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Are humans risk-sensitive foragers? An experimental model

Heide K. Deditius-Island
The University of Montana

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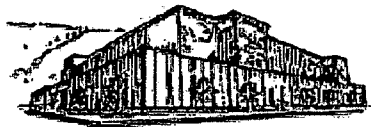
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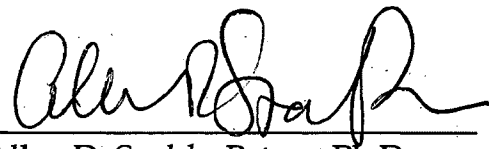
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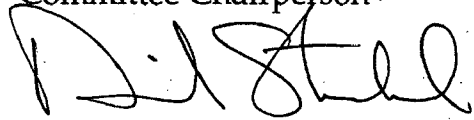Requirements for the degree of

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Are Humans Risk-Sensitive Foragers? An Experimental Model

Director: Allen Szalda-Petree, Ph.D.

Risk-sensitive foraging preferences in human adults were examined in relation to the variability of reinforcement amount in a binary choice experiment with constant delays. The goal of this study was to assess the sensitivity of males and females to variation in reward amount using a group design with the application of the daily energy budget and an evolutionary perspective as a model for the choice behavior. The experimental condition consisted of a computerized choice task with a series of forced choice trials followed by free choice trials. Participants had to make selections between two choice options, one yielding a fixed reward amount and the other with a variable reward, both options yielding an equal mean reward. The goal of the game was to win a promised monetary prize for accruing an unknown cache of points by making selections between the two choice options. During the experimental phase of the task, the participant had to log on to the Internet and play against an assumed competitor. The hypotheses for the study were two-fold; the first asserts that males would demonstrate risk-averse behavior under the positive budget (winning) and risk-prone behavior under the negative-budget (losing) and that the females would demonstrate risk-averse responding for both the positive (winning) and the negative budget (losing) conditions, with the most risk-aversion exhibited under the positive budget condition. The second hypothesis predicts that one or more dimensions from form V or form VI of Zuckerman's sensation-seeking scales would be predictive of choice behavior. The findings partially supported the first hypothesis such that, males exhibited a risk-sensitive bias under the positive budget condition compared to males in the negative budget. However, females did not demonstrate a choice bias under either budget condition. For hypothesis two, the sensation-seeking scales did not successfully demonstrate a relationship between sensation-seeking and risk preferences among males and females in the sample. Implications of the results for the choice preference task and the sensation-seeking scales are discussed in terms of a general energy-budget model.

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An Experimental Model

The conditions under which humans take risks have been widely debated. Perhaps one of the first to formally observe risk-preference outcomes was the Swiss mathematician Daniel Bernoulli. Bernoulli (translation, 1954) posited that individuals prefer one alternative above another in order to maximize the value or utility of the options available. There are numerous theories and models targeting choice behavior, all of which address this important question of why a decision maker selects one choice over another. In the natural environment, it is adaptive for choosing (foraging) organisms to select the food patch or resource option that best suits their needs. The selection of the optimal choice will ensure the forager's survival. Traditionally, the term "foraging" within the ecological literature refers to the allocation of food by nonhuman animals. However, foraging research has merged the fields of psychology and ecology and a more flexible definition has been adopted. The term "foraging" in the context of this paper will refer to the search, selection, and seizure of any desirable resource by human or nonhuman animals. The foraging choices of individuals under the circumstance of economics, mate selection, or even within the context of something as trivial as finding a place to park one's car is of significance because it may be telling of more distal explanations of behavior. In all of these examples, one choice against all alternatives will be of greater value, the selection

of that choice is contingent upon the perceived costs against the weighted

benefits of that choice.   In other words, the rewards of each choice are variable

and it is that variability of outcomes that makes one choice riskier than another.

The sensitivity of the forager to the variability will dictate the strategy employed

by the individual in making their choice selection. It is the sensitivity of the

choosing organism to variability in reward options that is of interest in this

study. The decision to select a choice yielding a fixed or variable outcome may

provide further insight into the underlying mechanisms of choice behavior by

humans from an evolutionary perspective.

Optimal Foraging Theory

Optimal foraging theory suggests that foraging strategies show heritable

variation, which is a consequence of evolutionary pressure and that natural

selection will favor those foraging strategies that offer maximum fitness (Pyke,

G. H., Pulliam, H. R., & Charnov, E. L., 1977). In theory, the forager's choice

behavior will always maximize or minimize resource exploitation, consistent

with the risk-reward relationship between the following factors: currency

(energy gain), time (search and handling) and solving for the option yielding the

optimal cost-benefit outcome.   The ideal strategy then for a forager is dependent

upon the individual needs of that organism. Schoener (1971) predicted that if an

organism has a static amount of time with which to procure its resources and if

the fitness of the forager increases continually in conjunction with nourishment

obtained, then the organism would be an *energy-maximizer*. Yet, if an organism requires time to perform other activities and the fitness of the animal does not increase, such that the amount of energy useful to the organism is fixed, then the forager is referred to as an *energy-minimizer*. Mellgren, Misasi, and Brown (1984) provided limited evidence to support the optimal foraging model by manipulating the travel requirements for food acquisition by two rats utilizing various patches with differing food densities in each patch (a sandbox). The purpose of this experiment was to assess how environmental constraints operate to affect the foraging behavior patterns of an optimal forager. The results for one of the two subjects demonstrated an increase in the number of food items harvested from a given patch. The increase in harvested food items also demonstrated an increase in the amount of time spent utilizing a given area as travel requirements from patch to patch increased, thus providing some support for the optimal foraging model.

Risk-Sensitive Foraging Theory

Similarly, risk-sensitive foraging theory (RSF) encompasses a number of models, most of which are based on the following choice paradigm: an organism has two or more foraging options (or patches) that yield the same average amount of nourishment, but the variability of obtainable food differs from option to option (e.g. Batson and Kacelnik, 1995). If the forager always favors the constant or fixed option, its preference is referred to as *risk-averse*, but if the

preference is for the option with greater variability, this behavior has been labeled *risk-prone*. Consistent with the model of optimal foraging theory, risk-sensitive foraging theory also assumes that animals will behave in ways that maximize their inclusive fitness. According to Smallwood (1996), the key contribution of risk-sensitive foraging theory is the sensitivity of organisms to variability in the reward rate and the preference of one foraging option over another in relation to the energetic gain and loss by the organism. In addition, the variability with respect to the amount or to the time to reward delivery is variable about the mean. Whether the forager is in a positive or a negative energy slope will be predictive of risk strategy, averse or prone. The negative or positive energetic slope is the organism's daily energy budget.

Daily Energy Budget

In a natural stochastic environment, food availability is variable, as is the interval of time between the search and the utilization of a given resource. The foraging choices of an organism may reflect where the animal falls on its energetic continuum. This continuum, one's positive or negative energy store is referred to as the daily energy budget. The selection of a more variable option reveals a higher rate of energy production (caloric) than consumption by the organism, whereas the selection of a less variable option demonstrates the opposite. When the average energy intake from either the variable or fixed option exceeds the needs of the animal, the energy budget rule predicts that the

animal will prefer the less variable option (Smallwood, & Carter, 1966). The daily

energy budget is one of the most tested predictions within foraging research with

a subject base that has a representation of virtually all classes. Examples include

nectarivorous birds (e.g. Carter & Dill, 1990; Carter, 1991; Pimm, 1978;

Wunderle, J. M., Santa Castro, S., & Fetcher, N., 1987), nectarivorous insects (e.g.

Real, 1980; Real, L., Ott, J., and Shvereine, E., 1982; Waddington, K. D. 1995;)

gravinous birds (e.g. Bateson & Kacelnik, 1997; Caraco, 1980, 1981, 1983, 1990;

Case, D. A.; Nichols, P., & Fantino, E., 1995; Hamm & Shettleworth, 1987; Tuttle,

E. F., Wulfson, L., & Caraco, T. 1990), migratory birds (e.g. Moore & Simm, 1986),

cichlid fish (e.g. Roche, Dravet, Bolyard, & Rowland, 1998; Young, Clayton, &

Barnard, 1990), adult humans (e.g. Pietras & Hackenberg, 2001), and rodents (e.g.

Barnard & Brown, 1985; Kirshenbaum et al., 2000). Caraco et al. (1980) tested the

hypothesized relationship between expected daily energy budgets and

sensitivity to the mean and variance of resource amount using yellow-eyed

juncos and dark-eyed juncos (1981) and found that risk-preferences could be

predicted as a result of whether the birds had obtained sufficient daily

nourishment. The juncos adapted their foraging strategies under different

conditions. They exhibited risk-averse behavior when they succeeded in

accommodating their energy requirement, but modified that behavior in a more

risk-prone manner when they were behind in fulfilling their daily energy

requirement.

Daily Energy Budget Models

One model of the daily energy budget, molar maximization theory, predicts that an organism will maximize the probability of obtaining enough food to meet the energetic costs within the specific foraging constraints. Therefore, the preference for one option over another reflects a forager's maximum resource requirements per unit time. A mathematical model of molar maximization, or the z-score model, proposed by Stephens and Charnov (1982) posits that risk-sensitivity may be conceptualized in terms of starvation due to energetic deficits.

For organisms with exceptionally high metabolic needs, operating at an energy shortage could lead to starvation. If the choice options lead to starvation or survival, risk-sensitive foragers reduce the probability of starvation, such that z represents the foraging constant or the predictive behavior of risk-averse or risk-prone strategy use. The formula can be interpreted as follows: $z = (R-u)/s$, where u is the mean food reward, s is the standard deviation of food reward, and R is the forager's energetic requirement. The utility of this model is in the predictive value of measuring a forager's behavior. Manipulations of variability in reward quantity and delay to reward have demonstrated differences in risk-preference. Under conditions of varying delay, foragers are risk-prone. Conversely, when the variability is in reward amount, foraging behavior is risk-averse. This illustrates the importance of timing as an element in risk-sensitivity

as well as reward magnitude (Bateson and Kacelnik, 1996; Reboreda and Kacelnik, 1991).   Daily energy budget models like molar maximization and the z-score model are referred to as second order models because they assume fitness functions, such that risk sensitive behavior arises in order to make certain future reproductive success.   When food contributes linearly to reproductive success, an animal foraging over an extended period of time should maximize its mean net rate of energetic gain (McNamara, 1996).

Scalar Expectancy Theory

Not only is reward amount of significance in models of risk, an equally important variable is time.   The weighting of the various foraging options will differ based on the differential time between search and food acquisition, and the handling time of the food in relation to the ingestion of the prey or food item. The intervals between meals are often referred to as the inter-capture interval, where "capture" refers to the ingestion of the food.   Weber's Law asserts that the just noticeable (minimum) difference in prey density (prey patches as analogues to stimuli) required to see two prey patches as different is proportional to the mean value of the two prey patch options.   If a forager expects no variability in prey density it will register a value within the range of the true density value plus or minus one just noticeable difference, thereby constructing a distribution of subjective variability based on the individual forager's perceptions of prey density.   Weber's Law presents a cognitive component, which is memory, the

memory of previous prey density in relation to what is currently experienced

(Kacelnick & Bateson, 1996).

A modified version of Scalar Expectancy Theory (SET), a continuation of

Weber's Law applied to foraging theory, suggests that a stimulus followed by a

variable delay to food or a desired resource will be remembered as the

combination of the delays in relation to the amount of food yielded after each

time interval. It is expected then that foragers will choose between two options

based on a memory representation for each delay or amount. When a

conditioned stimulus (CS) is presented to a subject, it creates a memory trace that

decays with time until the presentation of the unconditioned stimulus (US).

Following a reinforced trial, a value is attributed to the CS-US pair and the

memory trace of the CS decays in a hyperbolic manner. The hyperbolic decay

suggests that when mean delays are equivalent, a CS followed by a variable

delay to the onset of the US will be more valued than a fixed CS-US delay pair

(Kirshenbaum, 2001). SET predicts that variability in delay will be preferred

rather than a fixed option and that a fixed resource amount will be preferred to a

variable option (Kacelnik & Bateson, 1996). In other words, risk-prone behavior

should be expected when delay is manipulated and risk-averse behavior when

amount is manipulated. A problem with the SET model is that it is difficult to

predict using an energy budget manipulation because the delay to reward in

energy budget manipulations are based on the forager's success in allocating

resources, which are typically always variable. In addition, the daily energy budget model is based on the variability of reward, which according to SET should be predictive of risk-aversion. But the delays are generally also variable, which predicts risk-prone behavior, so applying SET in daily energy budget manipulations can be problematic. These delay constraints are of central importance in self-control studies as well; the self-control manipulations are also based on the idea of variable and fixed delays in relation to reward amount.

Self Control Studies

A self-controlled decision is generally defined as the choice of a larger, more delayed reinforcer over a smaller, less delayed reinforcer. Conversely, an impulsive decision is the choice of a smaller; less delayed reinforcer over the larger more delayed option. In self-control research, molar maximization theory poorly predicts performance and although self-control studies are not analogous to risk-sensitivity, they do apply the same principles of choice, the selection of one option yielding greater energetic gain than another. Self-control research is relevant to work in risk-sensitivity because similar mechanisms are addressed. For example, one might expect those species that demonstrate a greater degree of self-control to also conform more to the daily energy budget model of risk-sensitivity. Those species that exhibit self-control would be expected to be risk-averse under all conditions, except those that reflect an extremely negative energy budget where not risking would ensure death or extreme loss of energy.

A number of studies have addressed the self-control behavior of rats (Tobin, Chelonis & Logue, 1993; Van Haaren, Van Hest, & Van De Poll, 1988) primates (Anderson, Awazu, & Fujita, 2000; Tobin, Logue, Chelonis & Ackerman, 1996), pigeons (Logue, Peña-Correal, Mauro, 1984; 1985; Mazur & Logue, 1978), and humans both in adults (Forzano & Logue, 1992; Kirk & Logue, 1996; Logue & Peña-Correal, Rodriguez, & Kabela, 1986; Logue & King, 1991) and children (Logue & Chavarro, 1992; Miller & Weinstein, 1978). Pigeons and rats generally select the *impulsive* option within a self-control paradigm. While primates, both human and nonhuman are considered self-controlled in decision-making situations, female hominids typically choose self-controlled options slightly more than males (Logue & Chavarro, 1992). Historically self-control research has focused on the delay to reinforcement and the quantitative amount of reward offered as the most critical components of behavior, while response effort has been more conservatively addressed. The fundamental assumption underlying the inclusion of an effort manipulation is that by increasing response effort, self-control will also increase. Theoretically, self-control should increase with the addition of an effort requirement because the greater response effort taxes the individual of their energy surplus. The self-controlled option would then promote energy conservation and maximization of reward or reinforcement. Chelonis, Logue, Sheehy, & Mao (1998) have demonstrated that rats typically increase self-controlled choices as response effort increases within

0.8 N of force, as does the response latency. In contrast, Velkey (1995) applied an effort manipulation to an experiment using running wheels as the choice manipulanda with two different treatment conditions. The first treatment allowed for the concurrent operation of two different variable interval schedules. In this experiment the rats failed to achieve self-control. In the second treatment, the choices in the higher effort conditions were not significantly less impulsive than those from the low effort condition, but were not self-controlled responses. It could be argued that the inclusion of an effort variable is really operating on the time factor; increasing the amount of effort necessary to press a lever or turn a running wheel is in reality just increasing the pre-reinforcement delay, something to which both pigeons and rats have been shown to be sensitive.

Social-Cognitive Models of Choice

Analogous models of foraging theory and risk behavior can be found in economics, social psychology and sociology. Economic models of risk, uncertainty and decision-making generally stem from the expected utility theory proposed by Von Neumann and Morgenstern (1964). Expected utility theory is based on a set of axioms, which offer criteria for the rationality of choice. The utility of a risky prospect is equal to the expected utility of its weighted probability outcomes, such that a rational decision-maker will prefer the prospect in a decision that yields the highest expected utility, provided that the decision-maker is rational and consistent in its selections (Tversky, A. &

Kahneman, D., 1981; Von Neumann, J. & Morgenstern, O., 1964). Prospect

theory is essentially a modification of the expected utility theory, however noting

the violations of its assumptions like the *certainty effect* or choice preferences (e.g.

transivity of preferences) that do not necessarily yield the highest expected utility.

An example of such a violation is provided by Kahneman and Tversky (1979),

given the option of selecting Choice A, which provides a 50% chance of winning

a three week tour of England, France and Italy and selecting Choice B, which

affords a one-week tour of England with certainty, 78% of a 72-person sample

selected the more probable choice. Yet when the probabilities were further

narrowed, the *transitivity of preferences* axiom of the expected utility theory was

violated, using the same sample and same choices but with narrower

probabilities such that selecting Choice A, provided a 5% chance of winning a

three week tour of England, France and Italy and selecting Choice B, afforded

10% chance of winning a one-week tour of England, 67% percent of the

participants selected the less probable choice. However, it can be argued that

this is in fact not a violation of the transivity of preference axiom because the

options in the two paradigms are not equivalent. In the first option, there is a

certain probability and a 0.5 probability of gain. In the second option, the

combined probability of gain is only 0.15, suggesting that subjects or decision-

makers may be assessing the likelihood of gaining anything. If one does not

believe they will come away with a gain, then there is nothing to be lost in

selecting the higher reward condition. This preference switch is also referred to as the reflection effect, such that if the probabilities do not change, the two preferences are a reflection of one another. The reflection effect is analogous with respect to mean reward, the idea of a forager switching from a risk-averse to a risk-prone choice strategy. Risk-sensitive foraging theory does have a more subjective component just as this model of expected utility. The choice of the variable rewards patch or the constant food patch will be selected based on the organism's energetic requirements. If the animal requires little to satisfy its energetic necessities, then choose the constant option, but if the animal is at an energetic deficit, then choose the variable option. This choice between the two foraging strategies will be a subjective process of energetic interpretation. Utility and prospect theories are analogous to the biological foraging models. They all predict the maximization of gain and the minimization of loss in a decision dictated by uncertainty; nevertheless they cannot be entirely analogous since individuals foraging for food resources are often in the context of a starvation situation.

The security-potential/aspiration theory *(SP/A)* asserts that individuals tend to select either a low risk with a small outcome or they exploit the *potential* in a given situation by attempting to obtain the best results; which are then subject to the interpretation of the decision-maker. The smallest outcome that a person deems acceptable will influence one's level of risk taking (Lopes, L.L.,

1983; 1984; 1987; Schneider) and Lopes, 1968). Wang (1996) demonstrated that adults are more willing to select a riskier choice option if the lesser outcome is below their minimum aspiration level. SP/A recognizes individual differences and variability in choice more than the preceding utility models. SP/A addresses the idea that those with a lower aspiration level are likely security-seekers, who are more motivated to play it safe than to take larger risks. This security-seeking behavior is comparable to the *risk-averse* organism in foraging theory, such that the evaluation of the attained resource or potential is sufficient to warrant a more conservative risk strategy, in the case of a forager, the lesser variance option.

Sex Differences in Choice Behavior

Another variable to consider in risk-taking behavior is that of sex. Given the differences inherent to males and females regarding parental investment from an evolutionary perspective, it is not unreasonable to assume that females will be more risk-averse than males. Females would have to choose foraging patches based not only for their own survival, but also on behalf of their young. A female may be more likely to select the conservative or safe foraging option unless death was eminent and therefore would be risk-averse under most conditions except extreme negative budgets. It could be argued that one would expect to see more dramatic differences in employed foraging strategies by females if she must maintain her own inclusive fitness. In theory, it would be

more advantageous for females to select the risk-prone strategy only in times of

extreme dearth. In spite of this, it is unlikely that a female would select a more

variable food patch over a constant resource and risk the potential loss of her

offspring unless choosing not to take the risky option ensured death.

Slovic (1966) conducted an experiment involving a sample of 1,047

children ranging in age from 6-16. The children volunteered to play a game for

the chance at winning M & M candies. The purpose of this study was to provide

evidence for the validity of the masculinity-boldness stereotype by studying the

influence of age and sex upon decision-making and youngsters' performance on

a task involving risk. The results of this study specifically lend credence to the

prediction that females would be more risk-averse than males. Slovic's study has

been colloquially referred to in the literature as "the toggle-switch study"

(Kopfstein, 1973) because it utilized a switchboard with ten toggle switches. Out

of the ten switches, one switch acted as a "disaster switch," such that the

selection of this switch would result in the loss of their earned cache of M&Ms. It

was impossible for the participant to tell which switch was the "disaster switch"

so they had to flip the switches based on their mental assessment of the

probability of flipping a non-disaster switch and adding a spoonful of M & Ms to

their cache. Maximization would have been to take the risk of five pulls and

then stop and collect the reward cache because after five pulls, the probability of

switching the disaster toggle would be greater than a safe pull. Slovic's results

indicated that females took less risk with M & M rewards than the boys.   In

addition, the caution exhibited by the girls (total average of 2.20 spoons) was an

advantageous strategy, they earned more M & Ms than the boys (total average of

1.84 spoons). The optimal performance strategy used by girls in this study is

analogous to optimal foraging theory. The decision to stop flipping toggle

switches may demonstrate probability monitoring and an evaluation of the cost

to benefit relationship between continuing to risk and to quit while ahead. The

optimal foraging strategy in this case then was to quit half way through the task

in order to maximize one's net gain prior to losing all of the M & M rewards.

This is not counter to the daily energy budget rule because females may still

exhibit risk-proneness under negative energy conditions, but in relation to males

it will be less risk-prone. Although the aim of Slovic's research was to support

the boldness stereotype, the "toggle-switch study" may have simply

demonstrated conservative risk-taking on the part of the females in order to

maximize their net gain.

Kass (1964) addressed decision-making behavior in children as a function

of sex and probability preference as well. The sample consisted of 52 preschool

and elementary school children evenly divided by sex. The task utilized three

identical, simulated slot machines mounted side-by-side. A penny was required

for operation of each machine. The machines were assigned probabilities of 1/1,

with a very low reward; the second machine had a probability of 1/3, with an

intermediate reward amount and 1/8, with a high reward amount. The participants had free access to all three machines until they reached 210 trials, when they were asked to select the machine they liked best and play that one exclusively. At the onset of the session, the participants were given 14 pennies to use in play and were told that their earnings were exchangeable for prizes, the more money they won, the better the prize they could buy at the end. The results indicated a significant sex difference associated with low probability payoff and intermediate probability payoff. Boys made the greatest number of responses on the intermediate (1/3) and low probability (1/8) pay-offs and the least number of responses on the high probability pay-off machines (1/1). The results for the girls were completely opposite, they demonstrated a higher number of responses on the high probability pay-off machines (1/1) and the least on the intermediate (1/3) and low probability machines (1/8). Again, the differences between boys' choices and girls' choices here may be differences in sensitivity to maximization. Females may be more disciplined in their risk-taking as a consequence of perceived risk-reward values.

Logue and Chavarro (1992) performed a choice experiment in which two options were offered to children of preschool age. The impulsive option was one sticker with no delay to reinforcement. Selection of the self-controlled option yielded three stickers with a 30 second wait. Although neither preschool boys nor the preschool girls behaved significantly more self-controlled than

impulsive, the boys did choose the impulsive option significantly more than the

preschool girls.

Although experimental investigations into self-control and impulsivity are

preferred, there are other means with which to examine the behavioral and

personality trait of impulsivity. Impulsivity or the need for immediate

gratification can also be addressed through personality inventories. The lower

thresholds of self-control may also be associated with sensation-seeking, such

that risk-taking behavior may be a quality expressed by those with a high need

for stimulation or sensation.

Zuckerman's Sensation Seeking Scales

Marvin Zuckerman posited through the publication of a series of

sensation-seeking scales (forms I-VI) that individuals exhibit differing sensation-

seeking dimensions. Such that individuals may have a temperament that

corresponds to a profile of risk-taking or sensation-seeking. Individual

stimulation preferences have been shown to predict gambling and risk-taking

behavior. Those who score high on Zuckerman's sensation-seeking subscale of

disinhibition typically place larger bets at dice (Zenker and Wolfgang, 1982), and

blackjack (Kuhlman, 1975) than participants with lower disinhibition scores.

Sensation-seeking behavior may be attributed to one's optimal level of

stimulation. The idea of an optimal arousal level originated with Donald Hebb

through his research concerning pain thresholds. Hebb also applied the optimal-

level theory as a behavioral construct of motivation; too little stimulation leads to

sensation-seeking and too much stimulation leads to stimulation-avoidance

behavior (Zuckerman, 1994).   The SSS has been used to predict a broad range of

risky behaviors, including pathological gambling (e.g., Blanco, Orensanz-Munoz,

Blanco-Jerez, & Saiz-Ruiz, 1996; Blaszcznski, McConaghy, & Frankova, 1990),

alcohol abuse (e.g. Baker, Beer, & Beer, 1991; Darkes, Greenbaum, & Goldman,

1998), drug use (Galizio & Stein, 1983), involvement in high risk sports (Bouter,

Knipschild, Feij, & Volovics, 1988; Breivik, Roth, & Jorgensen, 1998; Freixanet,

1991), and engaging in risky sexual behaviors (e.g., Apt & Hurlbert, 1992;

Donohew, Zimmerman, Cupp, Novak, Colon, & Abell, 2000; Kalichman,

Johnson, Adair, Rompa, Multhauf, & Kelly, 1994, Kalichman & Rompa, 1995).

There are at least fourteen different variations of Zuckerman's scales, including

Forms I through VI, translations into Arabic (Torki, 1993), Hebrew (Birenbaum,

1986), Oriyan (Mahanta, 1983), Finnish (Eysenck & Haapasalo, 1989) and Spanish

(Perez, Ortet, Pla, & Simo, 1986), and adaptations for children (e.g., Russo,

Lakely, Christ, Frick, McBurnett, Walker, Loeber, Stouthamer-Louber, & Green,

1991).

The scales employed for this study were forms V and VI.   Form V, is an

interest and preference questionnaire, it measures an individual's disinhibition,

boredom susceptibility, thrill and adventure-seeking, and excitement-seeking

through factor analysis of each trait in a 40-item/trait scale, with 10-items

devoted to each trait. A total score can also be calculated for an overall

sensation-seeking score within one's interests and recreational preferences. Form

VI, is an activities schedule with two parts. The first part of this scale consists of

64 items designed to measure one's experience. A scenario is provided and the

participant must indicate whether they have never engaged in that kind of

experience, experienced it once, or experienced the scenario multiple times. The

second part of the scale has another 64-items with which the individual must rate

their intent in the future concerning disinhibition and thrill and adventure-

seeking again on a 3-choice scale. Zuckerman's sensation-seeking scales may

provide a valid and reliable means for testing individual differences in

stimulation-seeking behavior and how that pursuit of stimulation may influence

risk preferences in a foraging task.

Support for the daily energy budget model would reveal further insight

into human risk-taking behavior under ordinary, everyday circumstances like

gambling and a willingness to engage in monetary debt-earning behavior. The

support of sex differences in the choice tasks would further support to the

adaptionist model that males and females may be biologically prepared to

choose different options based on the risk potential of those choices. The

purpose of this research was to investigate the patterns of human foraging

behavior in a binary choice option using an indirectly manipulated energy

budget. The only other study of risk-sensitive foraging theory using a daily

energy budget model and human subjects was that of Pietras and Hackenberg (2001). Using a small-n design (n = 3), Pietras and Hackenberg were able to find risk-averse behavior under positive budget conditions and risk-prone behavior under negative conditions for two of the three subjects. The third did not demonstrate strong risk-sensitive biases. Although small-n designs are creditable and typical in comparative research, one of the goals of this study was to apply a group design to in a computerized choice task. In addition, one of the benefits of utilizing a human subject pool, is the ability of adults to describe their choice behavior and to provide further insight into the conditions with which they may select one risky option over an alternate. Given the verbal language abilities of our sample, we also sought to find a measure that may predict risk-sensitive behavior under a choice task. It was anticipated that Marvin Zuckerman's sensation seeking scales form V and VI would provide this predictive measure of risky choice selection.

Prior to executing the current choice preference study, a pilot was conducted to determine what methodological problems might arise as a consequence of developing a computerized risk task in a group design with human subjects. The first challenge was to find a reward that was salient and reinforcing for participant behavior and would also facilitated discrimination of the choice options. Points were provided as reinforcement for the two choice options, with either a fixed number of points for the risk-averse option or

variable for the risk-prone options. These points were then exchangeable at the end of the experimental session for a previously undisclosed sum of money. However, the money did not appear to be a significant motivator of behavior, primarily because participants did not believe they would actually receive monetary earnings for their points. A competitive component was added to enhance subject motivation and the money award was retained in order to maintain consistency between the two studies. In most natural foraging situations, there are competitors for desirable resources, therefore it is anticipated that the inclusion of a competitor would increase the saliency of the task and the meaningfulness of the win. In addition, the provision of the illusion of competition should lend creditability to the task as an analogue to foraging in a more naturalistic environment. For humans, the natural environment does not have to be outside, in the woods, or among the wildlife. Casinos, malls, and parking lots qualify as natural settings with which foraging for resource may take place, in this case the environment is within an academic setting.

There are two hypotheses for this study: The first asserts that males will demonstrate risk-averse behavior under the positive budget (winning) and risk-prone behavior under the negative-budget (losing), while the females will demonstrate risk-averse responding for both the positive (winning) and the negative budget (losing) conditions, with the most risk-aversion evidenced under the positive budget condition. The second hypothesis posits that the sensation-

seeking dimensions from form V or form VI will be predictive of choice behavior

and risk strategy in the experimental task.

Method

Participants

Male (n = 100) and female (n = 150) psychology students were solicited

from the Introductory Psychology Course subject pool consisting of 8 different

class sections ranging in age from 18 to 59 years.

Apparatus

Two PC computers were used for the choice task. The computer task was

programmed using a Visual Basic 6.0 program and operated under the Windows

95 operating system.

Procedure

Participants were welcomed into the experimental room (measuring 2.55 x

3.57 m) where two computers were situated side-by-side and separated by a

partition 1.8 m in height. The experimental room could accommodate two

participants per one-hour experimental session. Participant numbers, age and

sex of the participant were entered into a subject record form presented on the

computer screen just prior to the start of the computer task. Once this

information was entered into the computer, participants were asked to read and

sign an informed consent sheet. When the participants read the instructions to

the forced choice trials (see figure 1 in the appendix) and felt comfortable starting

the experiment, they clicked on an icon at the bottom of their participant record

form labeled "start," following this action the forced-choice trials were

presented.

The task was divided into two phases, the forced-choice phase and the

free choice phase. Forced choice trials were used to ensure that participants

received exposure to both choice options. The participants were presented with

one of the two choice boxes during each trial and "forced" to choose the

presented item and consequently learn the point value associated with that color,

but no data was recorded concerning choices. The side (left or right)

presentation of the choice box was randomized within the computer task and the

point value attributed to each choice box was counterbalanced in an effort to

minimize color or side bias rather than point discrimination. Participant

selection of the variable option yielded 1 or 5 points, with $p(1) = .5$ and $p(5) = .5$

whereas selection of the fixed option yielded 3 points exclusively. The two

choice options provided an average reward amount of 3 points, regardless of the

strategy employed; the two options had equivalent expected utilities. The trials

were divided into 10 forced-choice trials and 80 free-choice trials. In both sets of

trials, a choice was recorded after the participant clicked on the stimulus box

three times. In both the forced and free-choice trials, the participant had to

mouse-click three times on the stimulus box in order for their choice to be recognized as a decision and recorded in the data file. Three mouse clicks represented a committed choice rather than a single click in an effort to minimize impulsive choosing and to give participants an opportunity to change their decision. Once a choice had been made, the unselected box disappeared and the chosen box remained visible while the point value for that choice was displayed for 3-seconds (1 or 5 for the variable choice and 3 for the fixed choice). Following the forced-choice trials, a second instruction screen was presented (see Figure 2) and the free-choice trials commenced (see Figure 4). At the inception of the free-choice trials, a connecting screen was presented with a 10-second count down to "log-on" with a linking designation. In addition, the participants were shown a status screen with a bar indicating "even" along a status (winning vs. losing) barometer (see Figure 5). The program randomly assigned equal subjects to budget conditions by assigning a positive budget (winning) or negative budget (losing) to subjects by participant number. Following the first 20 trials, the status screen interrupted choice selection with the participant's status relative to the Internet competitor (they were told they were competing against a student from a university designated as "WSU"). Every 20 trials the status screen interrupted choice selection with a change in the location of the status bar along a winning or losing barometer; but the participant, regardless of their choice never fell ahead or behind after their budget was established as "winning" or "losing." The

change in placement of the status bar along the barometer was only to facilitate

the illusion of movement. During the free-choice trials the individual's

participant number was visible along with the University of Montana's

abbreviated letters, "UM" at the lower left hand corner of the screen. The

competing participant's number (same as the UM subject) and their University

designation "WSU" were also visible in the lower right hand corner of the screen.

This component of the task was included to provide some degree of realism to

the game and creditability to the Internet competitor; many of the games

available on the Internet provide these kinds of cues.

Following the free choice trials an appreciation screen (see Figure 3) was

visible and instructed the participants to self-address an envelope for their

winnings and the receipt of an announcement providing a presentation time and

location concerning the research and how their involvement contributed, this

acted as a formal debriefing. Participants were also asked to complete two of

Zuckerman's sensation-seeking scales (SSS), the Interest and Preference scale,

Form V and the Activities Scale, Form VI (1994). Subjects were paid one dollar

as a participation endowment (regardless of whether they were provided

feedback of winning or losing) following the experimental session. A monetary

reward was promised to the winner in the free-choice instruction screen, this was

honored to maintain consistency with a pilot study conducted prior to this

investigation. However, participants were not awarded this winning, nor were

they provided a debriefing until all participants data had been collected and

recorded in an effort to reduce participant outcome contamination by leakage

from other subjects.   Participants were sent their dollar endowment along with

an announcement flier regarding the date, place, and time of the debriefing

presentation. A post-experimental interview was also immediately administered

following the experiment in order to determine how competitive the subjects felt

as a result of the competitor pairing in the task.

Results

All statistical analyses of choice data were conducted using the proportion

of risk-prone choices. The risk-prone proportion was calculated by dividing the

number of variable option choices by the total number of trials (n=60, this

excludes the first 20 trials). Table 1 shows one-sample t-test results for the risk-

prone proportion for each budget/sex combination. The male/positive budget

group demonstrated a risk-averse bias while all other groups demonstrated risk-

indifference.

Insert Table 1 About Here

A 2 (budget) x 2 (sex) ANOVA was conducted using the proportion of

risk-prone choices as the outcome variable. Results from the ANOVA revealed

no main effect for Budget ($F(1, 247) = 1.10$, $p \geq .05$), no main effect for Sex

(F(1, 247) = 1.77, $p \geq .05$), but a statistically significant Budget x Sex interaction

(F(1, 247) =10.98, $p \leq .05$). A post-hoc analysis of the interaction, using Tukey's

HSD (NH=60.0194, α =.05), revealed that the male/positive budget group was

more risk-averse than the male/negative budget group and female/positive

budget group. All other pair-wise comparisons were not statistically significant.

Bivariate correlations were computed to determine if age (r = .004, $p \geq .05$)

counterbalance (r = -.042, $p \geq .05$), or time of day (r = .053, $p \geq .05$) correlated

with the proportion of risk-prone choices, there were no statistically significant

correlations among these variables and the dependent variable.

Insert Figure 6 About Here

The second hypothesis for this study predicted that one or more of the

dimensions on the sensation-seeking scales from form V or form VI would

correlate with risk-preference. There were two significant correlations with the

overall proportion of risk-prone choices from two dimensions within form V.

The first dimension was that of boredom susceptibility among male subjects

only, this was a weak, negative correlation with overall risk prone choices (r = -

.199, $p \geq .05$) The second dimension was that of disinhibition for females only,

this was a weak, positive correlation with overall risk-prone choices (r = .174, $p \geq$

.05). There were no significant correlations for any of the dimensions on form VI

for males or females. Thus, little to no support was found for hypothesis 2.

Insert Table 2 About Here

Score reliability can be eliminated as a potential cause for the poor

predictive ability of the sensation-seeking scales for choice behavior. The score

reliabilities are acceptable for all the dimensions in form V with the exception of

boredom susceptibility and disinhibition. The score reliabilities are fair to good

for form VI among both males and females, with 0.8 indicating good score

reliability.

Insert Table 3 About Here

Insert Table 4 About Here

The post-experimental interview questions were also examined to assess

the levels of motivation expressed by participants due to the monetary reward,

the competitive component, their level of interest in the task, and if they believed

they chose one choice option consistently more than the other during the task

(self-reported risk-sensitivity). There were no statistically significant differences

between male and female responses to these questions and therefore this cannot

account for differences in male and female choice preferences in the experimental

task.

Insert Table 5 About Here

Discussion

Hypothesis One. The results provide partial support for the first

hypothesis. There were statistically significant differences between males and

females in their choice preference, but the females did not demonstrate a

statistically significant choice preference toward the fixed or variable option for

this experimental task. The males demonstrated risk-averse behavior under a

positive budget and less risk-averse behavior under a negative budget. The daily

energy budget model, as a second order model is rigid in the assumptions it

applies to fitness. Second order models typically assume that the foraging

organism recognizes that they should optimize their net intake in relation to their

energetic requirements and has insight into where along the continuum of

energy they are currently operating; this is unlikely to be the case. Birds and

small mammals have a faster metabolism and therefore their energetic

discrepancies should be more divergent than for a large mammal, like a human

being. Humans are capable of going for long periods of time without eating due to relatively stable lipid reserves. These reserves provide an unparalleled advantage for large mammals that are not necessarily available to most birds, fish or smaller mammals. The application of second order models to large mammals using a risk-sensitive theoretical framework may be too inflexible, as it does not consider the possibility of other fitness functions underlying the behavior (Smallwood, P.D., 1996). This may explain why the females did not demonstrate risk-sensitive behavior under either the positive or negative budget condition. In addition, most of the participants in this study were between 18 and 25 years of age and in their first year of college, for most college females, this means they were of pre-bred age. Their behavior may have been different had they conceived one or more children. The cost to energetic reserves and the way in which females change their perceptions of valued resources once they have to care for another could also influence the way in which they respond to variation in resource rewards. Questions of parenting status were not asked in the demographics screen and therefore not recorded for this study. Parenting status may be a factor to investigate in further studies of risk-sensitive behavior among human, female subjects.

In spite of those studies that successfully demonstrated risk-sensitive behavior of mammalian subjects under manipulated budgets (Barnard & Brown, 1985; Battalio, Kagel, & McDonald, 1985; Zabludoff, 1988), a number of studies

using an energy budget manipulation with mammals have had greater difficulty

in teasing out significant sensitivity under both conditions. Kagel, and

McDonald (1986) reported risk-averse behavior by rats under a positive budget

in a discrete trials manipulation with variability in water as the variable reward

and risk indifference under a negative budget. Lawes and Perrin (1995) used

ambient temperature as a means of manipulating the energy budget for round-

eared elephant shrews. The shrews demonstrated some risk-averse responding

under a positive budget and no preference under a negative budget condition.

Given there are so many variables that can affect one's energy budget under

experimental conditions it is further complicated by using humans as a subject

source. Human behavior is not static, nor is it consistent. Behavior can be

influenced by context, previous experience, whether individuals have recently

eaten, been paid, and the way individuals perceive the risk option can also be

influenced by these same factors. Human subjects bring their previous

experience from the day, the week, the month and potentially their reproductive

history (likely more meaningful biologically to females) into the laboratory. We

further confuse the task by simulating a true negative budget condition. The

losing condition within the competitive treatment does not necessarily take

anything away from the participant when they lose. Unlike true negative budget

conditions, energy is removed from a current bank of reserves. The money

promised to the winner under the experimental condition is a surplus of

"energy" since they did not have any money to start. A potential solution to this problem would be to provide the participants with a monetary award prior to engaging in the task and to ask participants to make choice selections that would preserve their awarded sum. The goal in this context would change from trying to accumulate points to avoiding point accrual. This method could change the trajectory of responding by increasing the believability of the money reward and also better represent a negative energy budget.

In spite of the budget difficulties, the following question is still relevant to humans: Are we risk-sensitive foragers? To a modest degree, the answer appears to be yes for adult males, but the results are still inconclusive regarding females. It could be that this study did not target the most sensitive age group or the manipulation may not have provided relevant feedback for female participants in comparison to males. Pietras and Hackenberg (2001) successfully demonstrated risk-sensitivity in humans in their choice task. One of their two female subjects and the only male subjects demonstrated risk-sensitive choice preferences. As a group design, the current study did not address choice preferences among individuals. It may be worthwhile to further investigate individual responses to determine how many individual females were risk-sensitive as opposed to the averaged response of the group. This is clearly one benefit of a small-n design, as averaging behavior across the group may not necessarily reflect any one participant's behavior.

Hypothesis Two. The second hypothesis of this study was not supported,

given that only two dimensions from form V were correlated with proportion of

risk-prone choice preference.   Clearly the sensation seeking scales were not a

good indicator for predicting risk-sensitive behavior under this experimental

methodology.   Further investigation into other personality scales that include a

sensation-seeking or risk-taking dimension should be sought in place of

Zuckerman's form V and form V scales.

Further investigations into risk-sensitive behavior with human subjects

within a group design could aim to better manipulate the energy budget.   This

may be addressed by provisioning money to the participant at the inception of

the experimental task and requiring that they conserve that resource by selecting

choice options that reduce notable point accrual or by including an effort

component within the choice procedure.   Both of these changes may better reflect

a true energy state, rather than just telling the participant that they are winning

or that they need to click on the choice boxes.   If a joystick with varying force

settings were utilized as the vehicle for making a choice selection, then perhaps

subjects could be divided into low response effort and high response effort

groups. The low-effort group would represent the positive budget and the high-

effort group would act as an analogue to the negative budget.   Again the

participant would have to select from two choice options, but instead of clicking

on the stimuli, they would have to move a cursor via a joystick that has

adjustable force settings, thereby making the cursor movement difficult or easy. It is difficult to simulate or actually induce a caloric loss using human subjects in an experimental task, but a response effort component may be one way to better manipulate a biological energy budget and still use a human sample.   Increases in response effort may precipitate changes in foraging strategy. The organism would have to adjust their behavior and choice selection to accommodate the environmental demands made to the forager's energy reserve. Increased effort may then facilitate risk-prone choices and lower effort is predicted to foster risk-averse selections, such that higher energy demands are predicted to encourage riskier choice selection and lower energy demands more conservative choice selections.

It is relevant to investigate risk-sensitivity in humans because so much of our behavior is dictated by the estimation of the cost-benefits of a given choice. Insight into the mechanism and proclivity males and females may have for differing risk situations could facilitate greater understanding and additional research within the context of gambling, economics, and cognition. Further examination of this area of behavior must be addressed before conclusive statements can be made concerning risk-sensitivity among humans.

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Appendix I

Table 1

Risk Prone Choice Proportions for Males and Females

		n	Proportion of Risk-Prone Choices	SEM	One-sample t-value
Males	Positive Budget	53	.41	.029	-3.20**
	Negative Budget	47	.51	.023	0.381
Females	Positive Budget	73	.52	.018	0.832
	Negative Budget	77	.46	.021	-1.75

* p≤ .05 (2-tailed).
** p≤ .01 (2-tailed).

Table 2

Correlations Between T-Scores of Form V , Form VI and Proportion of Risk-Prone
(RP) Choices for Males and Females

Dimension	Sex	Correlation (r) with Proportion RP Choices
DIS	Males (n = 100)	.012
	Females (n = 150)	.174*
BS	Males (n = 100)	-.199*
	Females (n = 150)	.059
TAS	Males (n = 100)	.041
	Females (n = 150)	.086
ES	Males (n = 100)	.120
	Females (n = 150)	-.090
Total	Males (n = 100)	-.010
	Females (n = 150)	.100
E-DIS	Males (n = 100)	.013
	Females (n = 150)	.031
I-DIS	Males (n = 100)	.136
	Females (n = 150)	.057
E-TAS	Males (n = 100)	-.019
	Females (n = 150)	-.062
I-TAS	Males (n = 100)	.120
	Females (n = 150)	-.013

*Correlation is statistically significant at the .05 α level (2-tailed).
**Correlation is statistically significant at the .01 α level (2-tailed).

Table 3

Cronbach Alpha Reliabilities for Form V and Form VI Subscale Scores

Subscale Form V.		Cronbach's α	Mean	Std. Dev.
TAS	Males (n = 100)	.72	8.30	1.97
	Females (n = 150)	.75	7.46	2.41
ES	Males (n = 100)	.55	6.34	1.95
	Females (n = 150)	.68	6.11	2.27
DIS	Males (n = 100)	.75	5.67	2.60
	Females (n = 150)	.74	4.54	2.62
BS	Males (n = 100)	.41	3.41	1.79
	Females (n = 150)	.28	2.85	1.53
Total	Males (n = 100)	.77	29.72	5.45
	Females (n = 150)	.78	20.97	5.74

Subscale Form VI.		Cronbach's α	Mean	Std. Dev.
E-TAS	Males (n = 100)	.70	27.10	4.68
	Females (n = 150)	.66	25.25	4.44
E-DIS	Males (n = 100)	.89	91.57	13.79
	Females (n = 150)	.90	83.29	14.67
I-TAS	Males (n = 100)	.89	51.51	8.95
	Females (n = 150)	.88	47.60	8.71
I-DIS	Males (n = 100)	.90	96.45	16.82
	Females (n = 150)	.91	83.88	17.37

Table 4

T-Scores, Standard Deviations, Standard Errors of the Mean, and t-values
for Form V & VI

Subscale: Form V.		Means	Std.	SEM	One-sample t-value
DIS	Males (n =100)	47.71	10.72	1.077	0.316
	Females (n =150)	47.24	11.94	.972	
BS	Males (n =100)	48.14	8.93	.897	-0.405
	Females (n =150)	48.56	7.18	.585	
TAS	Males (n =100)	52.47	9.10	.914	-0.583
	Females (n =150)	53.16	9.07	.738	
ES	Males (n =100)	55.43	8.92	.897	0.773
	Females (n =150)	54.48	9.98	.813	
Total	Males (n =100)	51.68	10.34	1.04	0.593
	Females (n =150)	50.97	8.46	.689	
Subscale: Form VI		Means	Std. Dev.	SEM	One-sample t-value
E-TAS	Males (n =100)	60.06	9.99	1.00	-2.039*
	Females (n =150)	62.94	11.49	.935	
E-DIS	Males (n =100)	49.50	8.10	.821	-0.869
	Females (n =150)	50.54	10.03	.816	
I-TAS	Males (n =100)	53.86	9.44	.949	-0.782
	Females (n =150)	54.81	9.35	.761	
I-DIS	Males (n =100)	49.21	8.54	.859	1.671
	Females (n =150)	82.34	16.98	.855	

* p≤ .05 (2-tailed).
** p≤ .01 (2-tailed).

Table 5

Post-Experimental Interview Questions
Means, Standard Deviations, One-sample t-test, standard errors of the mean.

Post-Experimental Interview		Mean	Std. Dev.	SEM	One-Sample t-value
Motivator ($):	Males (n = 100)	2.2	.83	.083	-0.593
	Females (n = 150)	2.2	.76	.062	
Motivator (Competitor):	Males (n = 100)	1.6	.79	.079	-1.775
	Females (n = 150)	1.8	.82	.067	
Interest:	Males (n = 100)	1.9	.75	.075	-0.701
	Females (n = 150)	2.0	.67	.055	
Risk Sensitivity:	Males (n = 100)	.75	.44	.044	0.781
	Females (n = 150)	.70	.46	.037	

* $p \leq .05$ (2-tailed)   ** $p \leq .01$ (2-tailed)

SCALE
Motivator ($ Reward):
    Scale: 1- Had considerable influence on how I chose.
           2- Had some influence on how I chose.
           3- Had no influence on how I chose.
Motivator (Competitor):
    Scale: 1- Had considerable influence on how I chose.
           2- Had some influence on how I chose.
           3- Had no influence on how I chose.
Interest (Bored vs. Engaged):
    Scale: 1- I was bored with the task
           2- I was engaged in the task
           3- I was interested in the task
Risk Sensitive:
    Scale: 0- Chose the two options evenly
           1- Chose one option consistently more than the other

Figure 1

Instructions for the Forced-Choice Trials

INSTRUCTIONS

Once you start the program, you will be presented with set of practice trials. During these trials, a yellow OR a blue choice box will be visible. These two choice options yield differing point values, all you have to do is CLICK 3 consecutive times on the visible choice box until a point value is shown. The practice trials will only present you with one choice box (yellow or blue) at a time and none of the points will be incrementing. These trials are in place in an effort to familiarize you with the different point values of each choice selection. After 10 trials, you will be presented with another instruction screen.

The second instruction screen will signal the start of the free-choice trials, your points be incrementing for that task and you will be competing with another student for points. If you have questions, please ask the researcher now to clarify, if you do not, please click "start program" to begin.

Figure 2

Instructions for the Free-Choice Trials

INSTRUCTIONS

Now that you have been exposed to the two choice options, you will be asked to connect to the Internet to compete with a student from a participating college. In this part of the study, you will again select one of the two choice boxes in each trial. Again the two boxes will represent either a variable point amount of 1 or 5, or a constant amount of 3, just like in the forced choice trials. However, now your points will accumulate in a point box at the bottom of the screen. In addition, you will be able to determine where you are (winning, losing, or even) relative to your competitor via a status barometer along the right side of the experimental screen. Remember you are competing for points, but whoever wins the game will receive a MONETARY PRIZE provided by a grant funded by the National Psychological Community (NPC).

All of the sign-up times, including yours, were paired with sign-up times from the participating University. Given the variability with which students arrive to their appointment, there may be a brief delay while your competitor completes the forced choice trials, reads the instructions, and logs on the Internet. Please be patient. Your game id number will be your participant number and the abbreviation "UM" for the University of Montana. Your competitor will have the same participant number, but with a different college abbreviation. When you have read and understand these instructions, log on by clicking on the "connect" button at the bottom of the screen.

Figure 3

Appreciation Screen

Thank you for your participation!

You will receive two experimental credits for your involvement in this study. Before you leave, please address the envelope, complete our questionnaires, and wait for the post-experimental interview. YOU ARE EXPECTED TO MAINTAIN THE CONFIDENTIALITY OF THIS TASK! Please do not discuss any aspect of this experiment with your peers. Thank you & enjoy your day!
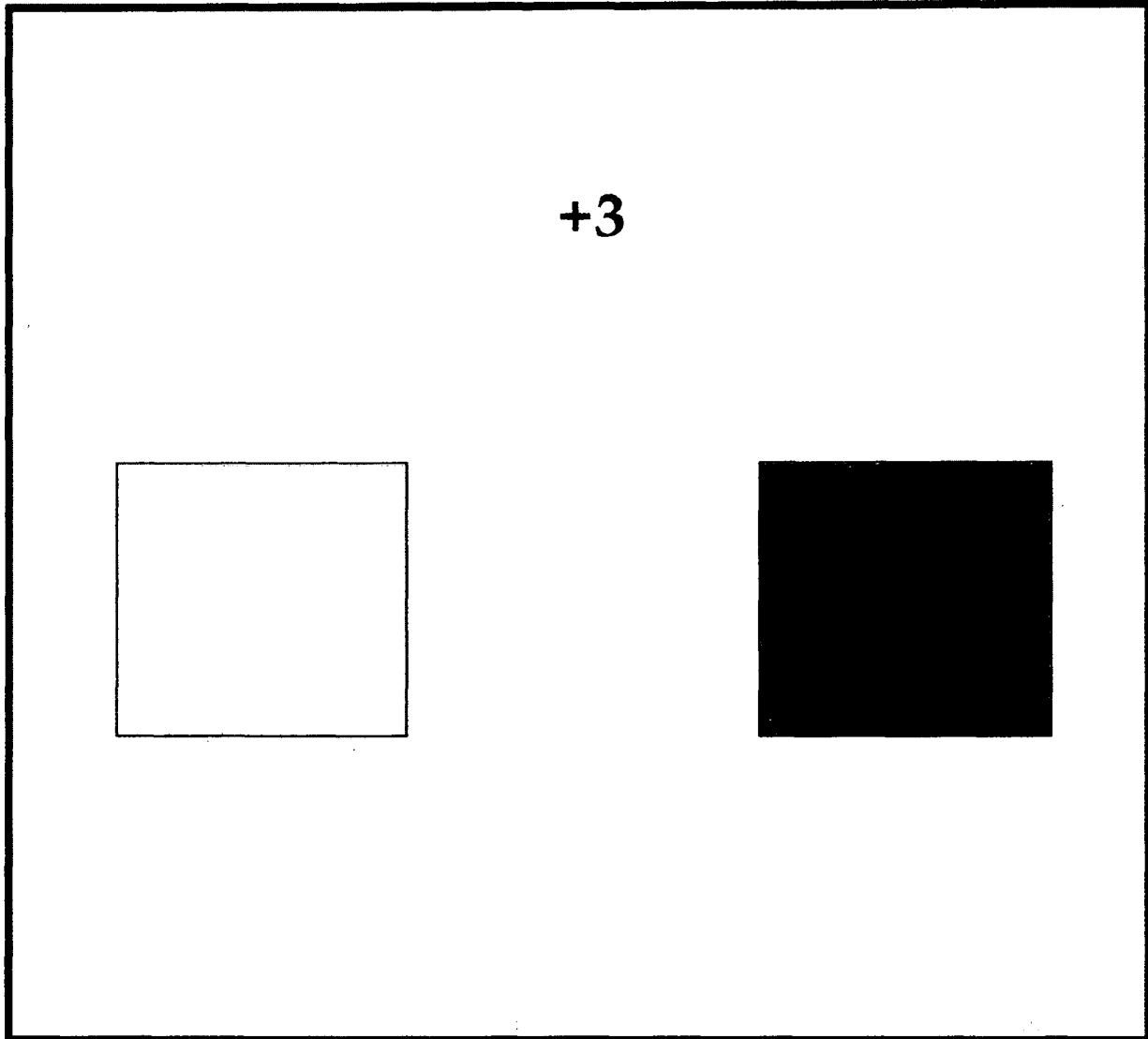

Figure 4

Free-Choice Screen
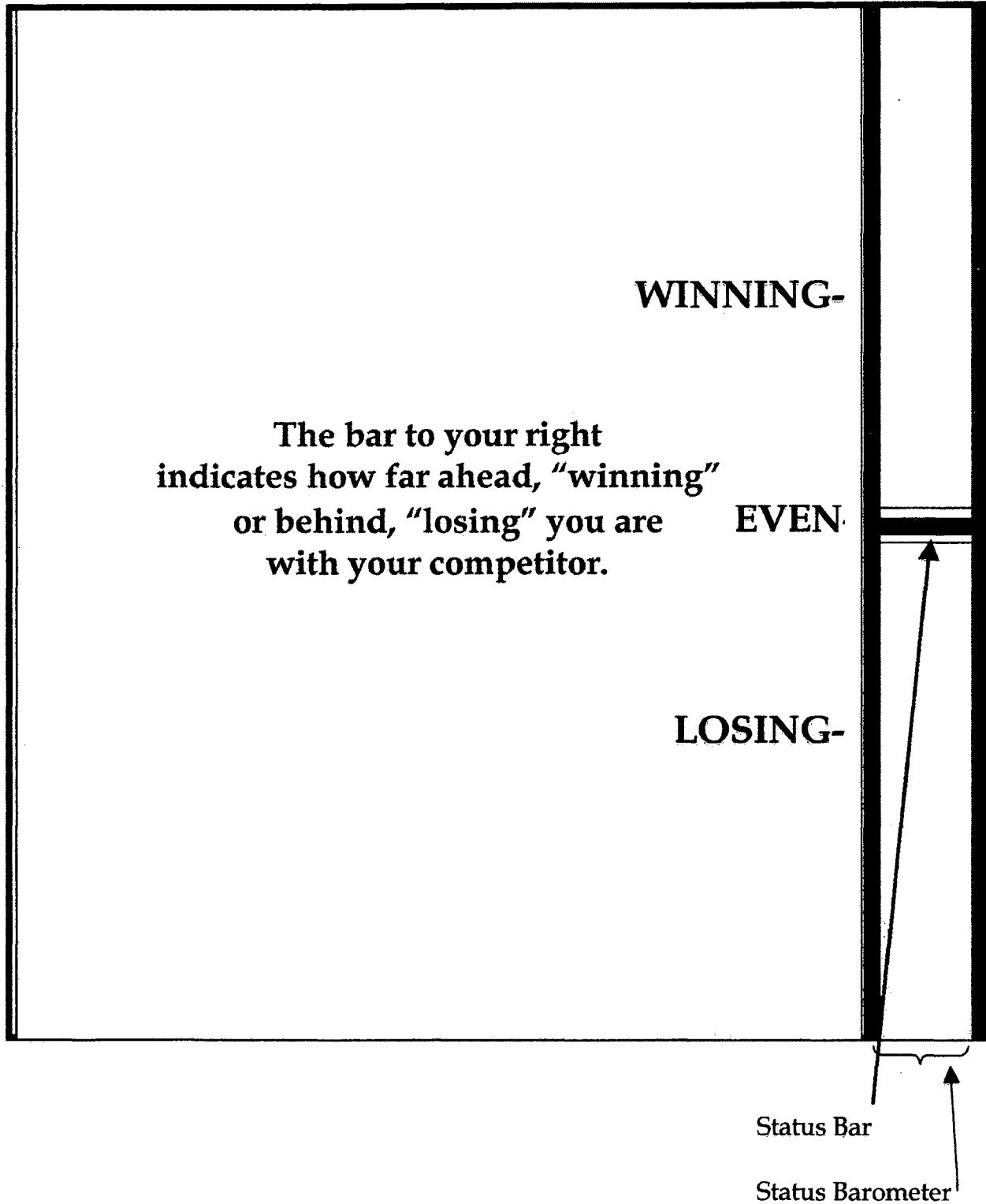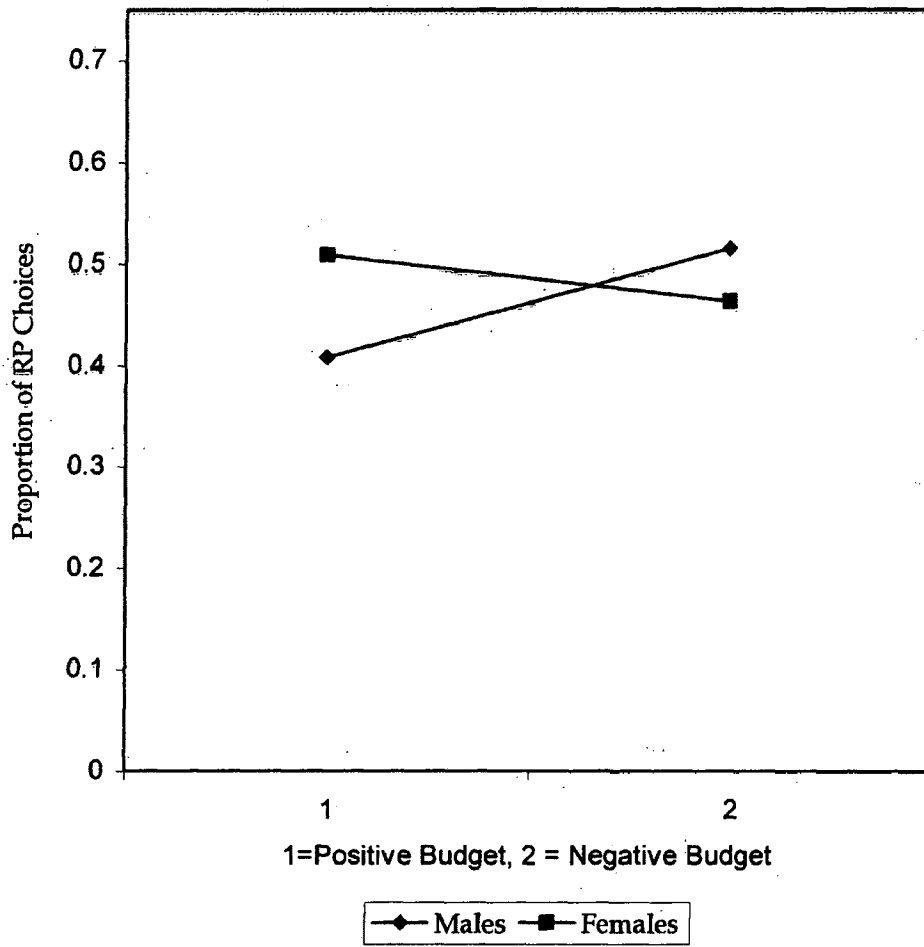
Figure 5

Status Screen

WINNING-

The bar to your right
indicates how far ahead, "winning"
or behind, "losing" you are   EVEN
with your competitor.

LOSING-

Status Bar

Status Barometer

Figure 6

Proportion of Risk-Prone (RP) Choices by Males and Females
Under a Positive and Negative Energy Budget

1=Positive Budget, 2 = Negative Budget

APPENDIX II

SENSATION-SEEKING SCALE, FORM V
INTEREST & PREFERENCE QUESTIONNAIRE

Participant Number: _____
Date & Time: _____   _____
Sex: MALE   FEMALE
Researcher: _____

Directions: Each of the items below contains two choices A and B. Please circle which of the choices most describes your likes or the way you feel. In some cases you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases you may find items in which you do not like either choice. In these cases, mark the choices you dislike least. **Do not leave any items blank.** It is important you respond to all items with only one choice, A or B. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are no right or wrong answers, as in other kinds of tests. Be candid and give your honest appraisal of yourself.

1.   A.   I like wild uninhibited parties.
     B.   I prefer quiet parties with good conversation.

2.   A.   There are some movies I enjoy seeing a second or even a third time.
     B.   I can't stand watching a movie that I have seen before.

3.   A.   I often wish I could be a mountain climber.
     B.   I can't understand people who risk their necks climbing mountains.

4.   A.   I dislike all body odors.
     B.   I like some of the earthy body smells.

5.   A.   I get bored seeing the same old faces.
     B.   I like the comfortable familiarity of everyday friends.

6.   A.   I like to explore a strange city or section of town by myself, even if it means getting lost.
     B.   I prefer a guide when I am in a place I don't know well.

7.   A.   I dislike people who do or say things just to shock or upset others.
     B.   When you can predict almost everything a person will do and say he or she must be a bore.

8.   A.   I usually don't enjoy a movie or a play where I can predict what will happen in advance.
     B.   I don't mind watching a movie or a play where I can predict what will happen in advance.

9.   A.   I have tried marijuana or would like to.
     B.   I would never smoke marijuana.

10. A. I would not like to try any drug which might produce strange and dangerous side effects.
    B. I would like to try some of the drugs that produce hallucinations.

11. A. A sensible person avoids activities that are dangerous.
    B. I sometimes like to do things that are a little frightening.

12. A. I dislike "swingers" (People who are uninhibited and free about sex).
    B. I enjoy the company of real "swingers."

13. A. I find that stimulants make me uncomfortable.
    B. I often like to get high (drinking liquor or smoking marijuana).

14. A. I like to try new foods that I have never tasted before.
    B. I order the dishes with which I am familiar so as to avoid disappointment and unpleasantness.

15. A. I enjoy looking at home movies, videos, or travel slides.
    B. Looking at someone's home movies, videos, or travel slides bores me tremendously.

16. A. I would like to take up the sport of water skiing.
    B. I would not like to take up water skiing.

17. A. I would like to try surfboard riding.
    B. I would not like to try surfboard riding.

18. A. I would like to take off on a trip with no preplanned or definite routes or timetables.
    B. When I go on a trip, I like to plan my route and timetable fairly carefully.

19. A. I prefer the "down to earth" kind of people as friends.
    B. I would like to make friends in some of the "far out" groups like artists or "punks."

20. A. I would not like to learn to fly an airplane.
    B. I would like to learn to fly an airplane.

21. A. I prefer the surface of the water to the depths.
    B. I would like to go scuba diving.

22. A. I would like to meet some persons who are homosexual (men or women).
    B. I stay away from any I suspect of being "gay" or "lesbian."

23. A. I would like to try parachute jumping.
    B. I would never want to try jumping out of a plane with or without a parachute.

24. A. I prefer friends who are excitingly unpredictable.
    B. I prefer friends who are reliable and predictable.

25. A. I am not interested in experience for its own sake.
    B. I like to have new and exciting experiences and sensations, even if they are a little frightening, unconventional, or illegal.

26. A. The essence of good art is in its clarity, symmetry of form, and harmony of colors.
    B. I often find beauty in the "clashing" of colors and irregular forms of modern paintings.

27. A. I enjoy spending time in the familiar surroundings of home.
    B. I get very restless if I have to stay around home for any length of time.

28. A. I like to dive off the high board.
    B. I don't like the feeling I get standing on the high board (or I don't go near it).

29. A. I like to date persons who are physically exciting.
    B. I like to date persons who share my values.

30. A. Heavy drinking usually ruins a party because some people get loud and boisterous.
    B. Keeping the drinks full is the key to a good party.

31. A. The worst social sin is to be rude.
    B. The worst social sin is to be a bore.

32. A. A person should have considerable sexual experience before marriage.
    B. It's better if two married persons begin their sexual experience before marriage.

33. A. Even if I have the money, I would not care to associate with flighty rich persons in the "jet set."
    B. I could conceive of myself seeking pleasures around the world with the "jet set."

34. A. I like people who are sharp and witty even if they do sometimes insult others.
    B. I dislike people who have their fun at the expense of hurting the feelings of others.

35. A. There is altogether too much portrayal of sex in the movies.
    B. I enjoy watching many of the "sexy" scenes in movies.

36. A. I feel best after taking a couple of drinks.
    B. Something is wrong with people who need liquor to feel good.

37. A. People should dress according to some standard of taste, neatness, and style.
    B. People should dress in individual ways even if the effects are sometimes strange.

38. A. Sailing long distances in small sailing crafts is foolhardy.
    B. I would like to sail a long distance in a small, but seaworthy sailing craft.

39.   A.   I have no patience with dull or boring people.
      B.   I find something interesting in almost every person I talk to.

40.   A.   Skiing down a high mountain slope is a good way to end up on crutches.
      B.   I think I would enjoy the sensations of skiing very fast down a high mountain slope.

SENSATION-SEEKING SCALE, FORM VI
Part I – Experience Questionnaire

Participant Number: _____

Date & Time: _____ _____

Sex: MALE   FEMALE

Researcher: _____

Directions: Below you will find a list of many different kinds of activities.
Please indicate whether you have actually engaged in this activity or not.
Answer all items using one of the following options:

A.   I have never done this.
B.   I have done this once.
C.   I have done this more than once.

Please mark only one response for each of the items: A, B, or C. Please answer all of the items.
Please be candid and honest in answering these items. There are no right or wrong answers. We
are only interested in your experiences, not in how others might regard these activities. Your
responses are entirely confidential.

_____1.   Climbing a steep mountain.

_____2.   Reading books about explicit sex.

_____3.   Running in a marathon.

_____4.   Traveling around with a spontenous, uninhibited, fun-loving group.

_____5.   Going to a "wild," uninhibited party.

_____6.   Walking on a tightrope.

_____7.   Being in the company of people who are very casual about sex, and who sometimes

                switch partners.

_____8.   Being "disrespectful" to a teacher or employer.

_____9.   Taking an unknown drug.

_____10.   Shocking older persons just for the fun of it.

_____11.   Swimming in the English Channel.

_____12.   Having sex in public (where others were doing the same thing).

_____13.   Parachute jumping.

_____14.   Having premarital sexual relations.

_____15.   Flying an airplane.

_____16.   Getting "high" in the company of other people.

_____17.   Doing something illegal, but enjoyable.

_____18.   Scuba diving.

_____19.   Horseback riding at a gallop.

_____20.   Sailing long distance.

_____21.   Swimming alone far out from shore.

_____22.   Having a sexual relationship with someone you just met and may not see again.

_____23.   Climbing Mount Everest.

_____24.   Skiing down high mountain slopes.

_____25.   Sacrificing safety to speed when driving a car.

_____26.   Doing something very unconventional.

_____27.   Trying cocaine.

_____28.   Exploring caves.

_____29.   Discussing your sex life with friends.

_____30.   Hunting lions and tigers.

_____31.   Going to an "X-rated" movie that shows open sexual activity.

_____32.   Getting drunk deliberately.

_____33.   Living with someone of the opposite sex in a temporary arrangement.

_____34.   Trying the drug LSD.

_____35.   "Doing what feels good," regardless of the consequences.

_____36.   Racing cars.

_____37.   Riding a motorcycle.

_____38.   Enjoying "wild" or unusual sexual fantasies.

_____39.   Backpacking in Europe.

_____40.   Hitchhiking.

_____41.   Traveling in Antarctica.

_____42.   Going to a party where there is heavy drinking.

_____43.   Associating with friends who are excitingly unpredictable.

_____44.   Going to a large rock concert.

_____45.   Taking a trip to the moon.

_____46.   Going out with someone just because you find them physically exciting.

_____47.   Doing something dangerous because someone dared you to.

_____48.   Doing unconventional things even if they are a little frightening.

_____49.   Refusing to follow an order from a parent or an employer.

_____50.   Snorkeling over a reef.

_____51.   Backpacking in the wilderness (in the U.S.A).

_____52.   Having sex with more than one person on the same day.

_____53.   Traveling up the Amazon.

_____54.   Stealing something when you knew you wouldn't be caught.

_____55.   Doing "crazy" things just to see the effects on others.

_____56.   Using illegal drugs (other than marijuana).

_____57.   Surviving alone on an island for a week.

_____58.   Nude swimming in the company of persons of both sexes.

_____59.   Seducing someone you wanted to sleep with.

_____60.   Taking a long-odds bet rather than a sure bet if you had the chance to make a lot

of money.

_____61.   Using marijuana.

_____62.   "Picking up" someone of the opposite sex.

_____63.   Gambling for high stakes.

_____64.   Going alone to a "singles bar."

Part II – Intentions for the Future

Directions: Below you will find a list of many different kinds of activities. Please indicate whether
you would like to engage in this activity *in the future regardless of whether or not you have engaged in
the activity in the past.* Answer all items using one of the following options: IN THE FUTURE:

A.   I have no desire to do this.
B.   I have thought of doing this, but probably will not do it.
C.   I have thought of doing this and will do it if I have the chance.

Please mark only one response for each of the items: A, B, or C. Answer all of the items.
Be candid and honest.

_____65.   Climbing a steep mountain.

_____66.   Reading books about explicit sex.

_____67.   Running in a marathon.

_____68.   Traveling around with a spontaneous, uninhibited, fun-loving group.

_____69.   Going to a "wild," uninhibited party.

_____70.   Walking on a tightrope.

_____71.   Being in the company of people who are very casual about sex, and who

sometimes switch partners.

_____72.   Being "disrespectful" to a teacher or employer.

_____73.   Taking an unknown drug.

_____74.   Shocking older persons just for the fun of it.

_____75.   Swimming in the English Channel.

_____76.   Having sex in public (where others were doing the same thing).

_____77.   Parachute jumping.

_____78.   Having premarital sexual relations.

_____79.   Flying an airplane.

_____80.   Getting "high" in the company of other people.

_____81.   Doing something illegal, but enjoyable.

_____82.   Scuba diving.

_____83.   Horseback riding at a gallop.

_____84.   Sailing long distance.

_____85.   Swimming alone far out from shore.

_____86.   Having a sexual relationship with someone you just met and may not see

                again.

_____87.   Climbing Mount Everest.

_____88.   Skiing down high mountain slopes.

_____89.   Sacrificing safety to speed when driving a car.

_____90.   Doing something very unconventional.

_____91.   Trying cocaine.

_____92.   Exploring caves.

_____93.   Discussing your sex life with friends.

_____94.   Hunting lions and tigers.

_____95.   Going to an "X-rated" movie that shows open sexual activity.

_____96.   Getting drunk deliberately.

_____97.   Living with someone of the opposite sex in a temporary arrangement.

_____98.   Trying the drug LSD.

_____99.   "Doing what feels good," regardless of the consequences.

_____100.   Racing cars.

_____101.   Riding a motorcycle.

_____102.   Enjoying "wild" or unusual sexual fantasies.

_____103.   Backpacking in Europe.

_____104.   Hitchhiking.

_____105.   Traveling in Antarctica.

_____106.   Going to a party where there is heavy drinking.

_____107.   Associating with friends who are excitingly unpredictable.

_____108.   Going to a large rock concert.

	109.	Taking a trip to the moon.
	110.	Going out with someone just because you find them physically exciting.
	111.	Doing something dangerous because someone dared you to.
	112.	Doing unconventional things even if they are a little frightening.
	113.	Refusing to follow an order from a parent or an employer.
	114.	Snorkeling over a reef.
	115.	Backpacking in the wilderness (in the U.S.A).
	116.	Having sex with more than one person on the same day.
	117.	Traveling up the Amazon.
	118.	Stealing something when you knew you wouldn't be caught.
	119.	Doing "crazy" things just to see the effects on others.
	120.	Using illegal drugs (other than marijuana).
	121.	Surviving alone on an island for a week.
	122.	Nude swimming in the company of persons of both sexes.
	123.	Seducing someone you wanted to sleep with.
	124.	Taking a long-odds bet rather than a sure bet if you had the chance to make a lot of money.
	125.	Using marijuana.
	126.	"Picking up" someone of the opposite sex.
	127.	Gambling for high stakes.
	128.	Going alone to a "singles bar."

End of Questionnaire.
Thank You.