcomes.

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CHAPTER I

INTRODUCTION

Ever since Esau traded his birthright to Jacob for a mess of pottage, we have been aware of individual differences in human impulsive behavior. More formal study of these differences has been much slower to arise however, and the fields of psychology and economics are just beginning to explore the patterns and inconsistencies of impulsive behavior. The possibilities for exploration of the concept of impulsiveness are almost as numerous as the meanings attached to the term. Impulsiveness has been investigated in several different areas of psychology, and from different perspectives.

Two major perspectives will be considered here. One is that of decision theorists, who are concerned with universal tendencies to make impulsive choices in particular situations. The tradition of the "economic man" has focused on human responses to situational variables, mainly in terms of money or goods that can be traded for money. Decision theory has, for the most part, adhered to that tradition, and concerned itself with the concrete situational variables that influence choice.

On the other hand, personality theory is primarily interested in stable individual differences in dispositions or tendencies to behave in certain ways.

Many of these tendencies are difficult to measure and/or test experimentally, but there is little question that humans are susceptible to psychological variables such as emotions, expectations, and desires, and that these differ widely for different individuals.

It is important to recognize the strengths and weaknesses of each approach while exploring what each has to say about a particular concept, in this case, impulsiveness. This discussion will concentrate on the contributions of each perspective to an understanding of individual differences in impulsive choice behavior.

Impulsiveness in Decision Theory

For most decision theorists, impulsiveness is defined as the preference of a smaller, more immediate reward over a larger, more delayed reward (e.g. Logue, 1988; Ainslie, 1974; Rachlin & Green, 1972). Impulsive behavior in this sense contradicts many of the assumptions of traditional economic theory, and has engendered a large body of research in the field of decision theory. Very little of that literature has even suggested the notion of individual differences in decision-making styles, however, much less explored such differences or incorporated them into theory.

Some paradigms for the study of human decision-making and impulsiveness will be examined first, then animal choice research will be reviewed.

Human Decision Making

Cognitive Factors. One body of literature relevant to a discussion of individual differences in impulsive behavior is concerned with the individual's perceptions or beliefs about the choice situation. Although situational factors, such as the context or wording of a problem, are considered in this literature to govern cognitive and behavioral responses, only a small stretch of the imagination is needed to envision a more egalitarian interaction between individual and situational factors.

Most decision making paradigms consist of presenting hypothetical situations to subjects and giving them a choice of responses. For example, subjects may be asked to choose between receiving $100 now and receiving $200 in two years. Most subjects choose the immediate reward. Interestingly, if subjects are given the choice between $100 in six years and $200 in eight years, most subjects prefer the larger, more delayed reward, despite the fact that the distance between the two rewards is still two years. Preference reversal (Ainslie, 1975; Ainslie & Herrnstein, 1981), as this phenomenon is called, is the tendency for a reward to become more attractive as it becomes more available. When both rewards are delayed, the relative discounting of the more delayed reward is small. But as the small reward becomes closer in time (more available),

subjects' preferences usually shift toward the small reward. In other words, the subjects' perspective contributes to decision making.

The class of subjectively expected utility (SEU; discussed in Abelson & Levi, 1985) models represents a more explicit acknowledgment of the importance of psychological variables in decision making. SEU paradigms commonly require subjects to supply their own probability estimates for uncertain outcomes, such as whether it will rain on a particular day, or, given objective probabilities (such as 80% chance of rain), to rate the value of the potential outcomes. Although such models have been heavily criticized for their failure to account for actual behavior, SEU is notable in that it sets the stage for the recognition of individual differences in assessment of choice situations. Proposed successors to SEU include portfolio theory (Abelson & Levi, 1985), which bases its predictions on individual differences in risk preference, and prospect theory (Kahneman & Tversky, 1979), in which decisions under risk are affected by the individual's "framing" of the problem.

Framing effects are based on an individual's reference point with regard to a choice. For instance, when asked to choose between a treatment that will save 200 of 600 epidemic victims, and a treatment which will allow 400 to die, most subjects choose the first

alternative, despite the fact that the outcomes of both treatments are the same. Framing effects have been demonstrated in more naturalistic experiments, using $7 gift certificates for a record store as reinforcers for college students (Loewenstein, 1988). The certificates were to be delivered to the students in one, four, or eight weeks. Subjects were then given choices about trading their certificates for larger, but more delayed certificates, and smaller, more immediate certificates. On average, the increased value required by the subjects for a more delayed certificate was three to four times the cost they were willing to incur for getting the certificate sooner. In other words, they were resistant to delay, but were also relatively uninterested in speeding up the reward once they had formed an expectation to receive the certificate at a particular time. Subjects had framed the problem in terms of the point at which they expected to consume, and any deviation from this was relatively undesirable. Framing effects can result from the wording of a problem on a questionnaire, for example, or from recent experience with similar problems (the $5 lost in the first game of blackjack is more highly valued than $5 lost in the attempt to recover from an accumulated $100 loss). Framing research provides information about the relative contributions of reinforcer delay and magnitude in human impulsive behavior, as well as demonstrating the special

contributions of psychological variables such as expectations.

One criticism of prospect theory, relevant to the current investigation and applicable to many decision research paradigms, is its reliance on "one-shot bets" -- single decision items. Laboratory subjects typically avoid risky alternatives in one-shot bets. However, they tended to prefer risky alternatives when the same bet was to be repeated ten times (Keren & Wagenaar, 1987). Rachlin (1990) presents a theory which suggests that strings of gambles affect the subjective valuation of individual gambles. In other words, although the value of an individual gamble is objectively negative, a gambler may perceive it as part of a subjectively positive series. The idea that many decisions may be part of a series of other choices will be discussed in more detail below.

Although the above theories have little or nothing to say about impulsiveness, and are in many ways inadequate in dealing with basic choice phenomena, the movement toward recognizing the contributions of individual differences and psychological variables is notable, and relevant to the present discussion.

Emotional Variables. Another recent example of recognition of the importance of subjective evaluation in the choice situation is based on temporal externalities such as regret, rejoicing, disappointment

(Loomes & Sugden, 1982), and savoring and dread (Loewenstein, 1987) which are by-products of decision-making that have value in their own right. The experience or expectation of such emotional responses can explain why people put off pleasurable events or rush to get unpleasant events over with. Elster (1985) suggests that impulsive decisions could be the result of the lack of influence of temporal externalities such as disappointment and savoring. For example, the emotions involved in waiting for a delayed reward may be highly unpleasant for some people, so that settling for a smaller reward makes up in emotional terms what is lost in reward quality. The explicit recognition of the importance of psychological variables, both cognitive and emotional, in decision research represents an important broadening of decision theory.

Operant Research in Humans. Another research direction is rooted in the operant learning tradition. In this paradigm, human subjects are studied in experimental situations similar to those used for animals. This methodology allows for meaningful comparisons between animal and human results, and for careful control of experimental variables. Some of the most rigorous attention to comparability has been demonstrated by Logue, King, Chavarro, and Volpe (1990) in recent studies of impulsiveness/self-control. Previous studies often used points exchangeable for

money as reinforcers, but this practice can be criticized as involving a very different kind of reinforcement from that in animal studies, where a deprived animal works for immediately usable food. In Logue et al.'s experiment, food- and water-deprived college students operated a mechanism to receive a juice reinforcer. Subjects were given as little instruction as possible, in order to minimize experimenter effects and increase the comparability to animal studies. The mechanism was designed so that alternative responses would lead to brief, immediate access or longer, delayed access to the reinforcer. Substantial individual differences were displayed in subjects' patterns of responding, i.e., some subjects preferred the self-control response exclusively, others preferred the impulsive response, and others showed intermediate preferences. In a follow-up study, paper-and-pencil measures of self-control, locus of control, dieting, desire for the reinforcer, etc., did not correlate with impulsive or self-control responses (Bonvino & Logue, 1990). These experiments are landmarks in two ways. First, most human research based on operant paradigms shows consistent self-control responding and little or no impulsiveness (Logue et al., 1990; for an exception see Solnick, Kannenberg, Eckerman & Waller, 1980). The careful methodology of the experiments of Logue et al. seems to have removed many of the situational demands

for a particular style of responding that led to self-control tendencies in previous studies. Second, these experiments are unusual in explicitly demonstrating and discussing individual differences in relation to impulsive behavior. Although the initial attempts at finding correlates of individual differences in impulsiveness did not succeed, Logue, et al.'s experiments are an important new direction in a field previously concerned only with situational variables.

Animal Choice Research

Operant Research in Animals.

Animal choice research is useful because it permits extensive exploration of the influence of different characteristics of reinforcement on behavior. Models are proposed, and are supported or refuted by results from carefully controlled studies of behavior. Human choice research is in danger of confounding by highly idiosyncratic cognitive factors and varied past experiences whose existence and importance are generally unknown and uncontrolled by the experimenter. In contrast, animal studies offer an opportunity to control past experience, and little concern that subjects' interpretations of the experimental situation might affect their behavior. Most animal studies are of course performed with rats and pigeons, although field and laboratory work on foraging patterns takes advantage of a wider range of species. Impulsiveness in

particular is a common topic for study. Subjects are trained to choose between a small, immediate reward and a large delayed reward. Interestingly, most studies of this kind show clear evidence of preference for immediate rewards (Logue, et al., 1990).

There are at least two important exceptions to this generality. Pigeons will take advantage of a precommitting strategy in order to receive a larger reward (Ainslie, 1974; Rachlin & Green, 1972). In other words, they will make a response ahead of time that will keep them from having the opportunity to choose the smaller reward. Notice the parallel between this kind of choice and the tendency of humans to choose the larger reward when the choice is made before the smaller reward becomes available. Also notice that pigeons are not permitted to terminate the waiting period (to "change their minds") while waiting for the delayed reward. If so permitted, they exhibit preference shift as the small reward becomes available and thus show impulsive behavior (Logue & Pena-Correal, 1984). We may conclude from such results that pigeons perceive a difference between the two alternatives, and prefer larger rewards in general, but are, like humans, highly sensitive to the availability of the reward.

A second exception is found in a research paradigm for training pigeons to choose the delayed reinforcer. This fading procedure is initiated by training the

animals to associate different keys with large or small rewards. If given a choice, the pigeons will make the response associated with the larger reward. The time between the response and delivery of the larger reward is gradually delayed, until eventually the pigeon is exhibiting "self-control". But the argument can be made that the fading procedure is designed so that, with gradually increasing delay over thousands of trials, the animal does not notice the change and perceives only the original choice between large and small reward. Therefore, evidence of self-control behaviors in typical laboratory animals is weak at best. Although impulsiveness in animals is well-documented, researchers have yet to develop a general model for describing and predicting choice behavior in animals.

Matching Law. One of the best-known and most useful models of choice is Herrnstein's (1970) matching law. According to the matching law, an organism divides its behavior (B) in proportion to the values of the two alternatives, where value is determined by ratios between amounts (A) and delays (D).

$$\frac{B_1}{B_2} = \frac{A_1}{A_2} \times \frac{D_2}{D_1} . \qquad (1)$$

This model easily predicts impulsive behavior, as well as pigeons' use of a precommitting device, and the preference shift exhibited when the choice is made further away in time from the point of small reward

delivery. However, sometimes behavior deviates from the strict matching law above in the form of bias (preference for one behavior when the two outcomes are identical) or undermatching (behavior ratio is closer to 1 than the parameters predict). Such deviations are better accounted for by a generalized version of the matching law (Logue, 1988):

$$\frac{B_1}{B_2} = k \left| \frac{A_1}{A_2} \right|^{SA} X \left| \frac{D_2}{D_1} \right|^{SD} . \qquad (2)$$

k represents response bias and is constant for a given animal and a given apparatus. SA and SD are exponents which represent the sensitivity to differences in amount and delay, respectively. If an animal shows preference for the small immediate reward in a situation where the strict matching law predicts preference of the larger, delayed reward, the generalized matching law could describe this result by saying that SA > SD.

Logue, Rodriguez, Pena-Correal, and Mauro (1984) demonstrate that these exponents can be affected by experience, and thus differ across subjects. Pigeons who had experienced a fading procedure showed more self-control responding on new problems than control pigeons. The faded pigeons were more sensitive to differences in amount, and less sensitive to differences in delay than were control pigeons. Individual differences in sensitivity to the two characteristics of the reinforcer

accounted for in this model are thus recognized as an important factor in impulsive behavior.

Foraging Theory. The foraging literature offers additional evidence regarding impulsive choice behavior in animals in the wild. An interesting example of different foraging strategies across species is found in two desert rodents, the kangaroo rat and the pocket mouse (reviewed in Olton, Handelman, & Walker, 1981). The kangaroo rat forages mainly on large clumps of seeds at long distances from its burrow, while the pocket mouse chooses the "impulsive" pattern of foraging on individual seeds found near its burrow. These animals have never been studied in operant paradigms, yet the similarity of their choices between small, immediate vs. large, delayed rewards to similar choices in the decision literature is striking.

Although most foragers work to increase amount of food, some, including the pocket mouse, appear to do this through a strategy of rate maximization. For instance, titmice in the wild must catch an insect every three seconds throughout a winter day just to survive (Krebs, 1978). In an experimental situation, the birds prefer exclusively a response with the highest reward rate. When size of prey and rate of encounter are manipulated, many animals are more influenced by rate of encounter than predicted by optimal foraging theories. In addition, studies of different species show that many

animals prefer immediate rewards (Krebs, 1978). In a natural setting, reward immediacy often signals likely frequency of further encounters with the prey, so when animals make "impulsive" choices, they may be increasing not only rate, but amount of total reinforcement as well.

Survival concerns leading to different rate preferences may be found in humans as well. Severely impoverished people might prefer a small, immediate amount of money or food to a delayed, larger reward, simply because they may not survive to collect the delayed reward. People in this situation are demonstrating sensitivity to the possible frequency of reward. Begging brings in a small, but steady, amount of money and searching for a job may result in a long-term advantage, but the job rewards may be too distant to be relevant to today's needs. Therefore, choosing to beg may show a sensitivity to rate that is adaptive under the circumstances.

So far the discussion of impulsiveness in animals and humans has suggested that impulsiveness may result from the evolutionary or social circumstances of the individual or species. However, individual differences in human impulsiveness may not always be based on such obvious distinctions. Some well-off people are impulsive with regard to food and money when survival is not an issue; some poor people exhibit self-control

despite situational demands to the contrary. The highly varied environmental and genetic contributions to individual personalities engender differences in impulsiveness not attributable to the characteristics of a particular situation.

Rate as a Variable in Decision Literature

There are typically five characteristics of reward and punishment considered in the animal and human decision literature: delay, rate, probability, magnitude, and quality. Most investigation has concentrated on interactions between delay and magnitude of reward (e.g. $100 now vs. $200 later; 2 pretzels now vs. 5 pretzels later). Although a few researchers have studied interactions of delay and reward/punishment quality (e.g. pretzels now vs. cookies later; grass here vs. fruit 200 yards away) these interactions are not easily compared with delay-magnitude interactions. Thus, magnitude and quality are usually equated in the literature, if quality is considered at all. Probability of reinforcement is often included in experiments with humans (e.g. Stevenson, 1986; Loewenstein, 1988; Kahneman, Slovic, & Tversky, 1982), and is incorporated into many models of human decision making. Rate, delay, and probability are closely related and easily confounded, so care must be taken when investigating and interpreting their effects (see Rachlin, Logue, Gibbon & Frankel, 1986).

Typically, rate of reinforcement is controlled for in animal choice experiments, and not addressed in human choice studies. A pigeon may be given a choice between a small, immediate reward and a large, delayed reward once every 60 seconds. Choosing the immediate reward will not speed up the beginning of the next trial, so although the magnitude of rewards in a training session is affected by the animal's choices, the number of rewards and spacing of trials remains constant. On the other hand, optimal foraging theories recognize the importance of rate, as well as the close connection between delay and rate. In optimal foraging models, rate of consumption for a certain prey type is determined by several time factors, including rate of encounter in the environment, and time spent in handling and preparing the prey for consumption.

Logue (1988) suggests the following, more general, time periods: C, the period during which choice responses are made; D, the period between the end of the choice period and the start of access to reinforcement; A, access to reinforcement; and T, a postreinforcer delay period before the next C. Handling time is not included in Logue's description (Houston & McNamara, 1988), but may be appropriately included in D, the delay before consumption, or A, for cases in which handling and preparation are themselves reinforcing. For example, receiving a paycheck and depositing it in the

bank is pleasant for many people, despite the fact that the money cannot be "consumed" until the check has been processed. Following Logue's definition, rate (1 / C + D + A + T) is a broader representation of the time variables involved in choice than simply delay, and should be incorporated into models of repeated choice situations.

Probability, mentioned above, can also usefully be subsumed under rate. In a probability paradigm with repeated choices, some of the expected A's will not occur, effectively extending the T from the last trial. In their discussion of "probability as rate," Rachlin et al. (1986) reason that probability information forces human subjects to treat a one-shot decision as if it were a series of choices, with proportional frequencies of outcomes. Probability information is provided directly to animals on a variable rate schedule (e.g., a food pellet is delivered once for every three lever presses, on average), while humans must infer rate of reinforcement from a single piece of information (33% chance of winning). To take a more common example, when the weather report indicates a 30% chance of rain, we know that in the past, it has rained on one out of three days with the same weather conditions. Knowing there is a low probability of rain is no help when we're caught in a downpour. It seems likely that most choices made by humans are not isolated, but exist as part of a

series of other choices (cf. Rachlin, 1990). Therefore rate should be considered more carefully as a determinant of human decision making.

What is missing when probability is described in terms of rate (and is also missing in foraging models) is the frustration resulting from the absence of an expected A. The potential for punishing consequences such as frustration and pain (getting rained on, missing a picnic) is likely to influence choices made by animals and humans, and, along with individual differences in rate preferences, should be included in models of choice behavior.

Impulsiveness in Personality Research

Whereas individual differences in impulsiveness have been largely neglected in animal choice and human decision research, individual differences in the ability to tolerate delay have been the focus of much personality research. The relevant work of Mischel, Eysenck, and Gray is considered here.

Delay of Gratification

Mischel's delay of gratification paradigm is based on a definition that matches the decision literature's definition of impulsiveness. Mischel demonstrated differences in children's ability to delay gratification, in other words, to resist temptation to fulfill a desire immediately in order to get a larger

reward later (Mischel, 1974; Mischel, Shoda, & Peake, 1988; Mischel, Shoda, & Rodriguez, 1989).

Cognitive and attentional processes used by subjects to sustain delay of gratification are explored in Mischel's work. In particular, children who are able to wait for the larger reward tend to use strategies for occupying themselves with thoughts other than those about the consummatory properties of the reward. Subjects who thought about the "hot" aspects of the reward were much less likely to wait. Such emotional and cognitive factors seem relevant to a discussion of impulsiveness, but, except for recent work by Loewenstein cited above, have been neglected in decision theory and research.

Central in Mischel's work is an explicit interest in individual differences in delay of gratification, and dispositional correlates of self-control have also been investigated. For instance, four-year-olds who prefer delayed rewards tend to be more intelligent, more socially responsible, more resistant to temptation, and more ambitious. Ten years later, these children are described by their parents as being more competent academically and socially than their peers, more able to cope with frustration and resist temptation, more self-assured, verbally fluent and expressive, and planful (Mischel, Shoda & Peake, 1988; Mischel, Shoda, & Rodriguez, 1989). Preschool delay times were also

significantly related to SAT scores. These results suggest that the experimental situation left ample room for relevant individual differences to act on behavior, and that these differences are related to many aspects of behavior, as well as being temporally stable.

As mentioned above, Mischel's paradigm relies on the familiar choice between a small, immediate reinforcer and a large, delayed reinforcer. It has something else in common with decision theory, however: a lack of attention to rate preferences. Mischel's research has been criticized on the grounds that subjects who make the "impulsive" choice not to delay are in fact responding to the chance to get out of the experiment early and obtain extraexperimental rewards. This argument leads to the possibility that "the child is sensitive to the <u>rate</u> of access to extraexperimental rewards" (emphasis added; Sonuga-Barke, 1988, p. 694). Mischel attempted to make clear to his subjects that their choice would not affect how much time they spent in a playroom after the experimental situation, but it is likely that some children (assuming they all fully understood the instructions) may have wanted to get out of the experimental room and into the playroom, then home, as quickly as possible.

Despite Mischel's findings of stable individual differences and correlates relating to behavior in a delay of gratification paradigm, the generalizability of

single instances of behavior must not be assumed. Single behaviors tend to be unstable, so one-time choices made by subjects in decision paradigms may be inappropriate measures of stable individual differences. This is especially likely if the choice is not particularly engaging or realistic, as is often the case (Epstein, 1983). Although Mischel's paradigm appears to have been successful in tapping behavior that correlated with relevant variables over a long period of time, it is still possible that the correlated measures were all determined by a stable third factor, such as family environment (Mischel, 1974). Such concerns leave room for doubt as to the usefulness of Mischel's paradigm as a definitive test of impulsiveness. The better method of investigation would involve aggregating behaviors in many situations over time to detect behavioral dispositions (Epstein, 1979; 1980). The aggregate measure would then be useful for testing theories about the origins and implications of choice behavior.

Impulsiveness as a Combination of Traits

Mischel's work represents a well-known paradigm for exploring the links between individual difference variables and impulsive behavior. Others have developed theories which propose a general structure of personality relevant to impulsiveness. In this research, impulsiveness is not clearly defined, but usually refers to a broad trait or combination of

traits, often including extraversion, with implicit or explicit references to risk-taking, non-planning, thoughtlessness, and irresponsibility.

Eysenck and Eysenck (1977) responded to criticisms of the use of the term impulsiveness in personality research to refer to several apparently different constructs, such as risk-taking, sociability, or disorderliness. Eysenck and Eysenck compiled questionnaire items from several scales designed to measure impulsiveness, and performed a factor analysis on responses from over two thousand subjects. The "impulsiveness" items were factored into four components. "Narrow impulsiveness" is a definitional scale characterized by items (such as "Do you often do things on the spur of the moment?") aimed at tendencies to act on impulse. The "risk-taking" factor includes items such as "Would life with no danger in it be too dull for you?" The "non-planning" factor includes items such as "Do you like planning things carefully well ahead of time?" (reverse scored), and the "liveliness" factor is characterized by "Can you put your thoughts into words quickly?" and other questions relevant to speed in decision-making.

The four factors were correlated with the three major personality dimensions of psychopathy (P), extraversion (E), and neuroticism (N) as measured by the Eysenck Personality Questionnaire (EPQ; Eysenck &

Eysenck, 1975). Narrow impulsiveness and nonplanning were related to N, risk-taking was related to both P and E, and liveliness was related to both E and N. Further, a 13-item sociability scale was compiled from relevant items in the EPQ, then correlated with the four impulsiveness factors as well as the combined impulsiveness measure. All four factors correlate positively with sociability (.18 to .39). The authors concluded that impulsiveness is indeed composed of several distinct elements, but that these elements correlate with each other and with sociability such that they belong to a set of traits making up the higher-order trait of extraversion.

A direct application of the Eysencks' findings about impulsiveness to decision-making has not been made, but it is clear that the four factors of the impulsiveness scale imply certain decision-making styles: failure to plan ahead, risk-taking, speed in taking action, and acting on sudden impulse. It seems worthwhile to investigate the relation between the Eysencks' impulsiveness measures and traditional operant and decision theory paradigms. The standard tests of preference for a small, immediate reward over a large, delayed reward can be correlated with performance on the Eysencks' impulsiveness scale, although, as discussed above, correlation would be limited by the difficulties in predicting specific behaviors from global attitudes.

It should be noted that Eysenck, while participating in research on impulsiveness and other primary traits, disapproves of putting a great deal of emphasis on such work. For Eysenck, a trait such as impulsiveness is merely a combination of P, E, and N, dimensions which are consistently found in factor analytic studies, and for which well-developed theories exist. Eysenck (1987) concludes that except for "certain specific purposes", concentration on specific traits rather than general dimensions is "essentially counterproductive" for understanding personality (p. 492). One of Eysenck's great contributions to personality psychology has been the simplification of personality dimensions to two or three comprehensive dimensions. Therefore, it is not surprising that he should prefer to concentrate on these major dimensions. However, for present purposes it is useful to extend Eysenck's work to provide better understanding of impulsiveness.

Sensitivity to Reward vs. Punishment

Gray's (1981, 1987) revision of Eysenck's personality theory contains an intriguing model of impulsive behavior. The model is based largely on differences in sensitivity to reward and punishment. People who are high on the extraversion and neuroticism dimensions are relatively insensitive to punishment and highly sensitive to reward. This leads to risk-taking,

venturesomeness, and nonplanning, in other words, impulsiveness. In contrast, high-neuroticism introverts are more sensitive to punishment than reward and tend to display anxious behaviors (see Figure 1). The model has received support from studies showing that extraverts respond best to a conditioning paradigm when reinforced with reward, while introverts respond best when reinforced with punishment (cited in Gray, Owen, Davis & Tsaltas, 1983; also Wolfe & Kasmer, 1988).

However, no studies have been conducted to demonstrate differences in decision-making based on personality variables and perceived outcomes of the decision. Gray's model predicts that extraverts would

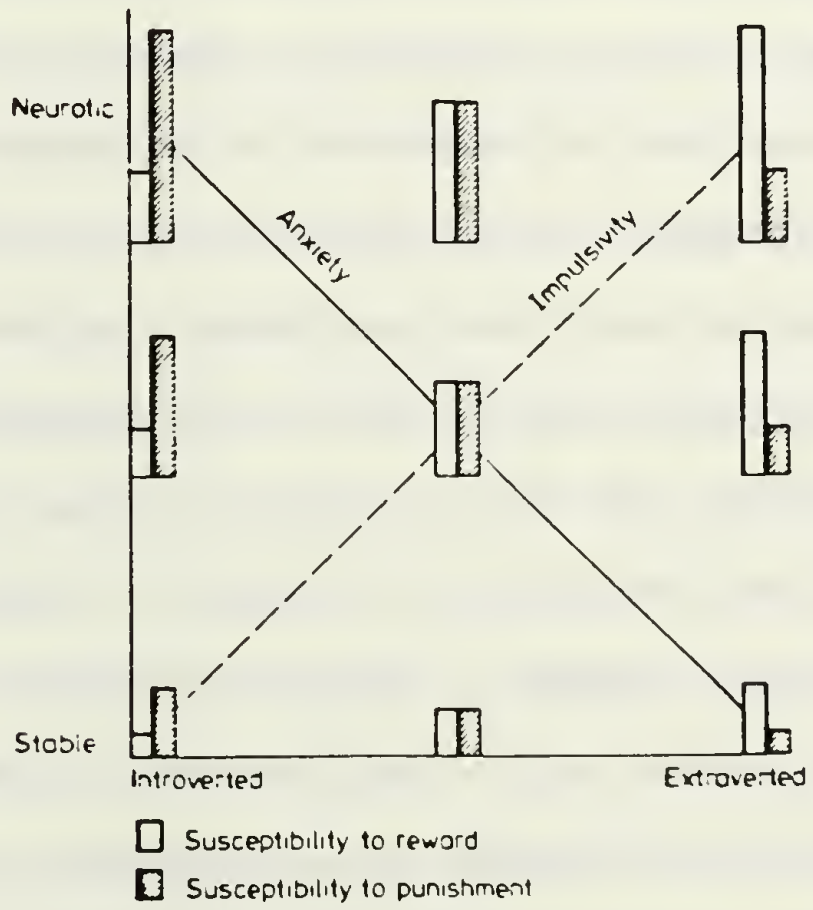


Figure 1. Gray's proposed relationships of (a) susceptibility to signals of reward and punishment to (b) the dimensions of introversion-extraversion and neuroticism (Gray, 1981).

tend to ignore potential negative outcomes of a decision while weighting positive outcomes more heavily, in other words, would take risks. This prediction is of course reversed for introverts. Decision research has demonstrated that subjects typically prefer risk when facing loss (e.g. prefer 90% chance of losing $1000, otherwise nothing, to 100% chance of losing $900), and make cautious decisions when expecting gain (e.g. prefer 100% chance of winning $900 to 90% chance of winning $1000, otherwise nothing; discussed in Abelson & Levi, 1985). However, the minority who do take risks in the gain situation have never been studied to find out why they chose as they did, nor have any other dispositional variables been considered.

How can an exploration of rate preferences be applied to Gray's analysis? First, impulsiveness, with its components of extraversion and neuroticism, and correlation with sociability, might be viewed as social risk-taking - speaking one's mind without considering the consequences, interacting nonselectively with many people, being willing to try new activities and situations. Impulsive individuals may be maximizing the rate of social contacts, thereby experiencing more successful interactions. The corresponding increase in failed interactions is ignored or discounted by these punishment-insensitive individuals. On the other hand, introverted individuals high on neuroticism are

oversensitive to punishing interactions, and attempt to minimize punishment by reducing the number of social interactions. Successful interactions are ignored or discounted, and so are of little use in changing the anxious behavior. Individuals between the two extremes take both punishment and reward into account, and behave so as to maximize reward and minimize punishment. Therefore, by moving one step further to elucidate rate preference in conjunction with sensitivity to reward vs. punishment, Gray's theory becomes a convenient framework on which to build an understanding of impulsive behavior.

Impulsiveness: A Potential Integration

The preceding discussion encompasses a broad range of theory and research. Some important elements of the reviewed literature are summarized below. A model designed to integrate these elements is proposed, and finally, a study testing some hypotheses related to the model and the literature is described.

Preference for Efficient Decision Strategies

Humans and animals have limited processing capacities, and tend to choose decision strategies that will maximize the ratio of reward to effort. In other words, they prefer to get the most reward for the least effort, and may be unwilling to use a complicated strategy that optimizes outcome when a simple strategy leads to satisfactory results. This "satisficing"

tendency (Simon, 1976, discussed in Janis and Mann, 1977) permeates human decision making, and is closely related to cognitive economy (Glass & Holyoak, 1986) and heuristic bias (Kahneman, Slovic & Tversky, 1982) effects observed in human perceptual and social judgments. The implication of this generalization for choice behavior is that individuals may develop a consistent pattern of sensitivity to the characteristics of a choice situation which allows for efficient processing and satisfactory outcomes in most cases.

Individual Differences in Sensitivity to Characteristics of the Choice

Gray's (1981, 1987) revision of Eysenck's personality theory rests largely on individual differences in sensitivity to reward and punishment. According to Gray, individuals who are relatively insensitive to punishment tend to take risks and act without planning, in other words, behave impulsively. The opposite of the impulsive individual in Gray's model is one who is highly sensitive to punishment; he characterizes such an individual as anxious.

Generalized matching laws (e.g. Logue, 1988) also incorporate the notion of differences in sensitivity to different aspects of a choice situation. Although the generalized matching law has not been used explicitly to discuss individual differences in behavior in the way that personality and social psychologists understand

them (but see Logue, Rodriguez, Pena-Correal, and Mauro, 1984, for experimental manipulation of individual differences in pigeons' self-control responding), it provides a useful model for describing choice behavior.

Neglected Variables

Typically, impulsiveness is described in decision research as a behavioral reaction to two variables, amount and delay of reward. But other research suggests that additional variables may be necessary for a complete description of impulsive behavior.

Rate. Foraging models and research suggest the importance of rate of reward, rather than the more specific delay term. Some animals are almost exclusively sensitive to the frequency of encounter of prey in the environment, and in controlled tests are found to ignore aspects such as size of prey in favor of a high rate of encounter (Krebs, 1978; see also Olton, Handelman & Walker, 1981 for related phenomena in the wild). As for rate sensitivity in humans, Sonuga-Barke (1989) has suggested that subjects behaving "impulsively" in Mischel's well-known delay of gratification paradigm (for a review see Mischel, Shoda & Rodriguez, 1989) were maximizing the rate of (extraexperimental) rewards by choosing a smaller but immediate experimental reward. In other words, some subjects preferred to take the smaller reward and leave

the experimental situation altogether rather than wait for the larger reward.

As Sonuga-Barke noted, an apparently isolated choice may be followed by access to a new set of choices. Even in an experimental situation, subjects may obtain extraexperimental rewards through exploring the room or cage, or by daydreaming. Therefore, while choices might be limited in an experimental situation, humans and animals are more frequently faced with the potential of maximizing rate of reward, where making an impulsive choice results in a small reward, as well as quick access to new choice (and reward) situations. Rate preferences are, in theory at least, always applicable in decision making, although the distinction between R and D may be troublesome in some laboratory situations.

Probability of reinforcement can also be subsumed under the rate term if it is viewed as the failure of an anticipated A to occur. The use of the rate term serves to simplify as well as clarify the variables used in choice equations. The possibility that human impulsive behavior is an attempt to maximize rate of reward is explored in the current study.

Punishment. The role of potential punishment in choice behavior has been neglected in the decision and foraging literatures. Although costs involved in consumption are considered (such as energy expended in

hunting, or money spent on a vacation), truly aversive consequences such as being bitten by a prey, or breaking a leg on the first day of a ski trip, have been ignored. The subjective probability of such consequences, and their anticipated aversiveness could be expected to influence choices about which prey to hunt, for instance, or whether to go skiing. As noted above, Gray's model calls for an assessment of sensitivity to punishment as well as reward. Time, effort and injury or other loss are all potential punishing outcomes even for a successful endeavor. In addition, frustration resulting from the nonoccurrence of an expected reward, mentioned above, turns probabilistic rewards into a source of punishment. Punishing factors should be taken into account in any general model of choice, and, as Gray suggests, may be especially relevant to a investigation of impulsiveness.

A Model of Impulsive Choice Behavior

The assumptions and generalizations just described can be integrated in the following model:

$$\frac{B_1}{B_2} = w1\frac{Q_1^+}{Q_2^+} + w2\frac{Q_1^-}{Q_2^-} + w3\frac{R_1^+}{R_2^+} + w4\frac{R_1^-}{R_2^-} . \qquad (3)$$

B_1 and B_2 refer to the impulsive and nonimpulsive behavioral alternative. Q_1 and Q_2 refer to the relative quality or quantity of the rewarding (+) or punishing (-) consequences associated with each behavioral alternative. R_1 and R_2 are defined as $1/(C + D + A +$

T), and express the rate of the rewarding (+) or punishing (-) outcomes associated with each behavioral alternative. Individual differences in sensitivity to these four dimensions of outcomes are described by the weights for each term.

This model differs from the generalized matching law in several ways. The reasons for substituting rate for delay and adding terms for punishing consequences are explained above. Note that the ratios for punishing consequences are not inverted, as in the generalized matching law, as the signs associated with the weights will indicate the direction of each term's effect on behavior. The model is represented by a linear equation for three reasons. First, the exponential representation of the sensitivity terms in the generalized matching law is better supported by convention than by data (Chapman, 1988). Second, until there is evidence of a nonlinear relationship, the simpler description of choice data may be the most appropriate. Third, the new model is partly based on Slovic and Lichtenstein's (1968) regression model for evaluating bets. A replication and variation of their study is included in the present study, and the above model provides a convenient way to describe the results.

A Paradigm for Determining Individual Differences in Sensitivity to Choice Characteristics

The explicit statement of a model of choice behavior raises the important question of how the model can be tested. Fortunately, Slovic and Lichtenstein (1968) developed a research method which assesses many of the factors of interest in the current discussion, and which can be modified to test model (3) more explicitly.

Slovic and Lichtenstein's (1968) investigation assessed subjects' attractiveness ratings of a series of duplex gambles. The task was designed to eliminate the confounding present in many earlier studies attempting to determine the relative importance of individual components of a bet. Duplex bets allow the probabilities of winning and losing, as well as their respective payoffs, to be independent.

In Slovic and Lichtenstein's study, the bets were presented on discs, one for wins and one for losses. The subject must (hypothetically) spin each disc to determine the outcome of the game. In each game, it was possible for the subject to both win and lose, lose and not win, win and not lose, or neither win nor lose. An example of the stimuli used is presented in Figure 2 (p. 34; see appendix A for the complete set of items).

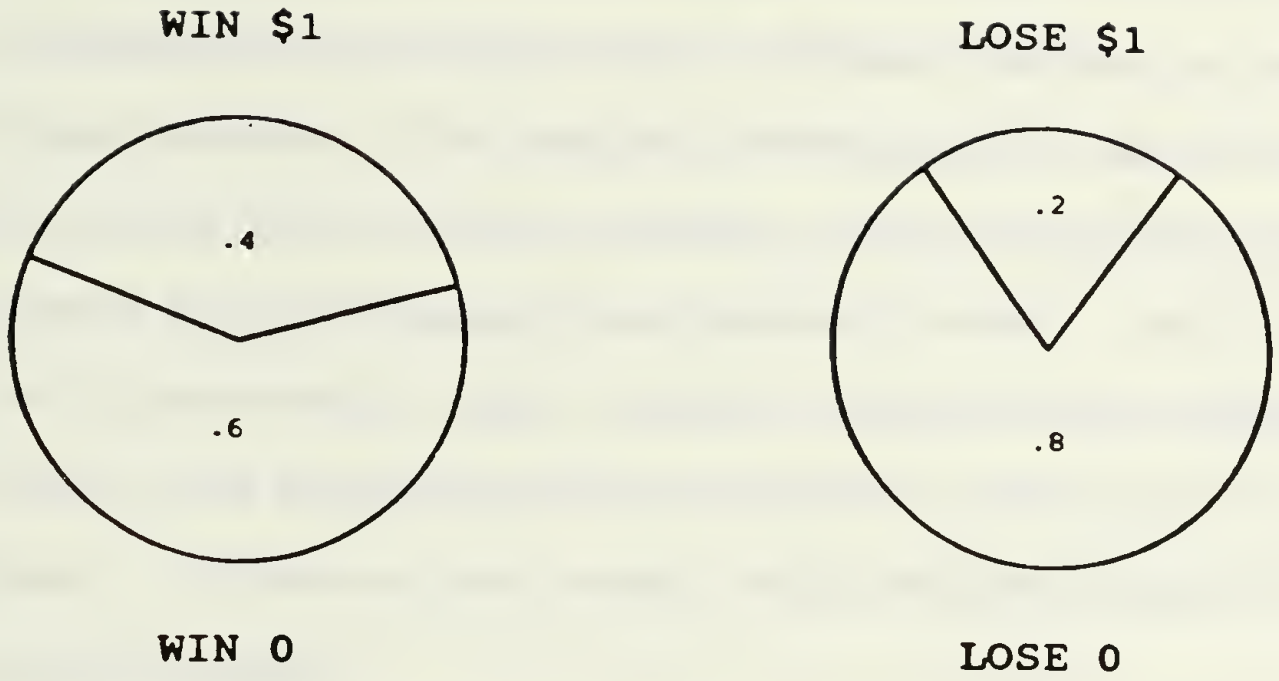


Figure 2. Example of stimuli used in Slovic and Lichtenstein's (1968) duplex gamble task.

Probability of winning and probability of losing (PW and PL) occurred at three levels: .2, .4, and .8. Amount to win and lose ($W and $L) also occurred at three levels: $1, $2, and $4. Combinations of the risk dimensions resulted in 27 different bets to be rated, with an average expected value of zero. (Note: Slovic and Lichtenstein report equivalent results using all possible combinations of risk dimensions (81 bets) and with 27, which is the next smallest number of bets allowing for equal representation of all dimension levels.) For instance, the bet in figure 2 can be described as follows:

PW = .4 PL = .2

$W = $1 $L = $1 EV = $.20

Subjects rated the attractiveness of each bet on a scale of -5 to +5. Subjects were also required to submit bids for the opportunity to play each game. Comparison of bidding results with rating results showed

the same pattern of responding, leading Slovic and Lichtenstein to suspect that bidding involves a two-stage process. The subject determines how much he or she would like to play the game, then translates the game's attractiveness into monetary units. For Slovic and Lichtenstein, then, ratings and bids were equally useful for determining the subject's evaluation of a game. In the current study, only attractiveness ratings were obtained.

Slovic and Lichtenstein correlated subjects' attractiveness ratings with the levels of each of the four risk dimensions across the 27 bets. Regression analysis was used to determine each subject's weights for the four risk dimensions. Slovic and Lichtenstein found notable individual differences in weighting patterns. The responses of many subjects were overwhelmingly determined by one or two of the risk dimensions, while large changes in the less important factors had little effect. These differences are evident in the comments elicited from subjects at the end of the study. Following are two examples: "I decided wholly on the basis of amount to lose"; "I found playing the bets most desirable only when I had an excellent chance of winning. . . didn't pay much attention to the amount I would win or lose." (Slovic and Lichtenstein, 1968, p. 10).

Each subject's weights are correlated with measures of impulsiveness obtained in the other questionnaires, described below. Expressed as a special case of the proposed model (3), the equation tested by the Slovic and Lichtenstein variation is as follows:

Attractiveness of B = w1(Q+) + w2(Q-) + w3(R+) + w4(R-) (4) since the variation involves a rating of a single behavior rather than a choice between behavioral alternatives.

Their investigation followed from two ideas that are similar to the generalizations on which model (3) is based. The first is "importance beliefs", described as follows: "when a person evaluates a bet, he pays more attention to some risk dimensions than to others because he believes that these particular dimensions are most important for his present decision" (Slovic & Lichtenstein, 1968, p. 1). Note that the proposed model (3) of impulsive choice in this paper is based on a similar assumption, except that instead of evaluating the dimensions of every choice situation, subjects in the new conception are believed to possess more stable individual differences in sensitivity to dimensions of choice situations. In other words, individuals tend to display a similar pattern of sensitivity to dimensions of choice in a variety of choice situations.

The second idea noted in Slovic and Lichtenstein (1968) is that a person's capacity for employing

importance beliefs may be limited. Stress, time constraints, or amount of information available may lead the decision maker to neglect or overuse some items of information. Both of the above considerations result in sensitivity to choice information that differs according to the individual's beliefs and the current choice situation. The present research focuses on stable individual differences in patterns of sensitivity which lead to differences in impulsive choice.

Research Plan and Hypotheses

Several hypotheses are tested in the current study. Most generally, it is expected that individual differences in sensitivity to different dimensions of a choice situation exist. In keeping with the above discussion, impulsive individuals are expected to a) be highly sensitive to rate of reward, and b) be relatively insensitive to potential punishment. Conversely, the least impulsive individuals should be a) relatively uninterested in rate of reward and b) highly sensitive to potential punishment. The least impulsive individuals, that is, those who are at the opposite extreme from impulsives, may share impulsives' higher sensitivity to rate, in which case we expect nonimpulsives to be highly sensitive not only to punishment, but to the rate of potential punishment in particular. Comparison of subjects' weights choice dimensions and correlations between the weights and

other impulsiveness measures tests the hypothesis that rate information is relevant to human decision making and that probability is merely a special case of rate.

Furthermore, the agreement between different measures and definitions of impulsiveness is tested using the results of three questionnaires as well as the subject's self-report of impulsiveness. The first questionnaire assesses, using Slovic and Lichtenstein's procedure, each subject's weighting of the dimensions of choice situations. The second is a measure of impulsive choice using items based on the decision research definition of impulsiveness (preference of small, immediate to large, delayed reward). The third is the EIS, a 42-item impulsivity questionnaire. Finally, subjects respond to the question "I am an impulsive person" on a 7-point true-false scale, and give examples of impulsive and non-impulsive behavior. Given the greatly different definitions on which the impulsiveness scales are based, close agreement is unlikely. Comparison of scores on the scales with each other and with subjects' self-reports and examples of impulsiveness provides insight into the definition of impulsiveness and the value of the measures tested.

CHAPTER II

METHOD

Questionnaire

Duplex Gamble Task: Rate Variation

The present study replicated Slovic and Lichtenstein's (1968) study in order to assess individual differences in attention to four risk dimensions of a bet. In addition, a variation of Slovic and Lichtenstein's procedure in which rate of winning and losing was substituted for probability was introduced.[1]

In the current study, a variation of the Slovic and Lichtenstein (1968) procedure was used to examine subjects' sensitivity to rate of winning and losing rather than probability of winning and losing. In the rate version, subjects were told that each of the 27 games represented an hour of play, and they rated the attractiveness of each game. Rate was determined by the hypothetical spin of a disc which had six divisions to

[1] A pilot study was devised to test whether the amount of money to be won and lost should be changed to keep up with 20 years of inflation since SL's study, and to determine which of three levels of rate intervals should be used in the rate version of the duplex gamble task. Although differences between the versions were small, there appeared to be more individual differences in weighting of risk dimensions for the bets in which the amount of money to be won or lost was $10, $20 and $40, and for the rate intervals of one to five minutes, two to ten minutes, and four to 20 minutes, than for longer rate intervals.

indicate the number of minutes the subject would wait before winning or losing the indicated amount, then spinning again.

As illustrated in Figure 3, the subject was faced with one win disc and one loss disc for every game (see appendix B for the complete set of items), as for the probability version. At the beginning of "play", both discs are spun simultaneously, then each disc is spun independently depending on the previous outcome. Three

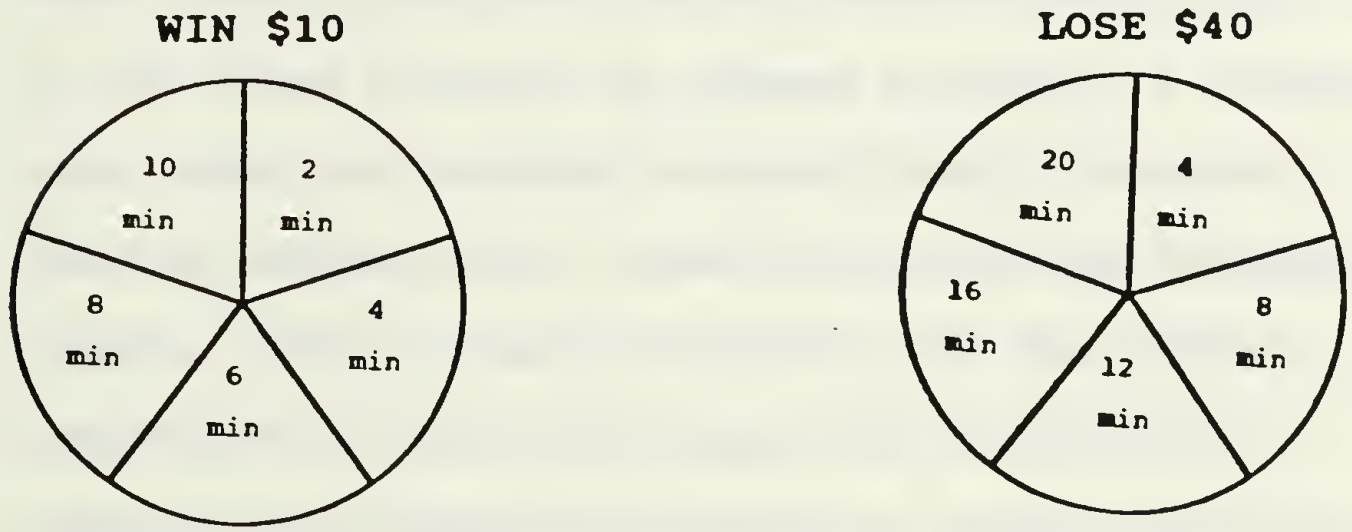


Figure 3. Example of stimuli used in rate version of duplex gamble task.

different ranges of rate were expressed by the discs. The range of five delays found on each disc introduced some uncertainty into the expected delay, and forced subjects to develop their own heuristics for play by making it difficult to calculate the expected gains and losses over an hour of play. In other words, subjects were less likely to simply determine the expected value of each game and translate that into an attractiveness rating. (No such precautions were taken in the Slovic

and Lichtenstein design, and no information is provided as to whether any of their subjects used or reported using the expected value strategy.)

The average delays for the three rate discs were 3 minutes, 6 minutes, and 12 minutes. The ratio of delays on the rate discs was the same as the ratio of probabilities used by Slovic and Lichtenstein, that is, 1:2:4.

Decision Research Items

A group of items based on hypothetical choices like those used in decision making research were used. All of the items involved an element of delay; a subscale of nine items was intended to specifically represent choices between small, immediate and large, delayed rewards. Some items were written for the present investigation, some have been used in published research, and others were based on actual choices or examples discussed, but not tested, in the decision literature. Many of these items were not originally formulated with regard to an investigation of individual differences in impulsiveness, but were included because they could be expected to relate to impulsive decision making. Most research done with this type of item merely indicates the percentage of subjects choosing each alternative, and is not concerned with correlates of choice. The following is an example of the items: "You have just won a contest. You can either receive

$100 now, or $200 at a later time. What is the longest you would be willing to wait for the $200 prize?" (See appendix C for the complete set of items, their origins and scoring.)

Eysenck Impulsivity Scale

The Eysenck Impulsivity Scale is a compilation of items designed to measure impulsiveness taken from several personality inventories. Under factor analysis, the items break down into four factors: definitional items comprising "narrow" impulsiveness (e.g. "Do you often do things on the spur of the moment?"), risk-taking (e.g. "Would life with no danger in it be too dull for you?"), nonplanning (e.g. "Do you like planning things carefully ahead of time?", and carefreeness (e.g. "Can you put your thoughts into words quickly?"). (See appendix D for the complete set of items.)

Self-report of Impulsiveness

Finally, subjects provided a self-report of impulsiveness, as well as behavioral examples of impulsiveness and unimpulsiveness. Subjects also provided personal information (sex, age, class, GPA, SAT scores, major) to be correlated with the other measures on the questionnaire. Mischel's findings (Mischel, Shoda & Peake, 1988; Mischel, Shoda & Rodriguez, 1989), suggest a correlation between academic performance and impulsiveness, which will be tested. (See appendix E for complete set of items.)

Subjects

Subjects were 159 University of Massachusetts undergraduates, who received experimental credit for their participation. Forty of the subjects were male, 118 were female, and one subject did not indicate sex. The subjects were recruited from psychology classes where they heard a brief description of the study and, if interested in participating, received a questionnaire with instructions for completing and returning it. Approximately 70% of the questionnaires distributed were returned.

Procedure

Eighty-seven of the subjects rated the attractiveness of 27 duplex gambles in a replication of Slovic and Lichtenstein's (1968) study, and 72 rated 27 bets in which probability of winning or losing was replaced by rate of winning or losing. Subjects received written instruction for completing the rating tasks properly. They were asked to indicate starting and finishing times for the rating task to investigate whether speed of task completion is a useful correlate of impulsiveness. After completing the probability or rate version of the duplex gambles, all subjects filled out the other questionnaires in the following order: decision research items, Eysenck Impulsivity Scale, self-report of impulsivity, behavioral examples of impulsiveness and nonimpulsiveness, and personal

information. Self-report and behavioral examples were completed at the end to avoid sensitizing subjects to the idea that they were being tested for impulsiveness, and to prevent their responses to other items from being colored by their own definitions of impulsiveness.

CHAPTER III

RESULTS

Subject Characteristics

There were no significant differences between probability and rate versions on background variables such as age, sex, and SAT score. Table 1 displays the mean (SD) for each background variable for subjects completing the rate and probability versions, separately and combined. On average, subjects were about 20 years old, in their third year of college, had a grade point average of 3.0, and combined SAT score of 1078. Seventy-five percent were female.

Table 1

Subject Characteristics: Mean (SD) for Probability and Rate Versions, Separately and Combined.

	Probability (n=87)	Rate (n=72)	Combined (n=159)
Age	20.48 (2.91)	20.74 (4.19)	20.60 (3.55)
Sex (1=M, 2=F)	1.79 (.41)	1.69 (.46)	1.75 (.44)
Year in school	2.49 (1.08)	2.69 (.93)	2.58 (1.02)
GPA	2.95 (.54)	3.06 (.45)	3.00 (.50)
SAT score	1065.70 (133.71)	1092.03 (131.07)	1078.00 (132.65)

Reliability and Intercorrelations of EIS and Decision Scales

Alpha reliability coefficients for the four subscales of the EIS are as follows: .79 for the definitional scale; .65 for risktaking; .59 for nonplanning; and .57 for liveliness. Alpha reliability

for the entire scale is .84. Reliability coefficients are reported on the diagonal of the correlation matrix in Table 2 (p. 45).

The four subscales of the EIS were significantly correlated with each other and with total EIS score. These correlations ranged from .26 to .81 (median = .42). Similar patterns of intercorrelations has been observed in earlier investigations (Eysenck & Eysenck, 1977; Beck, 1989). Intercorrelations between the subscales are displayed in Table 2 (p. 45).

Standardized item alpha reliability for the 20-item decision scale was .50. Nine items representing the definition of impulsiveness as preference for a small immediate vs a large delayed reward had an alpha reliability of .40. (See Appendix C for the items making up this scale.) Reliability coefficients are reported on the diagonal of the correlation matrix in Table 2 (p. 47). Reliability of these scales is itself an issue and will be discussed in the next chapter.

Dimension Weights

For both the probability and rate versions of Slovic and Lichtenstein's (1968) task, subjects' attractiveness ratings were correlated with the levels of each of the four risk dimensions across the 27 gambles. Regression analysis (described in Chapter I) was used to determine each subject's weights for the four risk dimensions. Following Slovic and

Table 2

Intercorrelations of Impulsiveness Measures and Background Information for Probability and Rate Versions Combined

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Self-report												
2. Decision scale	.12	(.50)										
3. 9-item subscale	.15	.73	(.40)									
4. EIS - Total	.58*	.22*	.18	(.84)								
5. Narrow definition	.48*	.30*	.33*	.81*	(.79)							
6. Nonplanning	.38*	.08	.04	.73*	.39*	(.59)						
7. Risktaking	.48*	.11	.09	.75*	.43*	.42*	(.65)					
8. Liveliness	.24*	.15	.03	.59*	.35*	.26*	.35*	(.57)				
9. Age	-.16	-.12	-.12	-.13	-.19*	.05	-.11	-.59*				
10. Sex (1=M, 2=F)	-.05	.04	.21*	-.04	.06	-.07	-.10	.03	-.07			
11. Year in school	-.14	-.06	-.01	-.17	-.16	-.01	-.14	-.06	.54*	.05		
12. GPA	-.11	-.15	-.13	-.21	-.16	-.08	-.21*	-.11	.12	.14	.05	
13. SAT score	-.10	.04	-.04	-.13	-.16	-.11	.00	-.11	.20*	-.16	.18	.18

* $p < .01$, 1-tailed.

Lichtenstein, individual differences in weighting patterns are apparent in that on average, a subject's highest weighting of a dimension is more than twice the size of his or her lowest weighting. For the probability version, the average maximum weighting was .58, and the average minimum weighting was .18. For the rate version, the average maximum weighting was .53, and the average minimum weighting was .25.

Subjects' attractiveness ratings were also correlated with the expected value for each gamble. For the probability version, correlations ranged between -.31 and .89, with median .64. For the rate version, correlations ranged between -.22 and .86, with median .66. It is interesting to note that some subjects marked the questionnaire with what appeared to be expected value calculations. However, either because they did not do the calculations properly, or because translating a calculated expected value into an attractiveness rating required subjective judgments, these subjects' EV x evaluation correlation coefficients were not notably high, and their weights were not so similar as to suggest that each dimension was weighted equally.

Differences between Probability and Rate Versions

Table 3 (p. 49) shows the mean attractiveness ratings for each of the 27 duplex bets, for subjects completing the probability and rate versions of the

Table 3

Comparison of Mean Attractiveness Ratings (SDs) of Probability and Rate Versions of Duplex Bets

Game	EV	Probability		Rate
1	-1.20	-3.05 (2.56)		-2.75 (2.96)
2	.00	.25 (3.11)		-.86 (2.88)
3	-3.00	-4.02 (1.84)		-4.44 (1.33)
4	.80	1.49 (2.78)	*	2.61 (2.41)
5	.00	-.51 (2.48)		-.96 (2.53)
6	1.20	1.84 (2.23)	*	3.70 (2.37)
7	-.80	-2.24 (2.47)	*	-3.41 (1.64)
8	.00	-1.70 (2.10)	*	-.45 (2.80)
9	-1.20	-3.09 (1.97)	*	-4.61 (.75)
10	-.60	-2.80 (1.93)	*	-3.65 (1.55)
11	.00	-.52 (2.55)		-.16 (2.06)
12	1.20	2.86 (2.21)		2.81 (2.53)
13	2.40	2.70 (1.84)		3.14 (2.24)
14	.00	-1.03 (2.55)		-.41 (2.18)
15	-.40	-2.46 (2.35)		-2.41 (2.61)
16	.00	-1.31 (2.56)	*	.06 (2.59)
17	.60[a]	1.32 (2.18)	*	2.46 (2.18)
18	-.80	-2.76 (1.82)		-2.82 (2.49)
19	.00	-.13 (2.20)		-.33 (2.08)
20	.00	-1.61 (2.63)	*	-.28 (2.88)
21	.80	.22 (2.42)		1.06 (2.70)
22	.00	-.67 (2.20)		-.54 (2.32)
23	.40	.49 (2.50)	*	2.03 (2.23)
24	.40	1.95 (2.31)		1.38 (2.59)
25	-.40	-2.55 (2.02)	*	-3.94 (1.68)
26	-2.40	-3.76 (1.80)		-4.29 (1.32)
27	3.00	3.84 (1.40)		4.01 (2.11)

[a] The expected value for this game is incorrectly listed by Slovic and Lichtenstein (1968, Table 2) as -.60.

* $p < .01$, 2-tailed.

questionnaire. Eleven of the 27 comparisons show significant differences between the means (t-test, $p < .01$, 2-tailed; the more stringent level of significance is because of the relatively large number of comparisons). Fifteen of the differences showed that the item was rated more attractive in the rate version; for the other 12 items, the item was more attractive in the probability version. The mean attractiveness rating over all 27 items was -.64 for the probability version and -.48 for the rate version. The mean of the standard deviations of attractiveness ratings across the 27 items was 2.26 for the probability version and 2.22 for the rate version.

Table 4 (p. 51) shows comparisons for other measures on the questionnaire. The weighting of risk dimensions for the duplex bets might be expected to show differences between questionnaire versions, especially given the differences on individual bets discussed above. For all but one of the risk dimensions, money to lose, there was a significant difference in average weighting of probability and rate version items. Notably, rate to win and rate to lose were both weighted more heavily (.40 and -.46) than probability to win and lose (.25 and -.35).

To study individual differences in patterns of weighting the risk dimensions, weights were converted to z-scores, after reversing the signs of the two loss

Table 4

Dimension Weights and Impulsiveness Measures: Comparison of Means (SDs) for Probability and Rate Versions of Questionnaire

	Probability		Rate
Dimension weights			
Prob/Rate to win	.25 (.18)	*	.40 (.15)
Money to win	.44 (.21)	*	.33 (.21)
Prob/Rate to lose	-.35 (.19)	*	-.46 (.12)
Money to lose	-.35 (.25)		-.28 (.21)
Z-scored dimension weights			
Prob/Rate to win	-.62 (.83)	*	.02 (1.02)
Money to win	.58 (.83)	*	.00 (1.04)
Prob/Rate to lose	.02 (.93)	*	.50 (.86)
Money to lose	.02 (1.03)	*	-.52 (.81)
Impulsiveness measures			
Self-report	3.12 (1.29)		2.92 (1.26)
Decision scale	31.06 (3.48)		31.45 (2.98)
9-item subscale	13.48 (2.07)		16.44 (1.69)
EIS - Total	20.15 (7.46)		19.98 (6.90)
Narrow definition	2.85 (3.33)		2.46 (3.01)
Nonplanning	5.66 (2.52)		5.66 (2.20)
Risktaking	5.79 (2.53)		5.52 (2.43)
Liveliness	3.06 (1.64)		3.26 (1.61)
EV x Evaluation	.58 (.25)		.59 (.21)
Time	10.76 (8.88)	*	14.09 (7.76)

* $p < .05$, 2-tailed.

dimensions (probability/rate to lose and money to lose). The reason for considering relative rather than raw weights becomes apparent in comparing two hypothetical subjects who both have a weight of .30 for the money to win dimension. For one subject, .30 may be the highest of the four weights, while for another it may be the lowest. Comparing the raw weights is therefore not very informative. Z-scores allow more meaningful comparisons between subjects.[2] Mean (SD) z-scores for the dimension weights for both versions of the duplex gamble task are displayed in Table 4 (p. 51).

The z-scored dimension weights offer valuable information by themselves. In the probability version, probability to win had the lowest relative weights, and money to win had the highest. In the rate version, money to lose had the lowest weights, and rate to lose had the highest. All of the differences between versions are significant.

The only other significant difference between the versions was for time to complete the duplex gamble task. Subjects completing the rate version took more time to complete the 27 duplex gambles (roughly 14 vs. 11 minutes; $p < .05$, 2-tailed).

[2] Correlations with raw weights were also obtained. For the probability version, raw weight of probability to lose was correlated .30 with subjects' self-report of impulsiveness, and .26 with the EIS definitional scale ($p < .01$, 1-tailed). For the rate version, there were no significant correlations with raw weights.

Since none of the other variables (EIS, decision scale, subject background) showed significant differences, it is appropriate to combine data from subjects completing different versions of the gambling task for all analyses not related to the gambling task. The correlations between impulsiveness measures and background variables for the combined subjects are displayed in Table 2 (p. 47).

Correlations

Variables Associated with Duplex Gamble Task

Because of the large number of relations tested, and the unexpected direction of some relations, only correlations significant at the .01 level (2-tailed) will be reported. There were no significant correlations between dimension weights, EV X evaluation coefficient, or time to complete task in the probability version of the duplex gamble task and impulsiveness measures or background variables (Table 5, p. 54).

For the rate version (Table 6, p. 55), sensitivity to money to lose was associated with more impulsiveness on the definitional scale of the EIS (.33). The EV X evaluation coefficient (a measure of the relation between subjects ratings of the bets and the expected value of the bets) was higher for younger subjects. Higher impulsiveness as measured by self-report, and the risktaking and liveliness scales of the EIS were

Table 5

Correlations between Z-Scored Dimension Weights and Other Questionnaire Variables for Subjects Completing Probability Version of Duplex Gamble Task

	Probability to Win	Money to Win	Probability to Lose	Money to Lose	EV x Evaluation	Minutes to Complete Task[a]
Self-report	.11	.09	-.10	-.06	-.16	-.07
Decision scale	-.01	.16	-.11	-.02	.04	.03
9-item subscale	.04	.13	-.15	.01	-.16	-.05
EIS - Total	.01	.11	-.10	.01	.04	-.18
Narrow definition	.02	.13	-.19	.05	-.05	-.10
Nonplanning	- 14	.08	-.10	.14	.14	-.17
Risktaking	-.01	.10	-.01	-.07	-.02	-.20
Liveliness	.02	-.02	.01	-.00	.02	.00
Age	.08	-.05	.15	-.16	-.04	-.04
Sex (1=M, 2=F)	-.00	.04	-.16	.11	-.20	.02
Year in school	-.08	.19	-.15	.04	.07	-.10
GPA	.07	.05	-.14	.03	.04	-.02
SAT score	.21	-.11	.07	-.14	.05	-.20

[a] Quite a few subjects overlooked the space for "End Time" at the end of the duplex gamble task, so time measures are missing for these subjects. For the probability version, correlations in this column are based on 63 subjects.

* $p < .01$, 2-tailed.

Table 6

Correlations between Z-Scored Dimension Weights and Other Questionnaire Variables for Subjects Completing Rate Version of Duplex Gamble Task

	Rate to Win	Money to Win	Rate to Lose	Money to Lose	EV x Evaluation	Minutes to Complete Task[a]
Self-report	.04	.04	-.03	-.07	-.04	-.31*
Decision scale	-.25	.02	.13	.15	-.00	-.11
9-item subscale	-.21	.14	-.03	-.11	.11	.10
EIS - Total	-.06	.06	-.17	.19	-.00	-.27
Narrow definition	-.21	.17	-.27	.33*	.07	-.08
Nonplanning	.14	-.22	.05	.05	-.06	-.22
Risktaking	.06	.07	-.08	-.09	-.02	-.31*
Liveliness	-.12	.02	-.12	.25	-.06	-.32*
Age	.07	-.16	.05	.07	-.43*	.02
Sex (1=M, 2=F)	-.01	-.07	-.04	.15	-.13	.08
Year in school	-.03	.03	.04	-.04	-.12	.09
GPA	.09	-.27	.24	-.02	-.17	.15
SAT score	-.08	.07	-.03	.04	.05	-.09

[a] Quite a few subjects overlooked the space for "End Time" at the end of the duplex gamble task, so time measures are missing for these subjects. For the rate version, correlations are based on 55 subjects.

* $p < .01$, 2-tailed.

associated with less time to complete the duplex bet task (-.31, -.31, -.32 respectively). [3,4]

Eysenck Impulsivity Scale

The EIS total score and subscales all correlated significantly with subjects' self-reports of impulsiveness, ranging from .24 for the liveliness scale to .58 for the EIS total score (median = .48; see Table 2, p. 47). EIS total also correlated .22 with the 20 item decision scale, and the definitional subscale correlated .30 with the 20 item decision scale and .33 with the 9-item decision scale ($p < .01$).

Decision Research Scale

Scores on the 20-item scale were correlated with total EIS score (.22) and with the definitional EIS subscale (.30). The 9-item decision scale was also correlated with the definitional EIS subscale (.33; see Table 2, p. 47).

[3] For each duplex bet in the rate version, a correlation was obtained between each subject's attractiveness rating of the bet and his or her scores on impulsiveness measures (self-report, 18-item decision scale, EIS total and definitional subscales). A comparison of average correlations for bets with high and low rates yielded no differences.

[4] Subjects were grouped according to which of the four risk dimensions from the duplex bet task received the highest weight. A 2 X 4 (questionnaire version X maximum dimension) analysis of variance was performed on impulsiveness scores (self-report, decision scales, EIS total and subscales). There were no significant main effects or interactions.

Subject Background Variables

Regarding subject background variables, females had more impulsive scores on the 9-item decision scale (.21). Older subjects had less impulsive scores on the definitional and liveliness subscales of the EIS (-.19, -.59, respectively) and had higher SAT scores (.20). Subjects with higher GPA showed less impulsiveness on the EIS risktaking subscale (-.21; see Table 2, p. 47; all correlations $p < .01$, 1-tailed).

Behavioral Examples of Impulsiveness

Subjects' responses to the open ended items "Please describe an occasion on which you behaved impulsively", and "Please describe an occasion on which you behaved unimpulsively" (see Appendix E) were classified according to the following categories:

Choices between Expressed Alternatives

This category includes examples in which the subject indicates a choice between two or more alternatives. Twelve percent of impulsive examples were included in this general category. Nineteen percent of unimpulsive examples were included.

Delayed Outcomes. A subset of the choice category, this includes examples in which one or more of the alternatives involved delayed outcomes. An example of impulsive behavior in this category is "I should have been studying for an exam but my friends were going to pick apples". This category is similar to the

definition of impulsiveness as a preference for small immediate over large delayed rewards, represented in the decision scale. Eight percent of the impulsive examples, and 13% of the unimpulsive examples were included in this subcategory.

No Reference to Delay. Other examples of choice did not refer to delayed consequences, but to a choice between simultaneous alternatives. For example "in an airport . . . trying to decide whether to go to Boston or NYC". Four percent of impulsive examples and 6% of unimpulsive examples were in this subcategory.

The distinction between the above categories was sometimes blurred. For example, "I skipped class and went to breakfast instead" was classified as a choice between present alternatives, even though skipping class probably involves long-term consequences. In general, if the subject did not refer to the future ("I skipped class even though it might affect my course grade"), the choice was considered to be between simultaneous alternatives. The exception was for examples involving homework (e.g. doing homework vs. going out with friends). These choices were assumed to refer to the future consequences of doing homework, even if a future exam or course grade was not mentioned. Presumably, students do homework not for immediate benefits but to get good grades, to avoid falling behind, or to avoid the embarrassment of being unprepared in class. Many

of the examples listed in the "future consequences" category involved homework. Otherwise, references to the future (e.g. "I wasn't sure if I would have enough money for the rest of the semester") had to be explicitly mentioned for inclusion in this category.

Decisions not Expressed as Choices

Most of the examples of behavior (88% of impulsive examples and 81% of unimpulsive examples) were not expressed as a choice between alternatives, but as an action either taken or not taken.

Consequences. Examples in which the costs or consequences of an action were expressed were included in this category. For example, "I'll do a shot of hard liquor without thinking about the after effects" (impulsive), and "Before I took the job I planned the pros and cons of moving, including money lost or gained" (unimpulsive). This category is comparable to the risktaking subscale of the EIS, or sensitivity to the loss dimensions on the duplex bet. Seventeen percent of impulsive examples and 19% of unimpulsive examples were included.

Planning. Examples of behaviors involving planning or lack of planning were included in this category. For example, "We were near a theater so we went to a movie" (impulsive), and "Planned a ski trip months ahead of time". References to planning were taken to include thinking about and working on a decision, "it had never

occurred to me before", etc. This category is comparable to the nonplanning subscale of the EIS. Twenty five percent of impulsive examples and 45% of unimpulsive examples were included in this category.

Time. Behaviors involving time or speed were included in this category. For example ". . . I realized what a bum I was living with. I went home and moved out within the next 12 hours" (impulsive) and "Took me one year to decide if I wanted to vacation for a week in Florida" (unimpulsive). Examples were included in this category if time was explicitly mentioned (e.g. "at the last minute", "five minutes later"). The liveliness subscale of the EIS focuses on speed of decision making, and time to complete the duplex bet task was considered in the present investigation as a potential impulsiveness measure. Forty-five percent of impulsive examples and 17% of unimpulsive examples were included in this category.

The percentage of examples in each of the five categories are displayed in Table 7 (p. 61), in order of frequency for impulsive and unimpulsive examples. Time was the most important element of examples of impulsiveness (45%), and planning was the most important element of examples of unimpulsive behavior (45%). These two characteristics make up 66% of the combined examples. Examples acknowledging consequences of behavior and those expressing a choice

between alternatives were much less common (34% of combined examples).

Table 7

Content Analysis of Subjects' Examples of Impulsive and Unimpulsive Behavior

	Impulsive	Unimpulsive	Combined
Time	45%	17%	30%
Planning	25%	45%	36%
Consequences	17%	19%	18%
Choice	12%	19%	16%
Delayed Outcome	8%	13%	11%
No Delay	4%	6%	5%

CHAPTER IV

DISCUSSION

The present study had two main goals. One was to explore a new conception of human impulsive behavior in which individual differences in sensitivity to rate factors influence impulsive decisions. The second was to find out how much agreement exists between impulsiveness measures based on different definitions, and drawn from different fields within psychology.

Four different kinds of questionnaire were used to address these questions. The first was a task in which subjects rated the attractiveness of a series of duplex bets. The bets were designed to permit identification of each subject's pattern of sensitivity to amount and rate or probability of winning and losing. The second questionnaire was a group of hypothetical choices and judgments based on the decision theory literature. These items were designed to assess individual differences in subjects' preferences regarding delayed outcomes of choice. A subset of the items specifically pertained to choices between small immediate and larger delayed rewards, that is, the typical definition of impulsiveness in human decision making literature. The third questionnaire was the Eysenck Impulsivity Scale, composed of 42 items compiled by Eysenck and Eysenck (1977) from other personality scales. The EIS breaks down into four subscales: narrow definition of

impulsiveness, nonplanning, risktaking, and liveliness. Subjects also responded to a single 7-point rating scale regarding their own impulsiveness. Finally, subjects gave behavioral examples of impulsive and unimpulsive behavior.

Before reviewing the results of the study, it is useful to discuss some of the findings from subjects' examples of impulsive behavior. In light of the conceptions tested in the present study, it is notable that few subjects described impulsive behavior as a choice of one alternative over another, or as a choice involving the loss of other opportunities. For example, many subjects described an opportunity to take a trip. They either went on the trip or did not, usually without mentioning positive alternatives (e.g. staying home to save money for a car). When alternatives were mentioned, they did not always involve delayed consequences. Rather, choices might be made between simultaneous alternatives (e.g. going to the basketball hall of fame vs. watching TV). Examples of unimpulsive behaviors were often decisions against behaving impulsively (e.g. not accepting a last-minute invitation to a party), in which case the alternatives are doing something or not. Most of the examples comprising the delayed outcomes category involved homework, where delayed outcomes are implied, yet, as discussed in the previous chapter, the delayed outcomes (e.g. tests or

course grades) were rarely mentioned. It is possible that homework serves as a secondary reinforcer -- that doing homework is itself rewarding as a result of being associated with the delayed rewards of good grades, being prepared, etc. In that case, subjects would not have to look to the future to make decisions about doing homework. A choice between doing homework and going to a party may be, from the subject's point of view, a choice between two immediate "rewards". In sum, there is little evidence from subjects' behavioral examples to support the definition of impulsiveness as a choice between immediate and delayed rewards, or even as a choice between two positive alternatives.

In addition, subjects' examples of impulsive behavior indicate that impulsive decisions are made without consideration of costs and consequences. This is not to say that subjects chose to accept the consequences and behaved impulsively anyway, but that such concerns did not enter into the decision process. Even when consequences were acknowledged, subjects rarely expressed regret or remorse in describing impulsive behaviors, rather, they usually seemed pleased at having seized an opportunity.

The conception of impulsiveness as the preference for a small immediate reward over a large delayed reward was extremely rare in the subjects' examples; similarly, there were no intimations that rate of reward was an

important aspect of impulsive decision making. (It should be noted here that many subjects described behaviors in some detail -- including, for example, times of departure, names of restaurants, other people involved -- so failure to mention alternatives cannot be attributed simply to terseness on the part of the subjects.) Both the duplex bet task and decision items are based on the assumption that impulsive behavior occurs in the context of a choice involving both gain and loss. However, the subjects' examples are quite clear on this matter, and their descriptions of impulsiveness as a seizing of opportunity without explicit consideration of consequences should be taken seriously. Discussion of the other results of the present study will consider the implications of the subjects' conception of impulsiveness.

Eysenck Impulsivity Scale

The EIS as a whole was highly reliable (alpha = .84) and intercorrelations among the four subscales were high (.26 to .81). The subscales and total were all significantly correlated with subjects' self-report of impulsiveness (.24 to .58), and, for the most part uncorrelated with background variables (there were three weak correlations involving age and GPA). Impulsiveness as measured by total score and the risktaking and liveliness subscales was associated with less time spent

completing the rate version of the duplex gamble task (-.27, -.31 and -.32, respectively).

The high reliability of the EIS and its success in correlating with self-report and time is perhaps not surprising, given the origins of the scale. Although it is possible that subjects were influenced by their previous responses to the EIS when responding to the self-report item, it is likely that the EIS itself is essentially a more reliable self-report measure of impulsiveness. The items in the EIS were originally written on the basis of face validity in measuring impulsiveness, were selected from various personality questionnaires on the basis of face validity, and the best items were retained in the EIS using the results of factor analysis. Therefore, it would be somewhat surprising if the scale were <u>not</u> related to subjects' own definitions of impulsiveness.

In fact, subjects' examples of impulsive and unimpulsive behavior were quite similar to the definitions implied by the EIS. Speed of decision-making ("liveliness", in terms of the EIS) was the most common element found in examples of impulsiveness, and planning was the most common element in examples of unimpulsive behavior. The correlation between self-report of impulsiveness and the risktaking subscale could be seen as consistent with a conception of impulsiveness as the failure to attend to consequences

of behavior. Risktaking might be viewed as action taken, not in spite of possible costs, but without taking account of them at all.

Rate Preferences

Weights obtained for each subject for the risk dimensions in the duplex gamble task indicated substantial individual differences in preferences. This was true for the probability version of the task, as well as for the rate version.

The probability version was a direct replication of Slovic and Lichtenstein's (1968) original procedure. This task was not designed to serve as a measure of impulsiveness, and as expected, there were no significant correlations between dimension weights for this task and scores on impulsiveness measures or background information.

The rate version was designed to assess individual differences in preference for rate of winning and losing, as well as amount of money to be won and lost. As predicted, weights for rate to win and lose were greater than weights for the probability of winning and losing (.40 and -.46 vs. 25 and -.35). This result supports the hypothesis advanced in Chapter I, that probability should be considered a special case of rate, relevant only for behaviors and outcomes independent of other opportunities. Also, within the rate version of the task, rate of winning and losing were weighted more

heavily than amount to win and lose (.40 and -.46 vs. .33 and -.28). In the probability version, amount to win was weighted more heavily than probability to win, and amount and probability to lose were weighted equally. Subjects appear to pay special attention to rate, suggesting that rate information is a familiar and relevant tool for decision making.

Considerations relevant to a series of choices are more often appropriate than those applicable only to an isolated event. This assertion can be illustrated with an example from daily sports news: Charles Barkley, a prized professional basketball player, has to make a lot of decisions on the court. If he shoots every time he gets the ball, he will make a lot of points. However, although his points per game will be high, he will also miss more baskets than if he shoots less frequently, and he will be responsible for losing the ball to the other team more often. Each opportunity to shoot affects later opportunities, therefore, his shooting decisions are linked to rate of reward. On the other hand, if Barkley is holding the ball two seconds before the end of the last quarter, his decision is not part of a continuing series. His throw can only affect the final score of the game; no other plays will be affected. (This is a simplified example, in which "extragame" rewards linked to success on the court, such as media exposure, salary, and deodorant ads are purposely

ignored. The difficulty of finding any behavior that is completely independent of future behaviors itself supports the significance of rate considerations.) Most of Barkley's decisions on the court affect later choices; his off-court behavior is probably similarly interrelated.

Sensitivity to the amount to lose dimension in the rate version was associated with impulsiveness as measured by the definitional EIS subscale (.33). In addition, for the rate version but not the probability version, time to complete the task was correlated with self-report of impulsiveness and EIS scales (-.31 with self-report, -.31 and -.32 for risktaking and liveliness, respectively). A possible interpretation of these differences is that the task involving rate engaged the subjects' attention in a way that permitted the expression of individual differences in impulsiveness. The rate task required subjects to imagine delays before winning or losing money. This is comparable to a situation in which individuals made a decision involving delayed consequences of choosing a reward (e.g. not studying for an exam in order to go to a party). On the other hand, the probability task involved immediate, one-time outcomes. Subjects' different reactions to these situations may reflect their responses to actual, everyday, decision situations. Although weighting of the rate dimensions

does not appear to be directly related to other measures of impulsiveness, the task as a whole may have represented a kind of choice situation relevant to impulsive behavior.

It is possible that the task involving rate was simply more difficult than the probability version, requiring subjects to spend more time on each item, and leading to more careful evaluations of each choice. This idea is borne out by the data indicating that subjects spent more time on the rate version. The same information may also suggest that the probability dimension was more difficult to comprehend, causing frustrated subjects to pay less attention to the probability dimension and focus on money to be won and lost. However, a comparison of the sums of the absolute values of the weights (see Table 4, p. 51) indicates that subjects did not pay more careful attention to one version. Disparity of the sums would have resulted from higher weighting of most or all of the dimensions for one version, indicating that more attention was paid to that version in general. In addition, none of the subjects (including pilot subjects, who were encouraged to comment on the task), expressed any difficulties with either version. All had been given written instructions and had completed three practice items before beginning (and timing) the 27-item task.

Despite the concerns mentioned above, the suggestion that rate variables may be relevant to subjects' decision making, and possibly to impulsive behavior, should be taken seriously. Foraging studies clearly indicate the importance of rate to survival strategies of wild animals, and there is no reason to believe that human and animal approaches to decision making are totally disparate. Nonetheless, rate is generally ignored in favor of probability factors in human decision making experiments (and animal models of human decision making). The present study demonstrates that it is possible to measure rate preferences in humans without confound and that there are sizeable individual differences in rate preferences. That these differences play an important role in decision making is suggested by the present results, and should be the focus of further study.

Counter to expectations, it appears that, if anything, impulsive subjects are most sensitive to loss, particularly amount to lose (.33 correlation between money to lose and EIS definitional scale). Following Gray's (1987) theory, it was predicted that impulsive subjects would be most sensitive to reward. In addition, sensitivity to punishment seems to contradict the notion that impulsive individuals ignore information about cost. However, the kind of decision described by subjects and the decisions made in the duplex gamble

task are quite different. The duplex bets are explicit in the gains and losses to be expected, and the subject is aware that he or she is supposed to use all available information. However, in everyday life, individuals are in control of framing their own choices, and are not forced to consider all relevant information. It is possible that impulsive individuals find cost information highly disturbing, and avoid attending to it when possible. When cost information is conspicuous, the same individuals may weight it heavily. The impulsive subjects who completed the rate task more quickly than their unimpulsive counterparts were responding to a situation in which they would (hypothetically) have to spend time contemplating losses (the delay period before losing money). They responded in this situation by making faster decisions, and concentrating on the losses they would be facing.

Decision scale

The decision scales, along with the subscale based on a precise definition of impulsive behavior -- that is, a preference for a small, immediate reward to a larger, delayed reward -- were surprisingly unreliable (.50 for the 20-item scale, .40 for the 9-item subscale). Both decision scales were correlated with the definitional scale of the EIS (.30 for the 20-item scale and .33 for the 9-item subscale, and the 20-item scale was correlated with EIS total score (.22).

However, low reliability limits the interpretability of the decision scales, and suggests that the items, though based on a simple and plausible definition, are not measuring a simple construct in subjects' behavior.

It is possible that the "real-life" nature of some of the decision items contributed to the inconsistency of responding. Some items were based on situations which may have been familiar to the subjects (dieting, doing homework vs. going out with friends), while others were more abstract (receive $100 now or $200 at a later time). Thus, subjects may have had a great deal of information about how they would act in certain situations, while for others they had to imagine their behavior, possibly leading to idealized or unstable responses. A more uniform sample of items measuring preference for immediate vs. delayed rewards may yield more reliable and informative results.

Delay of Gratification and Impulsiveness

The results indicate that hypothetical choices between small immediate rewards and larger delayed rewards (as measured in this study) are not strongly related to one another or to more traditional definitions of impulsiveness. Consequently, it seems likely that a delay of gratification paradigm, which is based on the same principle, would also not be correlated with self-reports of impulsiveness (Mischel rarely uses the term impulsiveness in connection with

delay of gratification, but its similarity to the decision theory model is undeniable). The next question to arise, then, is whether behavior in the delay of gratification paradigm is more meaningful than responses to the decision scale appear to be. In light of the misgivings expressed above about the construct validity of the hypothetical delay of gratification-type choices used in human decision research, how is it possible that Mischel's measure could show predictive validity?

Recall that waiting for the larger reward in a delay of gratification paradigm at age four is correlated with good grades, social competence, social responsibility, ambition, etc., ten years later (Mischel, Shoda, & Peake, 1988; Mischel, Shoda & Rodriguez, 1989). This striking result is evidence for the stability and validity of the construct assessed by the original single-item test. However, the delay of gratification paradigm is based on the same choice as the items on the decision subscale, which had very low reliability. The lack of reliability and convergent validity of hypothetical delay of gratification choices, considering their face validity and the rather spectacular performance of the original single-item delay of gratification choice is surprising, and indicates a special problem with subjects' knowledge of their own choice preferences. In an unpublished report, Mischel (1962, cited in Mischel, 1974) seems to have

confirmed this discrepancy: he found that responses to hypothetical delay of gratification choices, such as between a cheap, new bike now and a fancy racing bike in a month, were not correlated with choices in actual situations, like choosing between cheap toys now and more attractive ones in the future. Mischel's findings indicate that subjects are poor at predicting their own behavior with regard to delayed rewards, and that the items on the decision scale could be inadequate reflections of subjects' actual behavioral tendencies.

Again it is appropriate to consider the problem with regard to the proposed explanation of impulsiveness as a tendency to avoid framing a problem in terms of potential costs, as a result of increased sensitivity to punishing factors. In hypothetical situations, the subject is not in control of framing the problem, and is forced to take all information into account to at least some extent. A subject who is sensitive to cost information may weight that information heavily when confronted with it, but, when possible, may frame decision situations so that cost considerations can be avoided. This would explain why Mischel's subjects respond differently to hypothetical and actual choices, and why subjects fail to predict choice behavior accurately and consistently.

Mischel's research offers further evidence to support this notion. Subjects who succeed in delaying

gratification use strategies to avoid thinking about the reward and the delay. Children could wait longer for a larger candy bar if they focused on its shape or avoided thinking about it at all, than if they thought about its taste. The "impulsive" subjects avoided spending time attending to costs (and experiencing those costs in the form of frustration. "Unimpulsive" subjects framed the situation such that costs (not having a candy bar right away) were less apparent. It is possible that when impulsive subjects are unable to ignore cost considerations, they are highly influenced by them, while unimpulsive subjects are able to confront the punishing dimensions of a decision situation, and use strategies to diminish perceived costs in order to obtain their goals.

The correlation between delay of gratification at age four and social and academic success at age fourteen raises another interesting issue. Mischel (1974) conjectures that early family environment can teach the skills needed to wait for a deferred reward, and that these skills pave the way for other kinds of achievement. Individuals who wait for larger rewards tend to come from middle and upper socioeconomic classes and more achievement-oriented cultures. Conversely, individuals who prefer immediate gratification come from lower socioeconomic classes and less achievement-oriented cultures. However, there are no doubt

individual differences within socioeconomic groups, and even within families. A purely environmental explanation of individual differences in delay of gratification appears to be inadequate, so it may be helpful to look toward dispositional factors.

The ability to wait for a larger reward could be associated with a willingness to defer to the perceived values of society (patience, perseverance, "good things come to those who wait", etc.). There is an implicit moral element to waiting for a deferred reward in our society, as there is to getting good grades, being socially adept, and of course to resisting temptation. Mischel (1974) himself suggests the moral element to waiting for a reward when he refers to the type of individual with a strong tendency to choose larger, delayed rewards as showing the "Puritan character structure", and coming most often from "Protestant ethic" cultures (1974, p. 253). The ability to delay gratification at an early age, and later social and academic success are the manifestations of personal morality in our society.

Some individuals may learn strategies for minimizing the pain associated with delayed rewards in order to attain the goals valued by society. Individuals who value these goals to a lesser extent may concentrate more on immediate goals, failing to learn or use strategies for dealing with cost information, and

avoiding such information when possible. It is of course a long leap from the findings of the present study to a conclusion that impulsive individuals are hedonistic and antisocial, but this discussion is an attempt to synthesize disparate patterns of results in the study of impulsiveness. Firm conclusions cannot be drawn from present results that are often counter to expectations, but speculations as to their meaning are an important step toward progress in understanding the questions about impulsiveness and decision making raised in this paper.

Conclusions

Three measures based on different conceptions of impulsiveness were examined. Results indicate that, although the same term is used to describe the behavior assessed by each measure, they are not all clearly related. This is not surprising, given the widely different conceptions on which each measure was based, but use of the same term (impulsiveness) suggests better agreement. It is now appropriate to draw some conclusions about each of the measures, regarding their worth as measures of impulsiveness and as research tools.

Eysenck Impulsivity Scale

The EIS was strongly correlated with self-report of impulsiveness. Benefits of the EIS over a simple self-report of impulsiveness are clear: the EIS has been used

extensively, with norms available for large and varied populations, and the four subscales of the EIS provide useful definitions of impulsiveness. However, aside from being a helpful equivalent to subjects' self-report of impulsiveness, it is difficult to see how the EIS can serve to further the theoretical understanding of individual differences in impulsiveness. According to Eysenck (1987), impulsivity merely results from a certain combination of central personality traits, and by itself is not a worthwhile object of investigation. In addition, Eysenck's central personality dimensions provide only a descriptive explanation of impulsiveness, and lead to few testable hypotheses about the psychological processes involved in impulsive behavior or its origins. A measure like the EIS which is based on a descriptive theory cannot by itself contribute to a deeper understanding of the concept of impulsiveness.

Rate Preferences

Rate preferences were not directly related to impulsiveness, although the rate version of the duplex bet task appeared to activate subjects' individual differences in impulsiveness as it corresponds to other variables (time, EIS score). This finding, as well as the finding that subjects paid more attention to rate information than to probability information indicates that rate information is relevant to human decision making. This evidence, while not conclusive, points to

the necessity for further exploration of the place of rate preferences in human decision making. This neglected variable may prove important in permitting comparison and synthesis of the animal and human choice literatures, and promoting progress in human decision making.

Decision Scale

Items like those on the decision scale have been widely used (although admittedly not to assess individual differences), in research on human decision making, with the assumption that the hypothetical situations are equivalent to actual choices. However, the results of this study indicate that not only are verbal responses not a convincing substitute for actual behavior, but that the responses are only weakly related to one another. As discussed above, the difficulty may lie in the situational nature of the items, but this study produced no evidence that the verbal choices between small immediate and larger delayed rewards in the present study tap a useful psychological construct, and little evidence that choices involving delayed rewards are closely associated with impulsive behavior.

Despite the concerns just discussed, it may yet be tempting to say that the small immediate vs. large, delayed reward choice is still useful. After all, it has been the foundation for dozens of published works and has allowed comparisons between human and animal

choice behavior. But the problems with reliability of verbal choice items should not be ignored. The behavioral choices used in operant studies have indeed proved informative, but the results of this study call into question the assumption that verbal responses to hypothetical situations are related to simple behavioral choices. Past investigations with this concept have used only one or two items, with no attention to their reliability. The current study represents the first time some items (previously used confidently as illustrations of impulsive behavior) have been tested with subjects, and probably the first time more than two of this type of item have been used together. Continued attention to this type of choice should be accompanied by more careful scrutiny of reliability and construct validity issues.

Impulsiveness as Aversion to Cost Considerations

The examples of impulsive and unimpulsive behavior contributed by subjects in this study point to a possible definition of impulsiveness which contradicts some premises on which the other measures were based, but is helpful in accounting for data in this and previous studies. In contrast to the common definition of impulsiveness as a choice between alternatives, characterized by elements of delay and cost, subjects described behaviors that were characterized by immediate opportunity, and rarely mentioned alternatives or future

consequences. On the basis of these descriptions and the relations between other variables in the study, it was conjectured that impulsive subjects are highly sensitive to information regarding costs, but that in the presence of reward, they are averse to spending time attending to costs associated with the reward. They solve this problem whenever possible by framing the problem in order to avoid the unpleasant considerations of behavioral costs. Such a strategy may objectively lead to undesirable consequences, but impulsive individuals appear to disassociate the consequences from the reward. This accounts for the rapid decision making reported in impulsive behavior, the common belief (even among scholars of personality) that impulsiveness "lead[s] to trouble" and is contrary to "good judgment" (Fowles, 1987, p. 421), the apparent insensitivity to punishment displayed by subjects in some situations, and the disparity between responses to hypothetical and actual choice situations.

This conception of impulsiveness is an attempt to integrate the results of the present study. Because it is based on a number of unpredicted, even surprising results, it is not conclusive, but requires further replication and investigation. In general though, the results of this study should serve as a caveat regarding common definitions and measures of impulsiveness. Different perspectives within psychology clearly

disagree about the meaning of impulsiveness, and common impulsiveness measures appear to be at best inadequate, and at worst irrelevant to the explanation and investigation of individual differences in impulsiveness.

Impulsiveness as a Unitary Construct

The current investigation has been based on the assumption that the term impulsiveness is based on a single underlying construct, and that different definitions and operationalizations of that construct could be unified by the appropriate definition. However, in light of the findings of this study and the range of perspectives on impulsiveness, the possibility that impulsiveness is not a single construct, but a term encompassing many different, even unrelated, constructs, must be considered. Such a situation is not uncommon in academic psychology, although sometimes the discrepancy between different constructs bearing the same label is acknowledged. Memory is a familiar example of a construct which is defined and measure in many different ways. Different measures are not typically well correlated, but this is clearly recognized and explicitly discussed, with the result that what is meant by the term memory is generally made clear each time it is used. In the case of impulsiveness, investigators using the term pay little or no attention to different uses of the term, and do not attempt to clarify

distinctions between usages preferred for different purposes. Such failure to explicitly recognize differences in usage is not problematic as long as the segregation between different perspectives is complete. However, scholarship requires familiarity with relevant information from a broad range of sources, therefore the existing lack of communication regarding impulsiveness is inappropriate and counterproductive. Psychologists using the term impulsiveness should be prepared to offer a clear explanation of their use of the term, as well as to contrast it with other usages. If impulsiveness is not a unitary construct, findings from the many past research directions regarding impulsiveness cannot be compiled to further the general investigation, as was proposed in Chapter I. But a more important obstacle to progress lies in neglecting to appreciate the complex or multifaceted nature of the impulsiveness construct.

APPENDIX A

DUPLEX GAMBLE TASK: PROBABILITY VERSION

Please read these instructions carefully.

You are to imagine yourself playing the game described below. On the questionnaire you will see a series of these games. You are asked to rate each one according to how much you would like to play it.

The game is controlled by 2 spinners. One determines your chances of <u>winning</u> some money, and the other determines your chances of <u>losing</u> some money. Here are examples of the spinners that might be used in one game.

To play the game, spin both spinners. In this game, you have a .4 (40%) chance of winning $1, and a .6 (60%) chance of winning nothing. You have a .2 (20%) chance of losing $1 and .8 (80%) chance of losing nothing. It's possible for you to win $1 and lose $1, win $1 and lose $0, win $0 and lose $1, or win $0 and lose $0.

On the questionnaire you are about to receive, imagine yourself playing each of the games shown. The amount of money you can win or lose on each spin will vary, and your chances of winning and losing will also vary. In the blank by each game, write in your rating of how much you would like to play each game.

Try the three practice items on the next page, and make sure you understand the game before continuing. Don't forget to write your start and end times in the spaces provided.

PRACTICE ITEMS

In the space provided next to each game, indicate how much you would like to play the game, using the scale below:

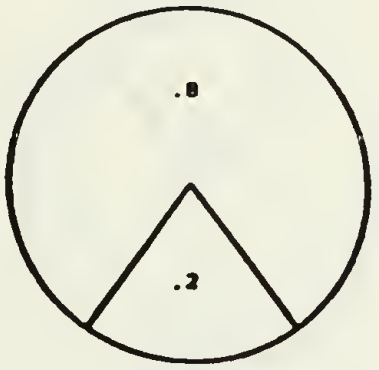
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

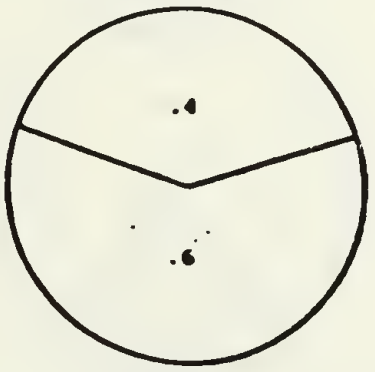
1. _____

WIN $20



WIN 0

LOSE $20



LOSE 0

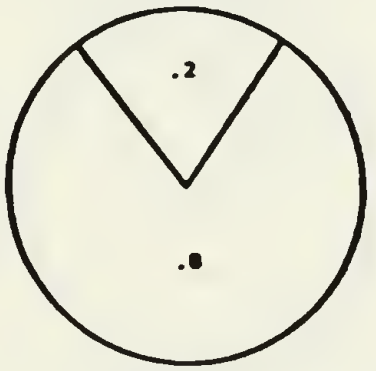
---

2. _____

WIN $10

WIN 0

LOSE $40

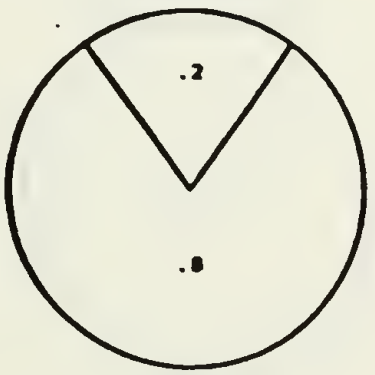


LOSE 0

---

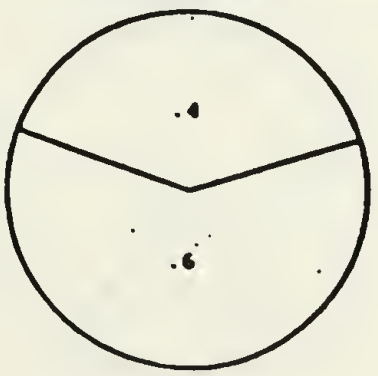
3. _____

WIN $10



WIN 0

LOSE $40



LOSE 0

Ask any questions you have before starting the next page. Record your start and end times in the spaces provided.

START TIME _____

In the space provided next to each game, indicate how much you would like to play the game, using the scale below:

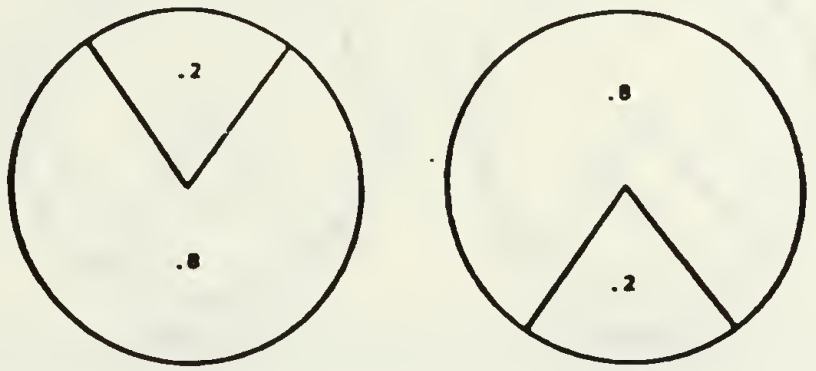
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer <u>not</u> to play — no preference — strongly prefer to play

---

1. _____

WIN $20 | LOSE $20

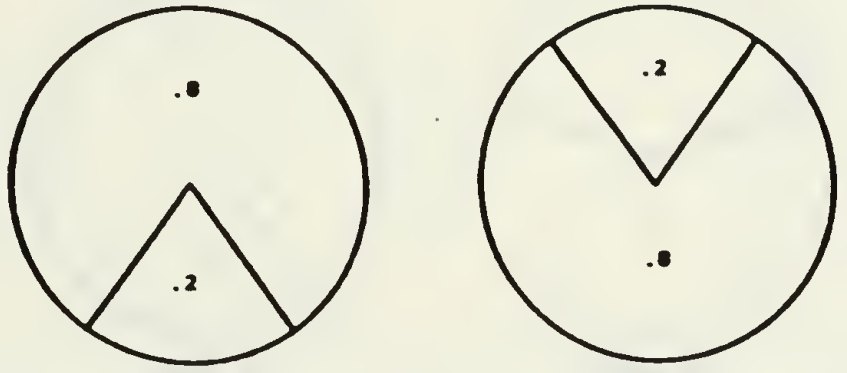


WIN 0 | LOSE 0

---

2. _____

WIN $10 | LOSE $40



WIN 0 | LOSE 0

---

3. _____

WIN $10 | LOSE $40

WIN 0 | LOSE 0

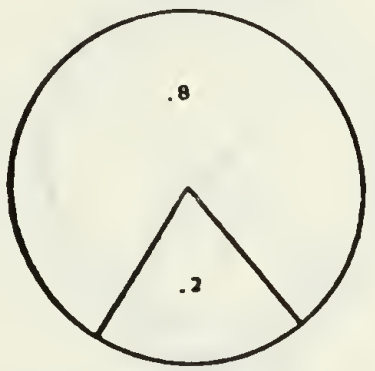
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

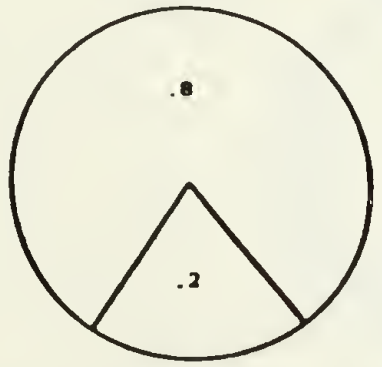
4. _____

WIN $20



WIN 0

LOSE $10

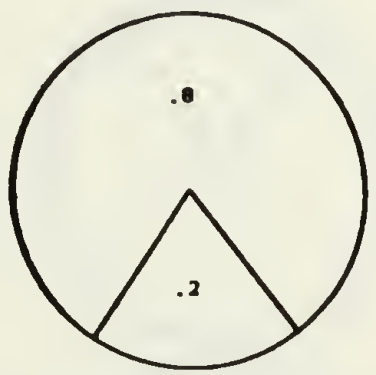


LOSE 0

---

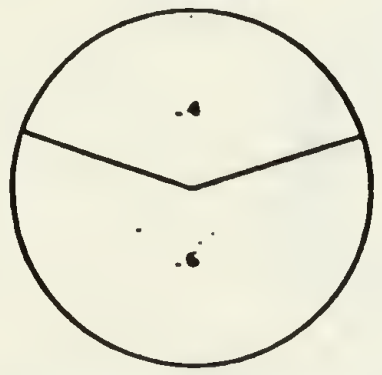
5. _____

WIN $20



WIN 0

LOSE $40

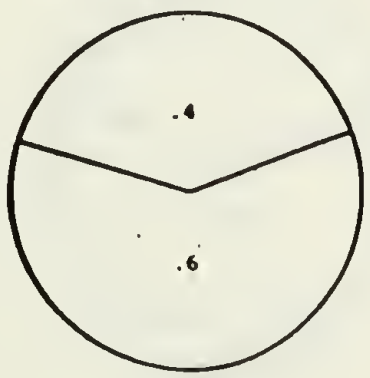


LOSE 0

---

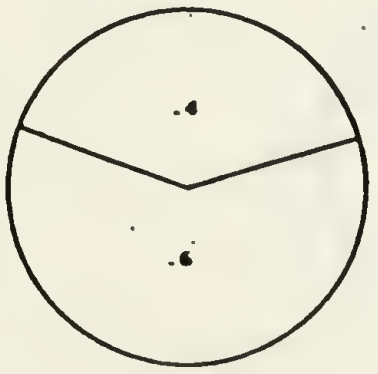
6. _____

WIN $40



WIN 0

LOSE $10



LOSE 0

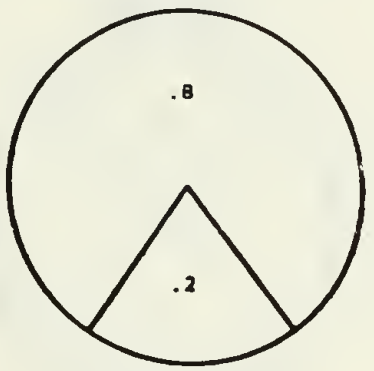
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

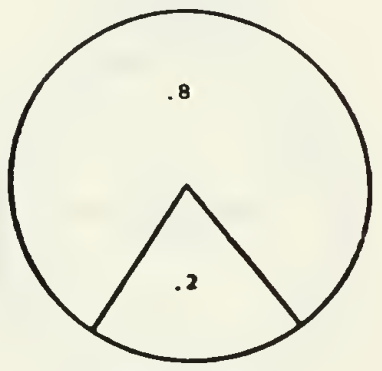
7. _____

WIN $10



WIN 0

LOSE $20

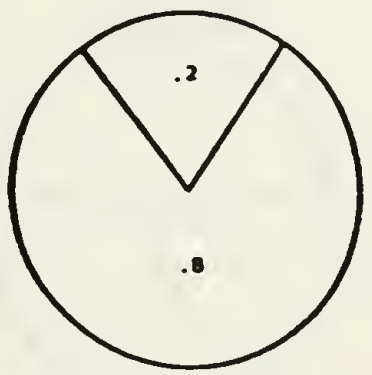


LOSE 0

---

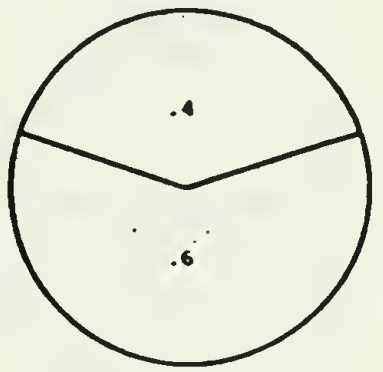
8. _____

WIN $20



WIN 0

LOSE $10

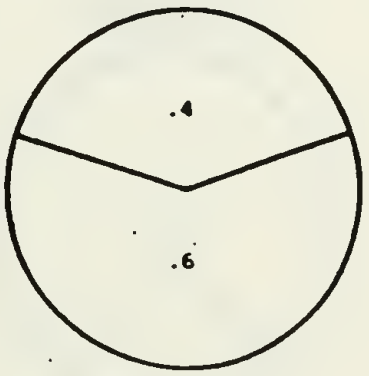


LOSE 0

---

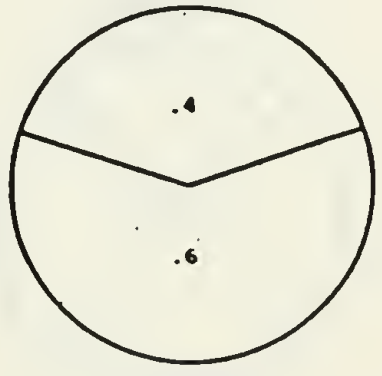
9. _____

WIN $10



WIN 0

LOSE $40



LOSE 0

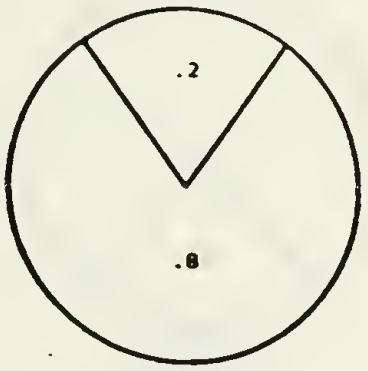
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

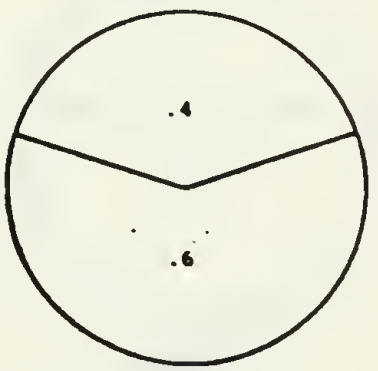
10. _____

WIN $10



WIN 0

LOSE $20

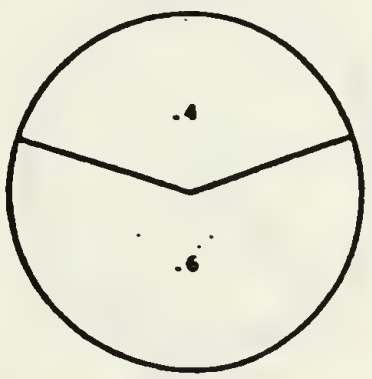


LOSE 0

---

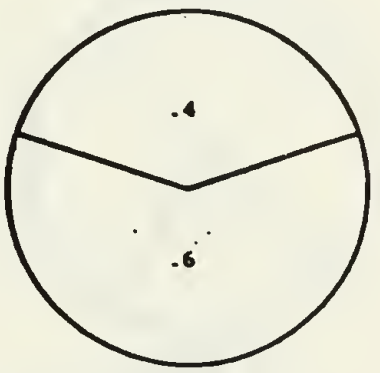
11. _____

WIN $20



WIN 0

LOSE $20

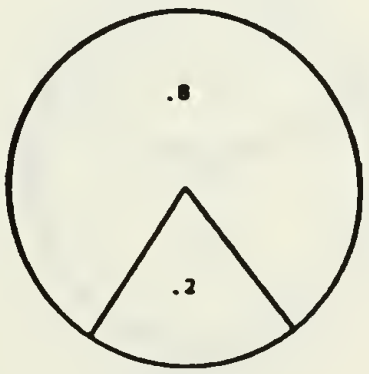


LOSE 0

---

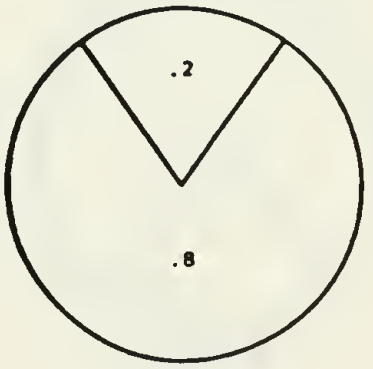
12. _____

WIN $20



WIN 0

LOSE $20



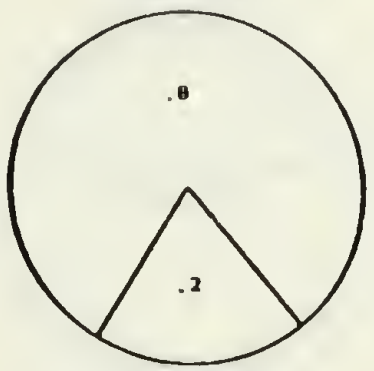
LOSE 0

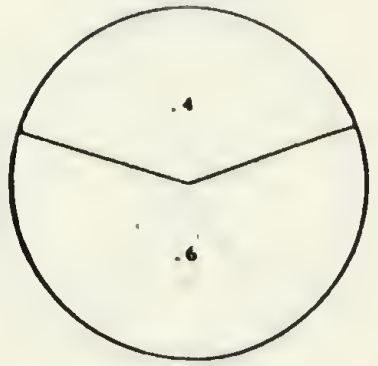
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

13. _____





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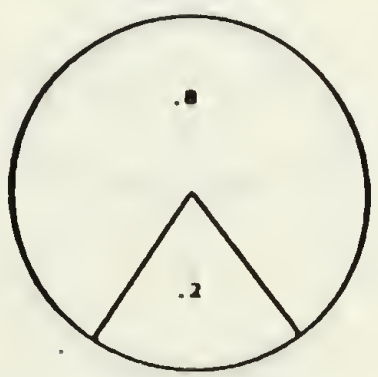
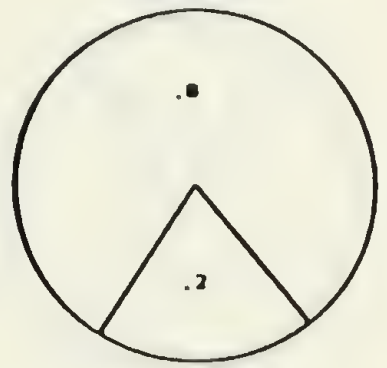
14. _____





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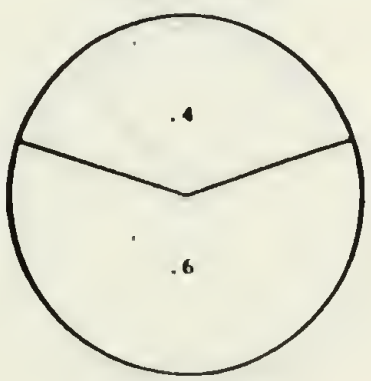
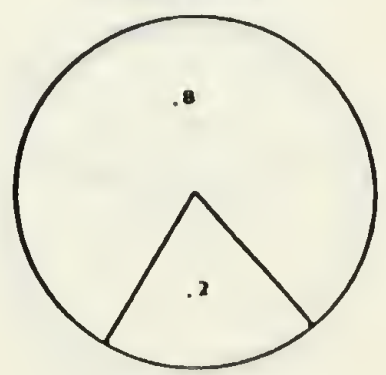
15. _____



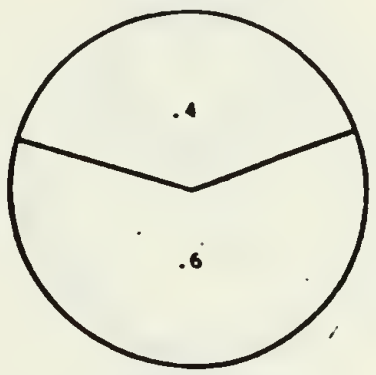


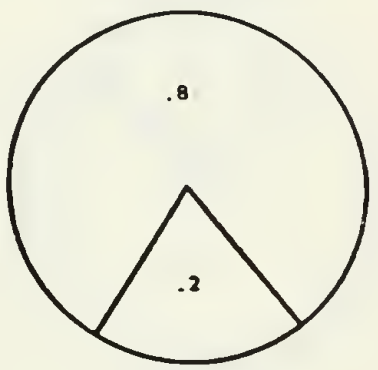
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

16. _____





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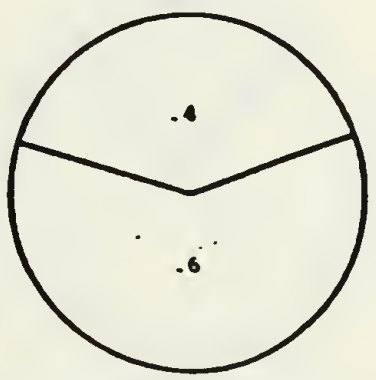
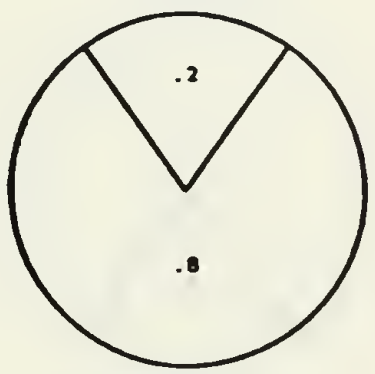
17. _____





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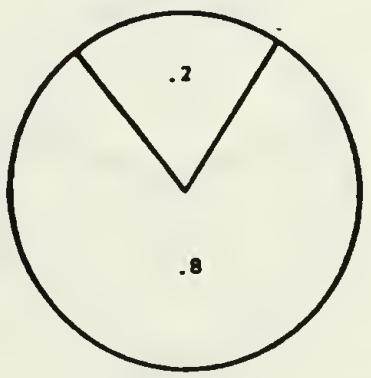
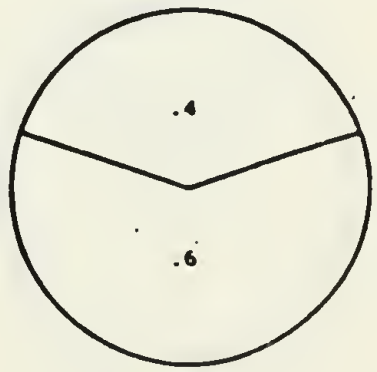
18. _____





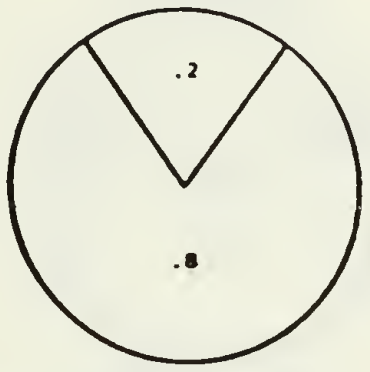
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

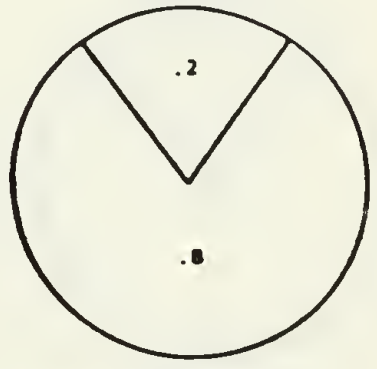
19. _____

WIN $10



WIN 0

LOSE $10

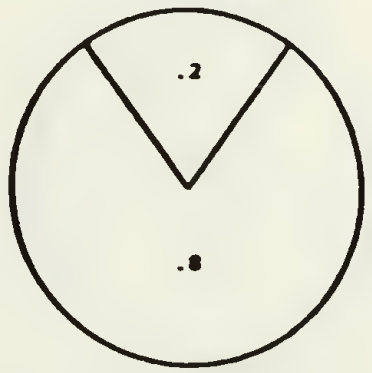


LOSE 0

---

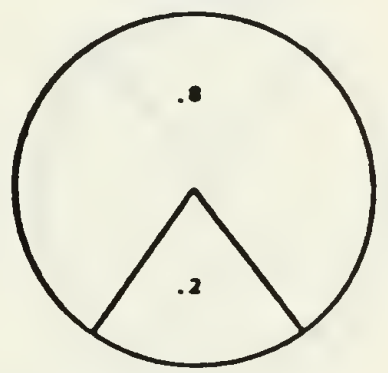
20. _____

WIN $40



WIN 0

LOSE $10

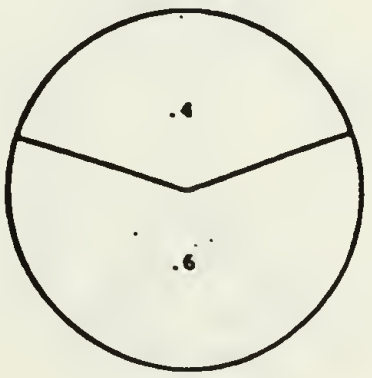


LOSE 0

---

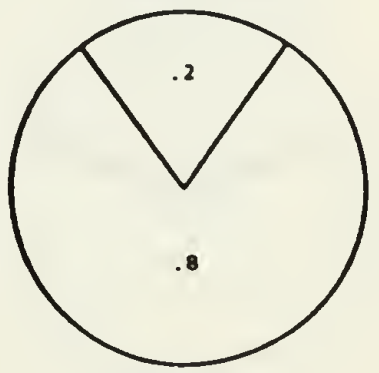
21. _____

WIN $40



WIN 0

LOSE $40



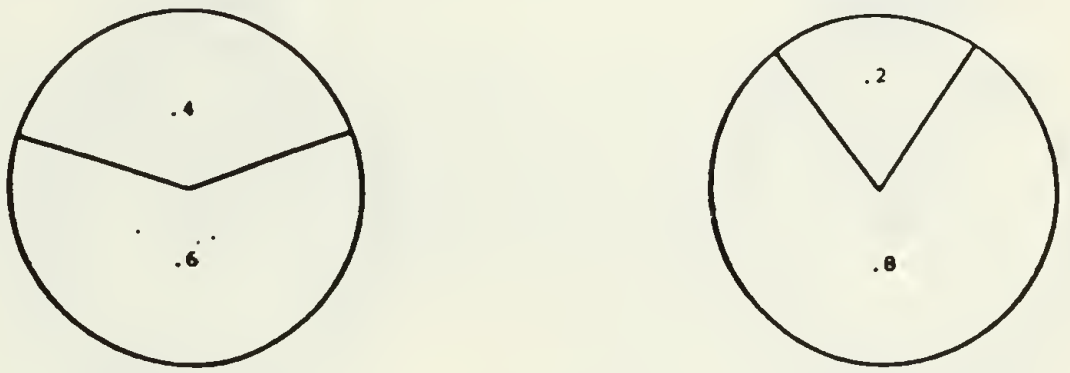
LOSE 0

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

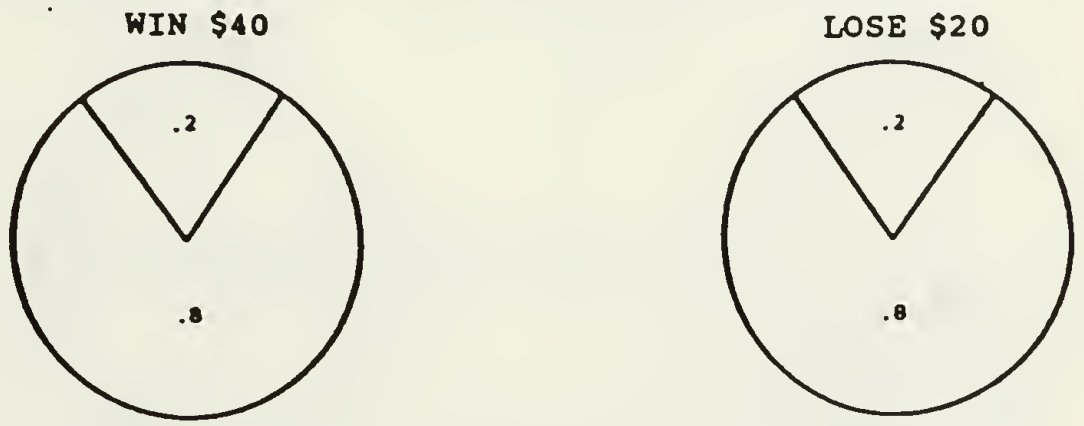
---

22. _____



---

23. _____



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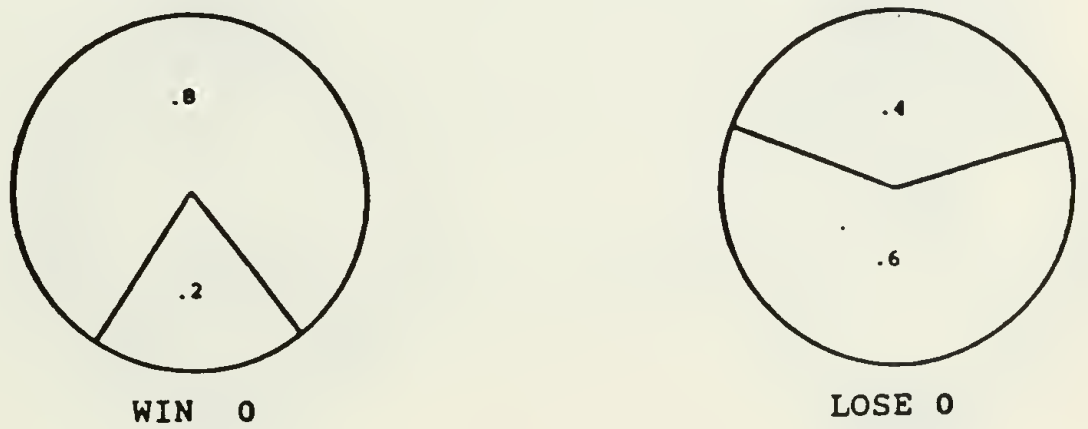
24. _____



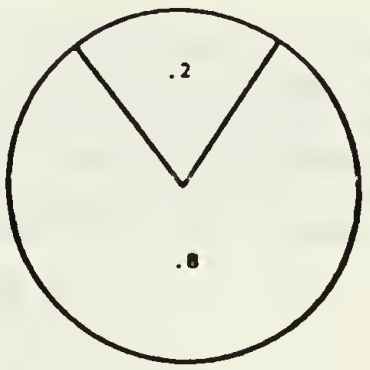
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

---

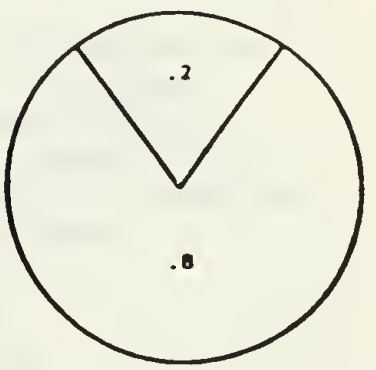
25. _____

WIN $20



WIN 0

LOSE $40

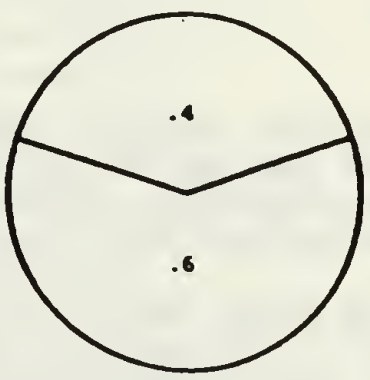


LOSE 0

---

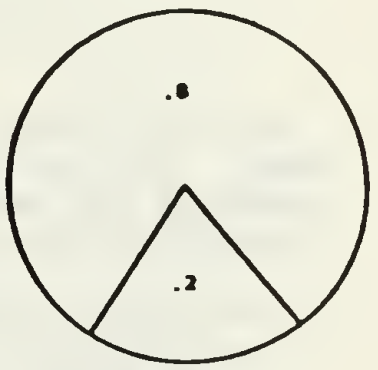
26. _____

WIN $20



WIN 0

LOSE $40

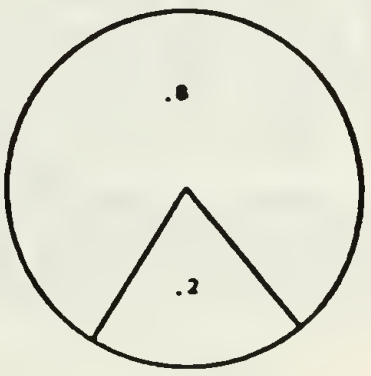


LOSE 0

---

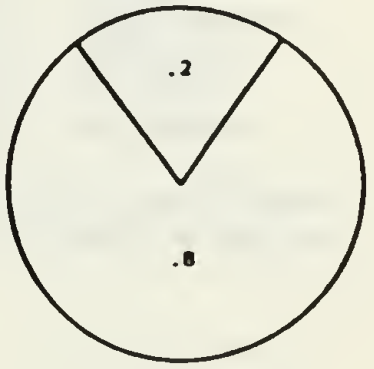
27. _____

WIN $40



WIN 0

LOSE $10



LOSE 0

END TIME _____

APPENDIX B

DUPLEX GAMBLE TASK: RATE VERSION

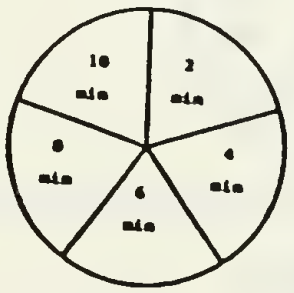
Please read these instructions carefully.

You are to imagine yourself playing the game described below. On the questionnare you will see a series of these games. You are asked to rate each one according to how much you would like to play it.

Each game is controlled by 2 spinners. One determines how long you must wait before winning some money, and the other determines how long you must wait before losing some money. After waiting the number of minutes shown on the spinner, you will win or lose the indicated amount, and spin again. Here are examples of the spinners that might be used in one game.

WIN $1

LOSE $1



When you start to play, spin both spinners. Let's say the win spinner lands on "3" and the lose spinner lands on "6". That means that in 3 minutes you will win $1 and spin the win spinner again. You will wait six minutes before losing $1 and spinning the lose spinner again.

Notice that after the first spin, you may not be spinning the 2 spinners at the same time. It is as if the game is a combination of 2 small games, one in which you win every so often, and one in which you lose every so often. It's possible for you to win more often than you lose, or lose more often than you win.

On the questionnaire you are about to receive, imagine yourself playing each of the games shown for 1 hour. The amount of money you can win or lose on each spin will vary, and the waiting times marked on the spinners will also vary. In the blank by each game, write in your rating of how much you would like to play the game.

Try the three practice items on the next page, and make sure you understand the game before continuing. Don't forget to write your start and end times in the spaces provided.

PRACTICE ITEMS

In the space provided next to each game, use the scale below to indicate how much you would like to play the game for one hour.

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

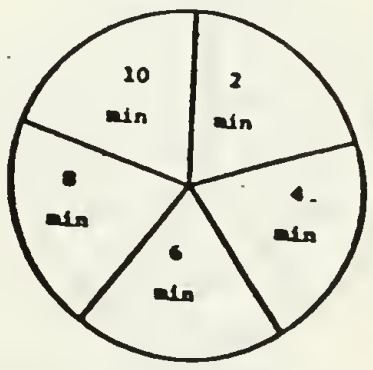
strongly prefer not to play — **no preference** — **strongly prefer to play**

---

1. _____

WIN $20

LOSE $20



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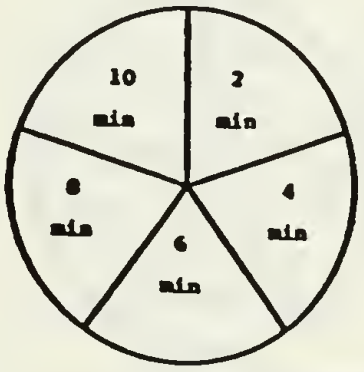
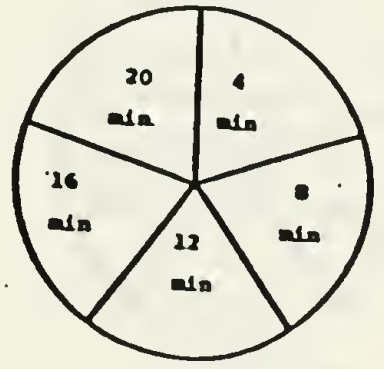
2. _____

WIN $10



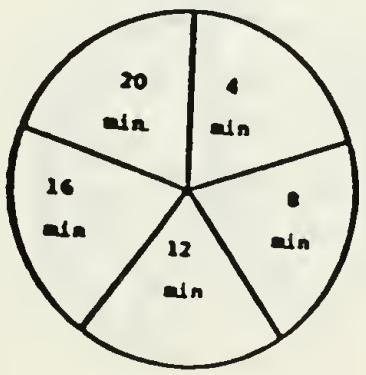
LOSE $40



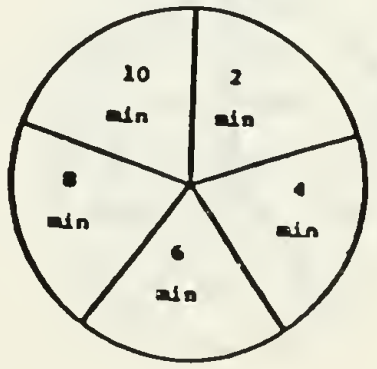
---

3. _____

WIN $10



LOSE $40



START TIME _____

In the space provided next to each game, use the scale below to indicate how much you would like to play the game for one hour.

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

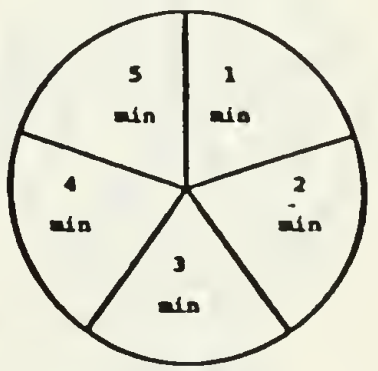
strongly prefer not to play — no preference — strongly prefer to play

---

1. _____

WIN $20

LOSE $20

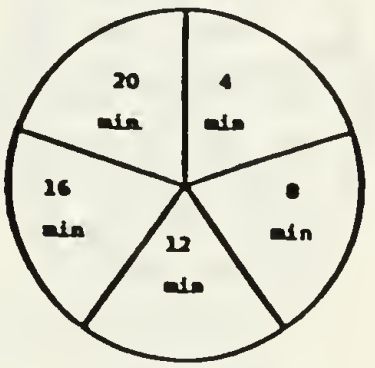


---

2. _____

WIN $10

LOSE $40



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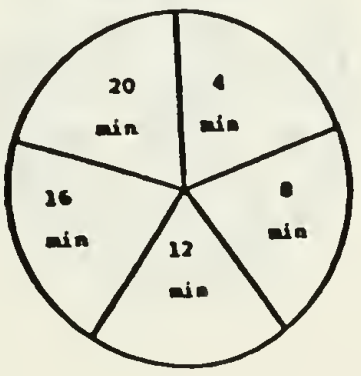
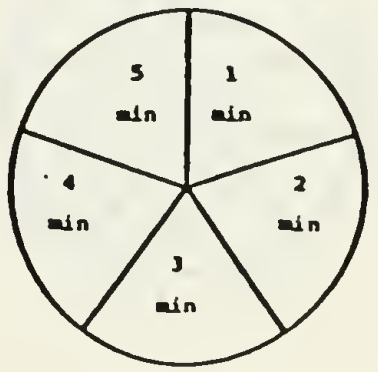
3. _____

WIN $10



LOSE $40



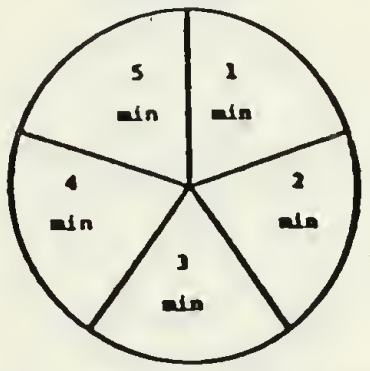
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

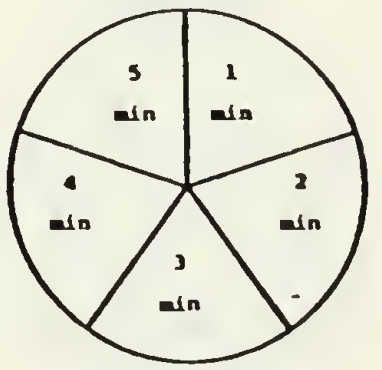
---

4. _____

WIN $20



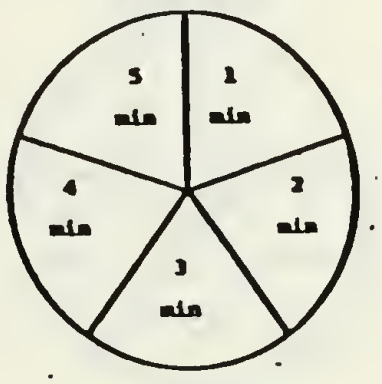
LOSE $10



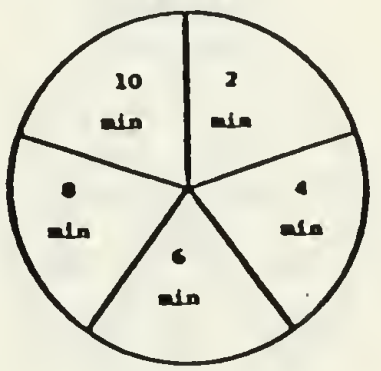
---

5. _____

WIN $20



LOSE $40



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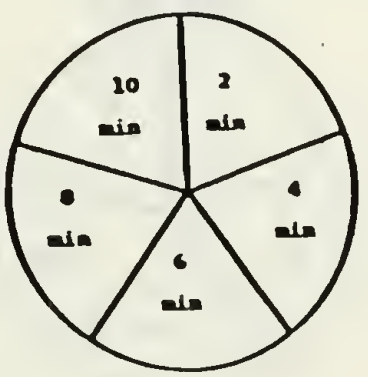
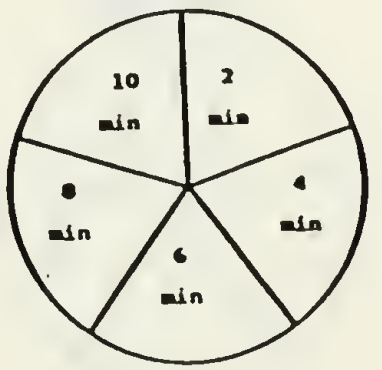
6. _____

WIN $40



LOSE $10



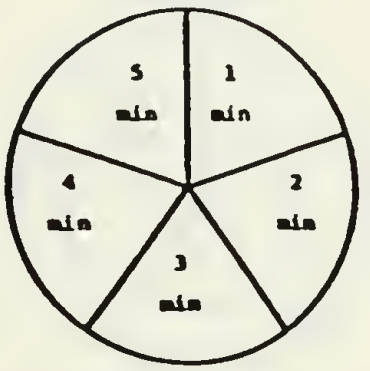
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer <u>not</u> to play — no preference — strongly prefer to play

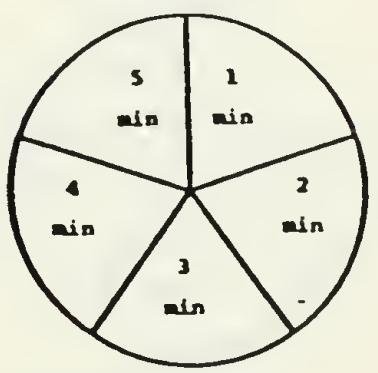
---

7. _____

WIN $10



LOSE $20



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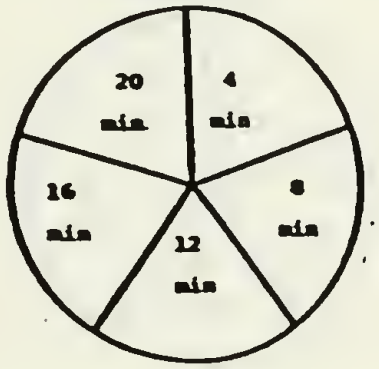
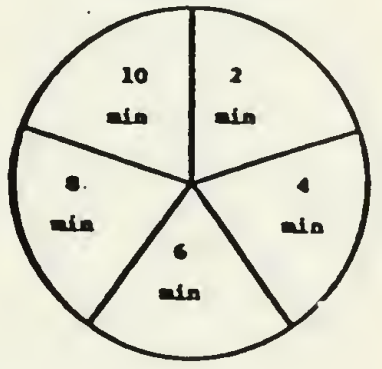
8. _____

WIN $20



LOSE $10



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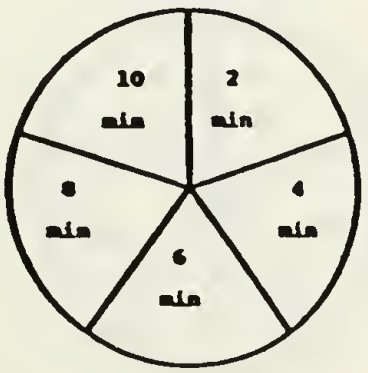
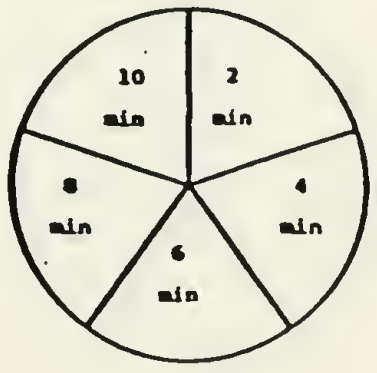
9. _____

WIN $10



LOSE $40



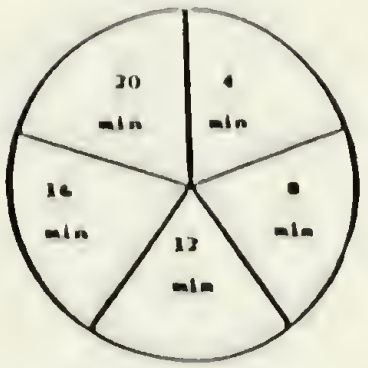
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

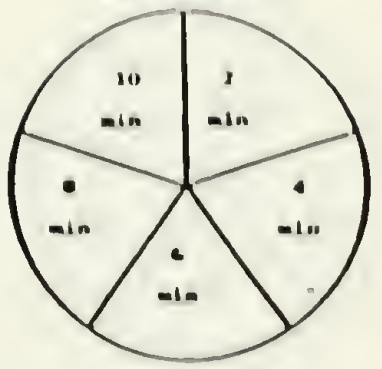
---

10. _____

WIN $10



LOSE $20



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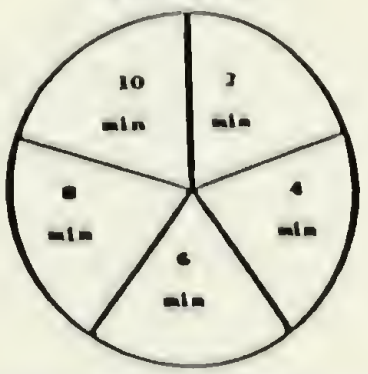
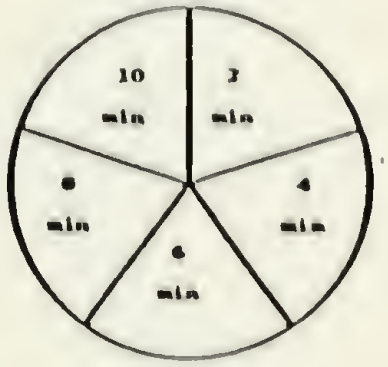
11. _____

WIN $20



LOSE $20



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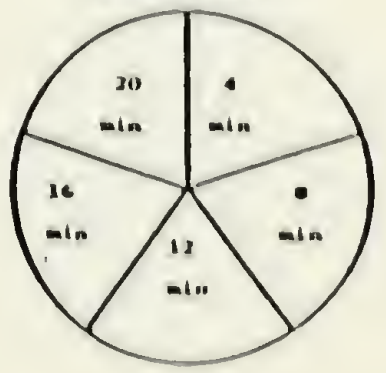
12. _____

WIN $20

LOSE $20



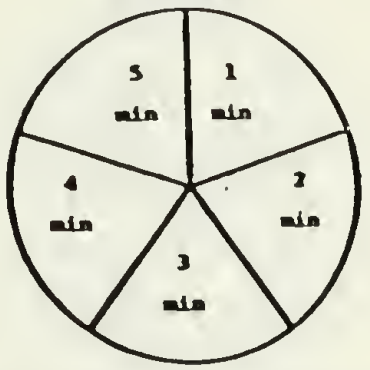
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

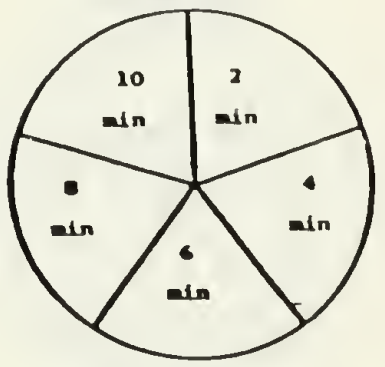
---

13. _____

WIN $40



LOSE $20



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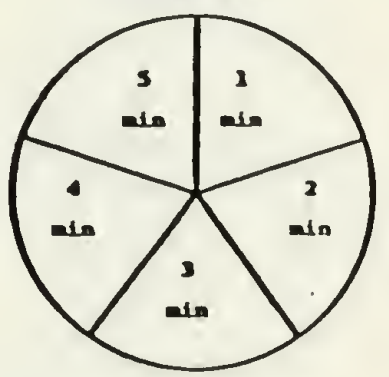
14. _____

WIN $40

LOSE $40



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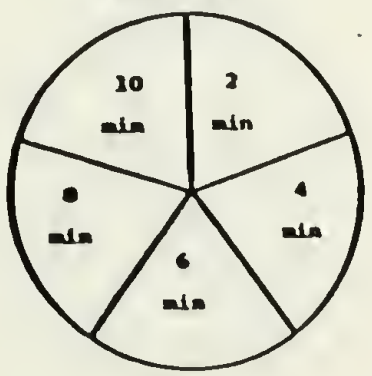
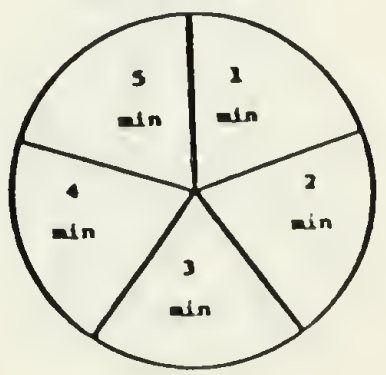
15. _____

WIN $10



LOSE $10



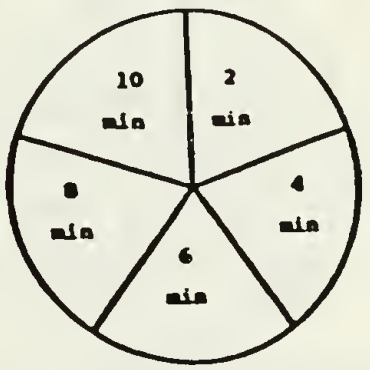
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

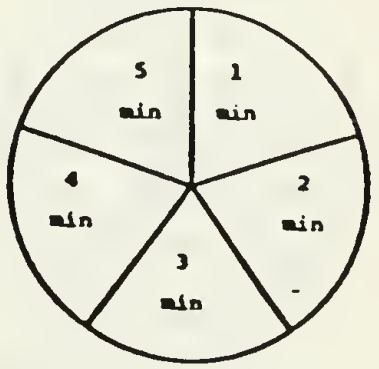
---

16. _____

WIN $40



LOSE $20



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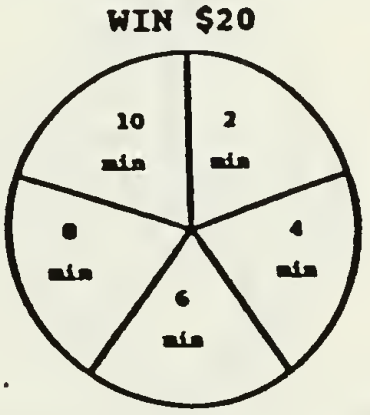
17. _____

WIN $20

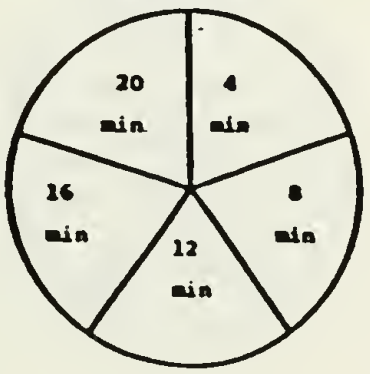


LOSE $10

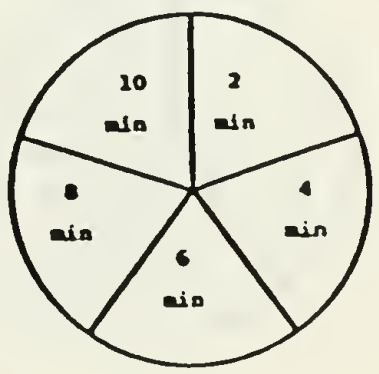
---

18. _____

WIN $40



LOSE $40



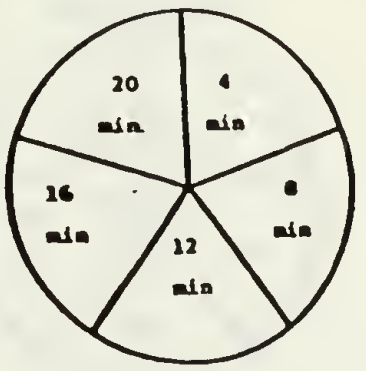
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

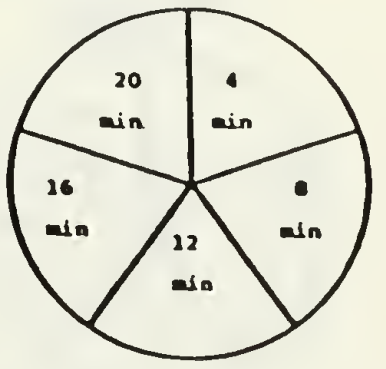
---

19. _____

WIN $10



LOSE $10

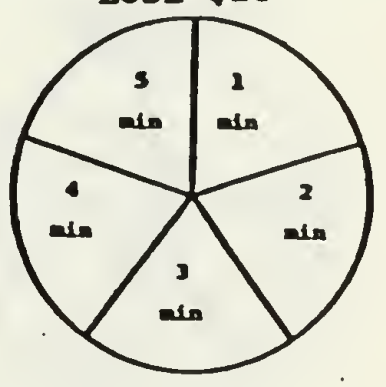


---

20. _____

WIN $40

LOSE $10



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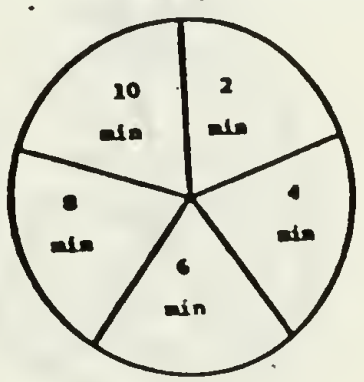
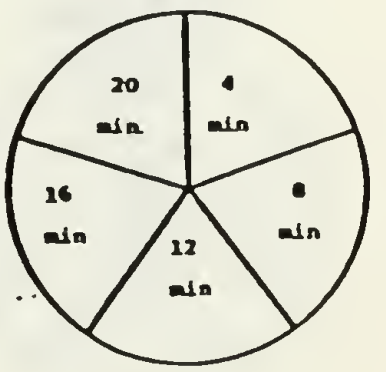
21. _____

WIN $40



LOSE $40



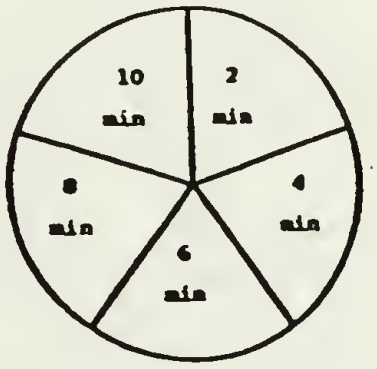
-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

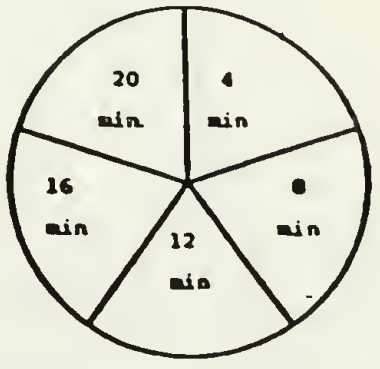
---

22. _____

WIN $10

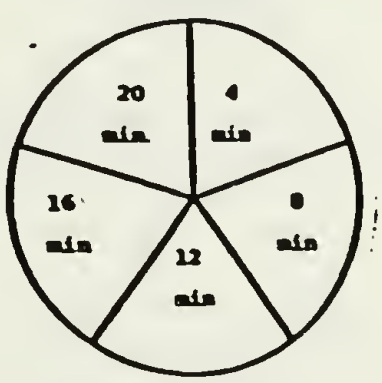


LOSE $20

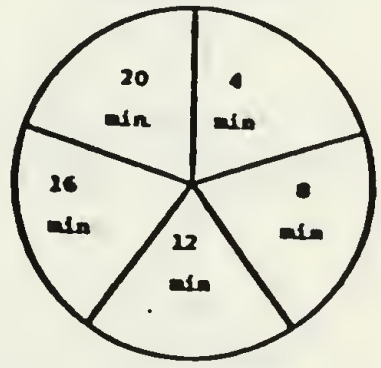


23.

WIN $40



LOSE $20



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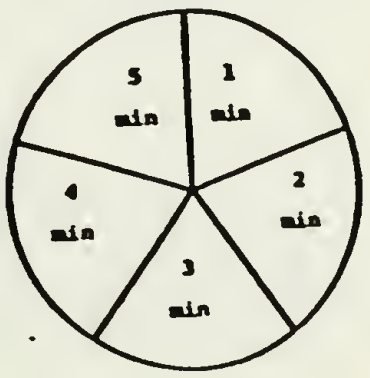
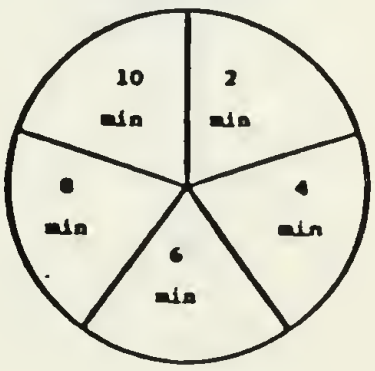
24. _____

WIN $10



LOSE $10



-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

strongly prefer not to play — no preference — strongly prefer to play

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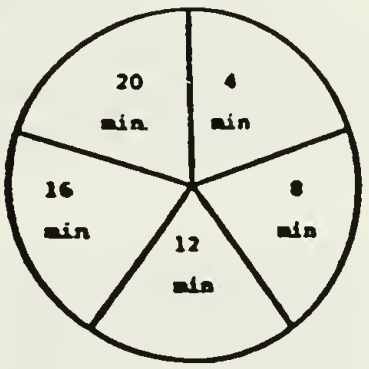
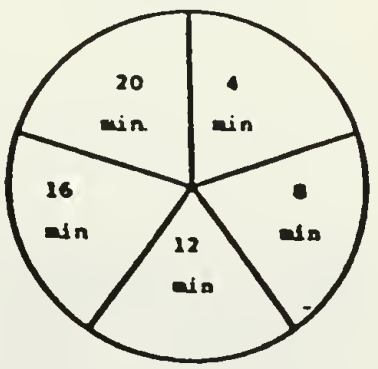
25. _____

WIN $20



LOSE $40



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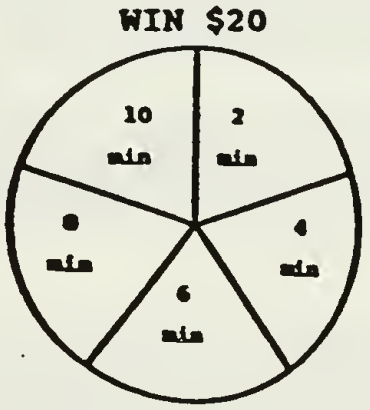
26. _____

WIN $20



LOSE $40

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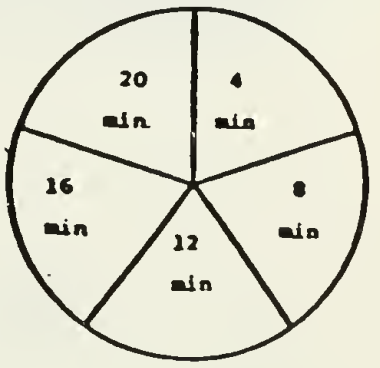
27. _____

WIN $40

LOSE $10



END TIME _____

APPENDIX C

DECISION MAKING SCALE

Scoring of each item is given in parentheses. Where applicable, the source of the item is identified.

Items Involving Immediate vs. Delayed Rewards

You are going to receive a kiss from the movie star of your choice. When would you prefer to receive it (Loewenstein, 1987)?

a) immediately (4)
b) 3 hours from now (3)
c) 3 days from now (2)
d) 3 weeks from now (1)

At the end of the semester, your psych professor offers an optional final exam that could raise your grade, but won't count against you if you don't do well. Taking it would cut into your summer vacation by a couple of days, but on the other hand you wouldn't mind improving your grade. What would you decide?

a) take the test because your grade is more important than a couple days of vacation (1)
b) forget the test and enjoy your vacation (2)

You are going to buy a used car. Please rank the following characteristics according to how important they are in making your decision. Place a 1 next to the most important characteristic, a 2 next to the second most important characteristic, and so on (Abelson & Levi, 1985, p. 259).

___ Price
___ Safety
___ Appearance
___ Repair and upkeep
___ Extra features (stereo system, air conditioning, etc.)
___ MPG

(For Price, Appearance, and Extra features, rankings of 1, 2, and 3 received a score of 2; rankings of 4, 5 and 6 received a score of 1. For Safety, Repair, and MPG, rankings of 1, 2, and 3 received a score of 1; rankings of 4, 5, and 6 received a score of 2.)

Given a choice between two classes, which would you prefer:

a) a class that is boring but which would look impressive to future employers (1)
b) a class that is interesting but won't look good on your transcript or resume (2)

Which would you rather have (Abelson & Levi, 1985, p. 244):

a) $5 (2)
b) a lottery ticket with one chance in 1000 of winning $5000? (1)

You are embarking on a new career selling used cars, and are choosing between two dealerships that would like to hire you. At dealership A, you can expect to sell many cars each month, but your commission on each car is rather low. At dealership B, you will sell only a few cars each month but your commission is high. Your monthly income would be about the same, no matter which dealership you work for. Assuming the working hours, conditions, etc. are comparable, which would you rather work for?

a) Dealership A (many sales at low commission) (2)
b) Dealership B (few sales at high commission) (1)

Items Involving Small Immediate vs. Large Delayed Rewards

Would it be a good idea for you to enroll in a "Christmas Club"-type account, which pays no interest but keeps you from withdrawing money until a prearranged date (Thaler & Shefrin, 1981)?

a) YES - good idea for me (2)
b) NO - not a good idea for me (1)

You have just won a contest. You can either receive $100 now, or $200 at a later time. What is the longest you would be willing to wait for the $200 prize? (indicate days, weeks, months, years) (Ainslie, 1986, p. 138)

(Twelve months or more=1; 6-12 months=2; 0-6 months=3)

If you decide to go on a diet, can you/do you stick to it?

a) YES (1)
b) NO (2)

I would rather get a small amount of something I wanted immediately, than have to wait for a larger amount.

a) TRUE (2)
b) FALSE (1)

Your rich uncle wants to give you the car of your dreams right now, but your rich aunt is trying to convince you to wait a year. How much money will she need to offer for you to put off receiving the car for a year?

$_____

($0-$4999=1; $5000-$19999=2;$20000 or more=3)

In a psychology experiment, you have a choice between getting $5 just for showing up, and getting $20 for doing nothing in an empty room for 30 minutes. What would you do?

a) take the $5 and leave (2)
b) sit for 30 minutes and get $20 (1)

You have won a contest, in which the prize is $100 to be received in 1 year, or a smaller amount of money to be received immediately. Check the <u>smallest</u> of the prizes below that you would be willing to receive now instead of the delayed $100.

___ $10 (3)
___ $20 (3)
___ $30 (3)
___ $40 (2)
___ $50 (2)
___ $60 (2)
___ $70 (1)
___ $80 (1)
___ $90 (1)

In deciding between two restaurants in the same price range, which would you prefer?

a) one with excellent food but a long wait between ordering and receiving the food (1)
b) one with good food and a short wait (2)

It's Sunday afternoon, and you're sitting down to work on a project due Monday morning. Some of your friends come by with a tempting plan to do something fun with them for the rest of the day. Are you more likely to

a) go with your friends, and let your class work suffer (2)
b) turn down your friends, and do a good job on the project (1)

Items not Included in Reported Analyses

At a party where you don't know many people, where would you be most likely to sit?

a) in an armchair, to avoid getting stuck too close to unpleasant people
b) in the middle of the sofa, so you can sit next to new people and maybe meet someone interesting

You are going to receive a painful shock. When would you prefer to receive it?

a) immediately
b) 3 hours from now
c) 3 days from now
d) 3 weeks from now

Would you/do you like to play the lottery?

a) YES
b) NO

APPENDIX D

EYSENCK IMPULSIVITY SCALE

Items are scored as follows: YES=1, NO=0, except where (R) indicates reverse scoring.

YES	NO	Do you often buy things on impulse?
YES	NO	Do you often get into a jam because you do things without thinking?
YES	NO	Would you prefer a job involving change, travel and variety, even though it might be insecure?
YES	NO(R)	Do you like planning things carefully ahead of time?
YES	NO(R)	Do you save regularly?
YES	NO	Do you enjoy taking risks?
YES	NO(R)	Would you rather plan things than do things?
YES	NO	Do you generally do and say things without stopping to think?
YES	NO	Do you usually make up your mind quickly?
YES	NO	When the odds are against you, do you still usually think it worth taking a chance?
YES	NO(R)	Would you make sure you had another job before giving up your old one?
YES	NO	Can you make decisions quickly?
YES	NO(R)	Do you usually think carefully before doing anything?
YES	NO	Are you an impulsive person?
YES	NO	Would you enjoy parachute jumping?
YES	NO(R)	Would regular health check-ups make you feel better?
YES	NO(R)	When you go on a trip, do you like to plan routes and timetables carefully?

YES	NO(R)	Are you slow and unhurried in the way you move?
YES	NO	Would life with no danger in it be too dull for you?
YES	NO(R)	Are you rather cautious in unusual situations?
YES	NO	Do you often do things on the spur of the moment?
YES	NO	Do you often get involved in things you later wish you could get out of?
YES	NO	Would you enjoy fast driving?
YES	NO	Do you prefer activities that 'just happen' to those planned in advance?
YES	NO	Do you usually speak before thinking things out?
YES	NO	Would you do almost anything for a dare?
YES	NO	Can you put your thoughts into words quickly?
YES	NO	If it were practically possible, would you like to live each day as it comes along?
YES	NO	Do you get so 'carried away' by new and exciting ideas that you never think of possible snags?
YES	NO(R)	Do you prefer to 'sleep on it' before making decisions?
YES	NO	Do you often change your interests?
YES	NO	Do you need to use a lot of self-control to keep out of trouble?
YES	NO(R)	When on vacation, do you look for relaxation instead of excitement?
YES	NO	Do you think an evening out is more successful if it is unplanned or arranged at the last moment?
YES	NO	Are you usually carefree?

YES	NO(R)	Before making up your mind, do you carefully consider all the advantages and disadvantages?
YES	NO	Do you get bored more easily than most people, doing the same old things?
YES	NO	Would you agree that planning things takes the fun out of life?
YES	NO	Do you get extremely impatient if you are kept waiting by someone who is late?
YES	NO	Are you an easy going person, not generally bothered about having everything just right?
YES	NO	Do you often long for excitement?
YES	NO	Do you hate standing in a long line for anything?

APPENDIX E

SELF-REPORT AND BACKGROUND INFORMATION

1. Please circle the number which best represents how impulsive you are in general.

very impulsive 1 2 3 4 5 6 7 very unimpulsive

2. Please describe an occasion on which you behaved impulsively:

3. Please describe an occasion on which you behaved unimpulsively:

****

Background information

Age:

Sex: M F

Class: Freshman Sophomore Junior Senior
Other:

GPA:

SAT score (combined math & verbal):

Major:

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