12-2004

The Effects of Stress and Sudden Changes on Decision-Making as Moderated by Individual Differences in Sensation-Seeking

Nataria T. Joseph

Running Head: SENSATION SEEKING AND RISKY CHOICES

The Effects of Stress and Sudden Changes on Decision-Making as Moderated by Individual Differences in Sensation-Seeking

by

Nataria T. Joseph

Undergraduate honors thesis under the direction of Dr. Mathews

Department of Psychology

Submitted to the LSU Honors College in partial fulfillment of the Upper Division Honors Program.

December, 2004

Louisiana State University

Contact Info:

P.O. Box 22024

Baton Rouge, LA 70894

ABSTRACT

Some argue that stress causes individuals to make ineffective decisions while others argue that stress aids decision-making by forcing individuals to rely upon implicit heuristics. However, highly impulsive individuals may lack the conditioned emotional responses to disadvantageous choices that aid implicit heuristics. Findings from the first experiment provide some support that the effects of stress may depend on an individual's level of impulsivity as measured by level of sensation seeking but should be interpreted with caution. A second experiment demonstrated that individuals with an initial preference for the risk changed their performance as a result of sudden changes in environmental cues while those with an initial avoidant of risk performed in a relatively consistent manner. Implications and limitations are discussed.

The Effects of Stress and Sudden Changes on Decision-Making as Moderated by Individual Differences in Impulsivity

Many individuals of different types of upbringings, socioeconomic status, and age suffer from disorders of volition, in which they make the decision to do something which they know will be harmful to their health, finances, social life, family life, or all of these factors simultaneously. This population includes drug addicts, gamblers, those with eating disorders, and those who promiscuously engage in risky sexual behaviors. Are all of these different types of people encountering a similar deficit which is causing them to suffer from this compulsive propensity to make what the rest of society would deem risky, disadvantageous decisions? If so, what is this deficit?

The general consensus is that these individuals, especially the drug addicts and gamblers, do harbor a similar deficit in decision making. However, there is disagreement about the primary mechanism by which this deficit operates. It has long been assumed that these disorders are characterized by an inability to control oneself, or impulsivity. Put simply, impulsivity means acting on one's desires without conscious thought about the long-term consequences. In fact, the Diagnostic and Statistical Manual of the American Psychiatric Association directly deems gambling as a disorder in which there is a lack of control over impulses (DSM-IV, 4th Ed.). This impulsivity may be explained in the context of the arguments of two major theorists, both of which argue that decision-making involves both cognitive evaluation of choices and some concurrent, nonconscious emotionality tied to the choices (Bechara & Damasio, 2002; Bechara, Damasio, Tranel, & Damasio, 1997; Damasio 1994; Loewenstein, 1996).

Loewenstein (1996) attributes impulsive decision making to the overriding existence of emotional arousal as defined by visceral influences. Loewenstein (1996) argues that

physiological arousal as characterized by "'visceral factors,' [which consist of] drive states such as hunger, thirst, and sexual desires, moods and emotions, physical pain, and craving for a drug [to which] one is addicted" may "crowd out" other considerations when one is attempting to cognitively evaluate a decision, thus, impairing balanced decision-making. Thus, due to the activation of these strong visceral influences, an individual is caused to prematurely make a decision before actually being able to access cognition and explicit memory for long-term consequences. For Loewenstein (1996), emotional arousal has an interfering effect on choice by blocking conscious rational thinking and impulsive individuals suffer from an excessive sensitivity to these strong physiological influences. What makes impulsive individuals more sensitive to these visceral influences than the normal population? Loewenstein's theory does not effectively explain this. Moreover, Loewenstein claims that individuals engage in risky behavior to reduce the stress of over-arousal caused by strong visceral influences.

This theory may be problematic when viewed in terms of Zuckerman's (1994) sensation-seeking concept, which entails "the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience." Zuckerman (1994) feels that individuals partake in sensation seeking, which has been shown to be significantly correlated with impulsivity, in order to increase arousal rather than reduce it. Additionally, Loewenstein's theory lacks explanatory power concerning impulsive behaviors, such as gambling, that have no innate, visceral factor associated with them. Unlike drug abuse, which may be driven by the state of craving and/or physical pain resulting from withdrawal, there is no unique drive state in the human physiology that is known to impel one to gamble.

Damasio's theory offers a framework that may better or more completely account for those disorders or volition left unexplained by Loewenstein's theory. Damasio (1994) attributes impulsive decision making to the lack or nonexistence of nonconscious emotional reactions that he calls somatic markers. Damasio (1994) postulates that conditioned emotional responses become somatic markers of risky choices. When one is considering a risky behavior, these somatic markers are activated without conscious thought and they cause one to quickly avoid impulsive and potentially risky choices. However, as substantiated by Bechara and Damasio (2002), substance-dependent individuals and individuals with specific brain damage do not develop these somatic markers, and therefore, they favor risky choices. In their study, Bechara and Damasio (2002) simulated a gambling task that captured the decision-making situations that those suffering from impulsive disorders face, which allowed them not only to substantiate the claim that substance-dependent individuals tend to choose disadvantageously but also to exhibit the role which emotions play in decision-making (Bechara & Damasio, 2002; Bechara, Damasio, Tranel, & Damasio, 1997). Within this gambling task, there were four decks of cards from which the participants had to choose. Two of the decks were ultimately disadvantageous and two were ultimately advantageous. Specifically, the disadvantageous decks were characterized by high immediate payoffs and unpredictable risks while the advantageous decks were characterized by low immediate payoffs and less risky losses. This task mimics the decisions that gamblers, substance-dependent individuals, bulimics, and those that engage in risky sexual behaviors face on an everyday basis in that they have to choose between engaging in that impulsive action and refraining from engaging in it. Usually, if they succumb to the impulse, they are afforded immediate, short-term gratification but experience severely negative consequences regarding their health, financial stability, occupation, and social life in the long

run. On the other hand, if they avoid that impulsive action, they will experience some discomfort, or even withdrawal, for a while but should eventually experience very positive consequences of this choice.

As intended, Bechara and Damasio (2002) found that substance dependent individuals and more so, patients with bilateral ventromedial prefrontal cortex lesions (VM patients), chose from the disadvantageous decks more often than normal individuals. They also found that, before choosing from the disadvantageous deck, the substance dependent individuals and more so, the VM lesion patients, displayed less anticipatory skin conductance responses (SCRs) than the normal individuals (Bechara & Damasio, 2002). Thus, they reasoned that there was a relationship between the amount of SCRs generated and the type of decisions made, with a greater amount of SCRs leading to more advantageous decisions and a more advantageous decision-making process in general. Specifically, Bechara and Damasio (2002) found that, in normal individuals, the activation of emotion, as indicated by physiological arousal learned as a conditioned response to considering partaking in an activity that the decision-maker anticipates will entail bad consequences, aided decision-making in terms of causing an improved manner of evaluating long-term consequences. Thus, the SCRs measured in Bechara and Damasio (2002) were observable manifestations of the somatic markers that Damasio (1994) postulates to aid decision-making by allowing one quickly and unconsciously to evaluate and avoid an impulsive and potentially risky choice.

There was not a clear-cut division between the performances of the three groups, though. For example, over a third of the normal individuals made just as many disadvantageous choices as the VM patients and some substance-dependent individuals performed advantageously (Bechara & Damasio, 2002). This shows that the presence of substance dependence or abuse is

neither a necessary or sufficient condition for the absence of or deficit in somatic marker performance. Additionally, not all participants who generated sufficient amounts of SCRs also were advantageous decision-makers (Bechara & Damasio, 2002). This also shows that there is not an entirely direct connection between a lack of somatic markers and poor decision-making. Thus, there must be some mediator moderating the relationship between somatic markers and decision-making. There must be some explanation to explain why some populations have defective somatic markers and some do not and why a lack of somatic markers disable some while not affecting others. In order to explain these inconsistencies, I propose that those normal individuals that performed badly were natural sensation-seekers and that those substance-dependent individuals who performed advantageously were non-sensation seekers or low sensation seekers. Thus, level of sensation seeking may be the moderating factor between the relationship between SCRs and impulsive decision-making.

Regardless of these inconsistencies and contrary to Loewenstein's (1996) claims, though, Damasio's theory claims that, for normal individuals, emotions help produce good decisions rather than interfere with rational thinking. Taking this into account, any variable that increased reliance on emotion during decision-making should enhance the avoidance of risky decisions for normal individuals but have the opposite effect (increase risky decisions) for those impaired individuals suffering from a predisposition towards acquiring disorders of volition. I propose that the presence of stress increases reliance on emotion and physiological factors.

Johnston, Driskell, and Salas (1997) argued that in naturalistic settings, stress leaves one to rely more upon hypervigilant decision-making, which is implicit in nature, than vigilant decision-making strategies, which involve conscious rational thinking. In familiar situations, such as an experienced driver avoiding a traffic accident, they hypothesized that the individual

should resort to an implicit, heuristic, and more time-efficient method of evaluating the options with which they are being presented (Johnston, Driskell, & Salas 1997). Hypervigilant decision-making involves only evaluating a limited number of choices, a process that may be guided or informed by somatic markers, visceral influences, or both. Specifically, somatic markers attached to a risky choice triggers avoidance of taking the risky choice into consideration while a visceral influence may trigger focus upon one option and disregard of the rest of the options. Thus, hypervigilance is seen as an adaptive strategy that allows one to maintain advantageous decision-making when under stress, such as time pressure, information overload, and environmental distractions.

The effectiveness of hypervigilant decision-making may primarily be due to the fact that it relies upon implicit memory for choices. Other areas of research have shown that implicitly acquired heuristics can effectively guide behavior toward correct choices. In fact, it has been shown that implicit knowledge in general, as characterized by a sort of "gut feeling" or intuition, aids decisions in different tasks even before explicit knowledge of these different tasks has been acquired, if acquired at all (Channon, Shanks, Johnstone, Vakili, Chin, & Sinclair, 2002; Schacter, 1990; Stanley, Mathews, Buss, & Kotlercope, 1989; Abrams & Reber, 1988). In specific regard to implicit processes involving emotion, it has been found that affective, or emotional, memory of an object or stimulus was sustained even when explicit recognition of this same stimulus is impaired (Johnson, Kim, & Risse, 1985; Seamon, Marsh, & Brody, 1984). The fact that this implicit memory is so strong and durable has some implications of its importance to memory and decision-making.

On the other hand, the fact that vigilant decision-making does not involve implicit methodology but is effective sometimes may be seen to contradict the claim that implicit

memory is essential to decision-making. However, vigilant decision-making involves carefully and explicitly evaluating each and every option available, which can be very time-consuming depending on the magnitude of the decision to be made. Thus, vigilant decision-making does lead to satisfactory decisions but only when stress is not an issue, and I assume that, on an everyday basis, those suffering from disorders of volition are more stressed than normal individuals.

The main assumption, then, is that individuals use mostly vigilant decision-making under normal circumstances and mostly hypervigilant decision-making when under stress. Why is it, then, that substance-dependent individuals and others suffering from disorders of volition are thought to exhibit less advantageous choices when under stress? Koob and LeMoal, supporters of the Hedonic Homeostatic Dysregulation explanation for drug use, claim that stress plays a role in causing the impulsive behavior of taking drugs (Koob & LeMoal, 1997). Stress activates the hypothalamic pituitary adrenal axis, which is also activated by the drugs of abuse. Thus, opiate and cocaine-dependent individuals have been shown to exhibit a larger, less adaptive response to stress than normal individuals because they recognize and are more sensitive to the activation of the hypothalamic pituitary adrenal axis and the level of arousal that it produces (Goeders, 2002). This response is thought to lead to the acquisition, continuance, and relapse of drug use (Koob & LeMaol, 1997). Thus, it is clear that stress leads to more reliance on implicit (emotional) decision-making in drug abusers and causes disadvantageous decision-making. However, this theory does not further explore the effects of stress on those suffering from other disorders of volition. Regardless, the natural inclination to revert to implicit cognition when under stress will be shown to be a disadvantageous thing only in the case of those who are high on the trait of sensation seeking. Why is this true? Well, this paper explores the thesis that individuals differ in

how well their implicit somatic markers tune their acceptance of risky choices and thus, how well their state of hypervigilance works for them under stress. It is proposed that some individuals develop risk averse somatic markers more easily than others like substance-dependent individuals and impulsive risk-takers. These individuals would tend to prefer less risky choices without stress, and would be even more risk averse under stress because they would be forced to rely more on their somatic markers when under stress. We intend to have participants perform the Mine-Hunter task, a task in which participants are asked to choose to send probes into one of the two worlds present in order to search for valuable minerals. One of the worlds is riskier than the other one but also contains more of the most valuable mineral. In the middle of the game, the participants will be forced to make their decisions within 3 seconds, a time limit which should place some sort of stress on the participants.

Specifically, we hypothesize that, before the onset of stress, the discrepancy between the performance of those deemed as high impulsive and those deemed as low impulsive will be somewhat existent. However, once the stress is applied, this discrepancy will grow stronger, which is reflective of the discrepancy that exists in the real-world situation with those who are impulsive making mostly disadvantageous choices and those who are not impulsive making mostly advantageous decisions. We assume that this will happen because, according to Johnston, Driskell, and Salas (1997), stress causes individuals to rely more on hypervigilant decision-making, which is much more implicit and emotional than normal or vigilant decision-making. Thus, since according to Damasio (2002; 1997), those prone to impulsivity exhibit a lack of emotional responses to stimuli involved in their situations, they should make extremely disadvantageous decision under stress because they will be left to rely on hypervigilant implicit decision-making. In other words, since the only emotional arousal that they have of any

heuristical value is the impulse or craving to choose the risky option, they will choose disadvantageously when faced with stress. On the other hand, those with low impulsivity will also be forced to rely on implicit, hypervigilant decision-making since research has shown that implicit memory is acquired before explicit memory, which they will not likely have at the point of the initiation of the stress (Channon, Shanks, Johnstone, Vakili, Chin, & Sinclair, 2002; Schacter, 1990; Abrams & Reber, 1988). They will likely have acquired, due to their experience in the task during the pre-stress phase, somatic markers or conditioned responses for the disadvantageous world and, thus, will choose advantageously when under stress and forced to rely upon this implicit, hypervigilant "gut feeling." It is not possible to predict what will happen when the task is non-stressful again because there is no theory in the literature based on a similar paradigm. However, it is our inclination that, by the point in which the task is manipulated to become non-stressful again, they may have acquired more explicit knowledge, and thus, since their implicit memory will not be as activated because of the lack of stress, they will be able to rely on true cognitive knowledge of the task and thus, continue to make mostly advantageous decisions. The impulsives should be making a few more advantageous decisions than they did at the beginning and while under stress because they should gain some explicit knowledge about the task by then and they will not be relying that much on those visceral influences that were stronger under stress.

Methodology

Experiment 1

Participants

Seventy-nine participants participated in this study. All participants filled out the questionnaires while only fifty-two actually completed the Mine Hunter task. Participants were

from the psychology participant pool at Louisiana State University. They received 2 extra credit points in a psychology course for their participation. The participant that obtained the highest account balance on the Mine Hunter task received $25 as a reward. This reward was offered as an incentive for generating participant interest in trying to learn the game and for the purpose of giving the participants a stake in the game so that it will be more ecologically similar to gambling or numerous other risky activities.

Materials/Stimuli

In order to separate those participants that are prone to impulsivity from the non-impulsive participants, we administered three questionnaires to them. The Zuckerman Sensation-Seeking Scale Form V (SSS-V) consists of 40 forced choice questions (see Appendix A for scale in its entirety). A participant's score on SSS-V was determined by counting the number of times they chose the choice deemed beforehand as a sensation seeking activity or representative of such, with the highest possible score being 40. We also administered the impulsive-sensation-seeking scale of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) to participants (see Appendix B). Lastly, we administered the Sensation-Seeking and Anxiety States scales (SSAST) "because [Zuckerman (1994) feels that since] the state just preceding behavior is generally more predictive of behavior than the trait, a measure of sensation seeking as a state could be useful in experiments." The SSAST scale is based on this idea (see Appendix C).

Following along with the task paradigm of Damasio (2002; 1997), we had participants perform the Mine-Hunter task, which consists of two different worlds, the mountain-field world and the volcano-tree world. The primary task involved in Mine-Hunter is to search for valuable minerals by, on any given trial, choosing to send probes that will search for these minerals into

either of the two worlds. It costs $80 to send each probe. The two types of minerals that can possibly be discovered are Newtonite, which is worth $495, and Bubaru, which is worth $240. Mirroring the fact that Damasio's design consisted of options that were more valuable on an average trial than the other options yet more risky in the end, the mountain-field world has a probability of .6 for the discovery of Newtonite and a probability of .1 for the discovery of Bubaru but is the overall risky, disadvantageous world because, there is a probability of .3 for experiencing a probe wreck, which entails losing $1000. The volcano-tree world only has a .1 probability for the discovery of Newtonite and a .6 probability for the discovery of Bubaru yet is the overall advantageous world and is not risky at all because choosing from it will never result in a probe wreck. Based on these probabilities and values, it was always advantageous for a participant to choose to send probes into the volcano-tree world. For both worlds, the more probes they sent, the more opportunity for gain and the less of a loss they would experience. During Phase 1, which is the stage in the experiment in which the participant is getting acquainted with the Mine-Hunter task and should be moving towards learning the relationship between the different worlds and monetary gains and losses, participants are allowed to take however long they want to make their decisions. Phase 2 is the phase in which we attempted to stress the participants by not giving them an overly sufficient amount of time in which to make their decisions. On each trial during this phase, they only have 3 seconds to make their decision. If they do not make their decision within the allotted time, they will lose $550. During Phase 3 the time constraints are removed and participants again have however long they need to make their decision. A table of the expected outcomes or values of each world in the different phases can be found in Table 1.

Design & Procedure

This experiment involved a mixed factorial design with 2 factors, Sensation-Seeking (Low X High) and Phase of Game (Normal1 X Stress X Normal2).

Each session of the experiment lasted for about 1 hour, with the number of participants in each session ranging from 2 to 5. Before the participant started the Mine Hunter task, they filled out the following questionnaires in the following order: SSAST, SSS-V, and Impulsive Sensation-Seeking scale of ZKPQ. There were three phases of the Mine Hunter task, each lasting for 12 minutes. Along with some technical instructions for operating the game, participants were instructed as follows: "On each trial, you should choose one of the two worlds shown on the screen to send probes into in order to search for valuable minerals. On any given trial, you can send 1 to 5 probes but only in one world at a time. Each probe you send costs $80. If you find the mineral called Newtonite, you gain $495, and if you find Bubaru, you gain $240. Your goal is to win the most money by finding minerals and avoiding probe crashes. We are offering a reward of $25 for the best mine-hunter. Now, you will play three games of Mine Hunter. In the first game, which lasts 12 minutes, you should play at your own pace and try to learn the game. In the second phase or game, you will be allowed only 3 seconds to make you decision on each trial so you must make you decisions quickly. If you fail to make your decision within the allotted time, you will lose $550. In the final phase you can once again play the game at your own pace. You should try to win as much money as possible in each phase of the game. Remember that you will have three phases and that during the second phase you will have to make your decision very quickly or you will lose a lot of money." We informed participants that there was the possibility of experiencing a probe wreck but we did not tell them which world consisted of the possibility of probe wrecks.

Results

Participants were labeled as low sensation seeking and high sensation seeking according to their scores on the SSS-V. We decided to use the SSS-V as the standard for the separation of the low sensation seekers from high sensation seekers because the participants' scores on it and the ZKPQ were highly correlated with each other (r=.716). Thus, there was no incentive to use both. Also, the SSAST wasn't significantly correlated with either of the other questionnaires (SSAST and ZKPQ, r=.039; SSAST and SSS-V, r= -.03) and didn't seem to be factoring in on the same construct variable. Additionally, scores on the SSAST weren't even correlated with or predictive of performance during Phase 1 of the game, r= -.177, or any of the other phases for that matter, so it did not have content validity for our particular purposes. After we scored the SSS-V, we labeled the top scorers (*M(SSS-V Score)*= 25.76, N=12) as high sensation seekers and the bottom scorers as low sensation seekers (*M(SSS-V Score)*= 10.07, N=12). Everyone in the middle was labeled as normal or moderate sensation-seekers (*M(SSS-V Score)*= 19, N=28).

For each phase, we counted the number of times that the participants chose from the risky world, calculated the mean number of probes that participant sent to the risky world per trial, and multiplied these to find a measurement of the total number of probes sent to the risky world. Next, we divided this number by the total number of probes sent to both worlds in order to find the percentage of the number of probes the participant sent to the risky world relative to the total number of probes the participant sent to both worlds. A repeated measures ANOVA was conducted on this final number or data obtained. There was not a significant difference between the phases, $F(2,98) = 1.26$ or the different types of sensation seekers, $F(2,49) = 1.73$. However, there was an interaction between phase and sensation seeking type, $F(4,98) = 2.938$, $p<.05$ as

shown in Figure 1. In other words, the different levels of sensation seekers were affected differently by the different phases.

Discussion

Using the decision-making paradigm of the Mine Hunter game combined with a stress phase, we attempted to simulate what Loewenstein would consider conditions under which those high sensation seekers and those suffering from disorders of volition would choose disadvantageously. However, there was no overall difference between the percentages of probes that the participants sent to the risky world in different phases. Due to the small amount of usable participants from the participant sample, it is probable that the statistical analysis did not have much power to find a difference even if there was one. On the other hand, our hypothesis that the number of probes sent to the risky world would be simultaneously affected by both level of sensation seeking and phase of the game was supported through the finding of a significant interaction between these two factors. This shows that high sensation seekers were affected by the stress phase differently than the low sensation seekers. Contrary to our hypothesis, the low sensation seekers weren't affected much by the stress; in other words, their performance did not become more advantageous as we had expected but neither did it become more disadvantageous. As can be seen in Figure 1, the high sensation-seeking group showed an increasing preference for the risky choices once the stress was added and continued upon this disadvantageous path through the end of the third phase while the other sensation seeking groups showed a decrease in Phase 3. This might show that there may be some connection between stress and disorders of volition in that those predisposed to suffer from one of these disorders may be less apt at making decisions under stress than non-impulsive individuals.

Because of the fact that we failed to include a control group that did not experience the stress phase but instead experienced all phases with an unlimited amount of time in which to make their decisions, though, these results should be interpreted with caution. There is no way to determine whether the participants behaved differently as a result of learning that had occurred or truly as a result of the stress period. Also, because of the fact that we did not include a manipulation check, there is no way to determine if the stress phase really did stress the participants. If replicated, this experiment should include a manipulation check at the end of the experiment that asks such questions such as the following: When you had only 3 seconds to decide, did you become stressed? By asking the participants to rate how stressed they were, we could also see if participants that were more stressed behaved differently than those who were less stressed. If, in fact, the participants did behave differently as a result of learning, it is still valuable to note that the low and high sensation seekers were affected differently, regardless of whether they were affected by the stress or their own learning that had possibly taken place.

Additionally, this research was limited due to technical difficulties. Half of the computers used needed to be updated to include more temporary storage space upon which to load the Mine Hunter game. Because of this limitation, half of the computers got progressively slow in executing the game as the game went on. However, it is important to note, though, that there was not a significant difference between the percentage of risky probes sent as a result of which computer the participant was sitting at, $F(4,47) = 1.605$, $p > .05$. Also, those who chose the risky world more had a relatively smaller account balance at the end of the third phase.

Most importantly, after conducting Experiment 2, we went back and looked at the data from Experiment 1 in order to see if level of sensation seeking as determined by score on the SSS-V was correlated with or predictive of behavior in the experiment and the correlation

between sensation seeking score and performance was very low, r=.13. Based on these results, we feel that there is probably is no direct relationship between sensation seeking and decision making even though the lack of correlation may be due to the limited range of the participants scores on the SSS-V. If we would have gotten more extremely low scorers and extremely high scorers, we maybe could have gotten a better correlation. In short, the results from this experiment are uncertain due to a lot of uncontrollable shortcomings. A total replication is necessary in order to validate these results.

Experiment 2

Experiment 2 was conducted to determine if high sensation seekers are affected by a lack of the ability to adapt their decision making processes based on changes in environmental cues. In their study, Schunn, Lovett, and Reder (2001) attempted to figure out whether information about previously advantageous decisions was remembered implicitly or explicitly. They also wanted to know if an individual needed to consciously recognize changes in which decisions were most advantageous in order to start choosing the newly advantageous options. Their paradigm involved a problem-solving task called the Building Sticks Task (BST). In the Building Sticks Task, the goal of the participants on each trial is to build a stick of a given length by combining certain sticks of smaller length. For some trials, the only way to achieve this desired length was to use the "overshoot strategy," which involves putting many stick segments together to build a stick of longer length than needed and then taking away some segments until the desired length is achieved. On the other trials, using an "undershoot strategy" is more advantageous. "Undershooting" involves starting with a shorter total length and building up to the desired length by adding more sticks. They measured adaptivity by observing if the participants switched strategies once the one they were using became disadvantageous. Though

only correlational in nature, their study showed a relationship between explicit awareness and adaptivity to changing success rates. They failed to establish individual differences in working memory capacity as the reason for different levels of awareness. It is essential to note that, although those that were explicitly aware did adapt better than those that weren't aware, those that weren't explicitly aware did show some adaptivity. In other words, they switched strategies when the one they were using became disadvantageous but they didn't do so as much as those who had acquired explicit awareness. This finding shows that implicit awareness may play some role in the ability of individuals to make advantageous decisions.

Under the conditions of the Mine Hunter task, we can use strategy adaptivity in order to further determine whether sensation-seekers are first, different in their decision-making and second, more or less adaptive to changing environmental cues. We intend to use a sudden change in the risk involved with, and thus, the advantage of choosing, the risky world in order to examine adaptability to changing conditions. We hypothesize that when there is no longer the possibility of experiencing a probe crash in the beforehand deemed risky world, high sensation seekers should no longer show a preference for this world, because it no longer provides them with those risky, novel experiences that they desire. On the other hand, those low sensation seekers who have explicitly learned the relationships of the worlds and gains and losses should switch to the former risk world because they realize that there is more opportunity for gain there and no longer a risk there. Consequently, when there is once again a possibility of probe wreck, high sensation seekers should once again show a preference for the previously risky world and low sensation seekers should switch preference back to the non-risky world where there is no chance of experiencing a probe wreck. Technically, there is no theoretical paradigm to explain this; thus, there are no theoretical bases for the aforementioned hypotheses and they are truly

only conjectures. We will simply be examining whether low or high sensation seekers are more adaptive.

Participants

Twenty-seven participants completed the study in its entirety. These participants were screened from the following psychology courses at Louisiana State University: Psychology of Thinking and Decision Making, Psychology of Memory and Forgetting. One hundred students in these courses were given the Zuckerman Sensation-Seeking Scale Form V (SSS-V) and received one extra credit point in the respective psychology course in which they completed the questionnaire. Out of these students, the top 40 scorers and the bottom 43 scorers were invited to participate in the experiment. Only thirty-three of these participants signed up to participate through the psychology participant pool at Louisiana State University and only twenty-seven, thirteen low sensation seekers and fourteen high sensation seekers, completed the full number of trials. These participants received 2 extra credit points in a psychology course for their participation. The participant that obtained the highest account balance on the Mine Hunter task received $25 as a reward. This reward was offered as an incentive for generating participant interest in trying to learn the game and for the purpose of giving the participants a stake in the game so that it will be more ecologically similar to gambling or numerous other risky activities.

Materials/Stimuli

In order to separate those participants that are prone to sensation seeking from the non-sensation-seekers during the initial screening, we administered the Zuckerman Sensation-Seeking Scale Form V (SSS-V) (see Appendix A for scale in its entirety). For this experiment, we didn't administer the ZKPQ because in Experiment 1, it was highly correlated with the SSS-

V anyway. We didn't administer the SSAST for the same reasons that we didn't use it in the analysis for Experiment 1.

Once again, we had participants perform the Mine-Hunter task. Although it still costs $80 to send each probe, most of the other values we used in Experiment 2 are different from those used in Experiment 1. We used different values and probabilities for Newtonite and Bubaru in order to make the experiment more sensitive to differences and robust. In other words, we wanted to make the differences between the worlds more salient so that we could better separate the low sensation seekers from the high sensation seekers and better gauge whether explicit learning could possibly occur within the constraints of this paradigm. In Experiment 2, Newtonite is worth $1050 and Bubaru is only worth $495. Still mirroring the fact that Damasio's design consisted of options that were more valuable on an average trial than the other options yet more risky in the end, the mountain-field world has a probability of .7 for the discovery of Newtonite and a probability of .4 for the discovery of Bubaru but is the overall disadvantageous world because, there is a probability of .3 for experiencing a probe wreck, which entails losing $3000, which is much larger and thus, more salient than the $1000 value that was used in Experiment 1. The volcano-tree world only has a .4 probability for the discovery of Newtonite and a .7 probability for the discovery of Bubaru yet is the overall advantageous world because choosing from it would never result in a probe wreck. There are three phases of the Mine Hunter task, each lasting for 200 trials. During Phase 1, participants face the pre-established probabilities of experiencing a probe crash in the risky world. During Phase 2, participants have no chance of experiencing a probe wreck in any of the worlds. Finally, during Phase 3, the participants once again have a .3 probability of experiencing a probe wreck in the risky world. Given the probabilities and values, during Phase 2, it is always

advantageous for a participant to send probes into the mountain-field world whereas during Phases 1 and 3, it was always advantageous to send probes into the volcano-tree world. The only exception for these two phases is that sending 5 probes into the mountain-field world is more advantageous than sending 1 probe into the volcano-tree world. Once again, as the amount of probes that the participants sent increased in either world, their opportunity for gain also increased. A table of the expected outcomes or values of each world in the different phases can be found in Table 2.

Design & Procedure

This experiment also involved a mixed factorial design with 2 factors, Sensation-Seeking (Low X High) and Phase of Game (Probe Crash1 X No Crash X Probe Crash2). In contrast with Experiment 1, though, participants were not told when they entered a different phase of the game and the phases were differentiated by the possibility of probe wreck and not by the stress of having to choose quickly.

First, a screening session was conducted in which potential participants completed the SSS-V form. After scoring these forms and seeing how scores were distributed among the participants, we asked those who had scores equal to or less than 19 and equal to or greater than 22 to sign up to participate in the Mine Hunter game. This was done in order to ensure that we didn't have any participants who were moderate in sensation seeking level like in Experiment 1. In other words, a more distinctive division between low and high sensation seekers was attempted in order to allow for a more powerful design.

Each session of the experiment in which participants played the Mine Hunter game lasted for an average of about forty-five minutes, with the number of participants in each session ranging from 1 to 5. Participants were instructed as follows: "On each trial, you should choose

one of the two worlds shown on the screen to send probes into in order to search for valuable minerals. On any given trial, you can send 1 to 5 probes but only in one world at a time. Each probe you send costs $80. If you find the mineral called Newtonite, you gain $1050 and if you find Bubaru, you gain $495. Sometimes there is an unexpected probe crash that will cause you to lose $3000. Your goal is to win the most money by finding minerals and avoiding probe crashes. We are offering a reward of $25 for the best mine-hunter." Once again, we informed participants that there was the possibility of experiencing a probe wreck but we did not tell them which world consisted of the possibility of probe wrecks.

Results

The mean SSS-V score for low sensation seekers included in the analysis was 14.21 and the mean SSS-V score for high sensation seekers was 26.86, which resulted in a less variable range of scores than that for the first experiment. Our attempt to make a larger distinction between low and high sensation seekers failed because the extremely high scorers and extremely low scorers that we invited back to participate decided not to sign up to participate. In order the examine the results, we conducted a repeated measures ANOVA on a number of different measurements, the first one being the percentage of times a participant chose to send probes into the risky world in each phase. This measurement was found simply by dividing the number of times the participants sent probes to the risky world by the total number of times the participant sent probes, which was set at 200 trials per phase. There was no significant difference between the different phases on this measure, $F(2,50)=2.313$, $p>.05$. However, it's important to note that partial eta squared was .085, which means that the phase accounted for about 8.5% of the variability in this measure. Due to the low sample size, there was only 44.8% power to find a difference even if there was one. Also, there was no significant difference between low and high

sensation seekers on this measure, $F(1,25)=.414$, $p>.05$. Finally, there was no significant interaction between sensation seeking and probe phrase, $F(2,50)=.137$,$p>.05$. As can be seen in Figure 2, low sensation seekers chose from the risky world a little more than high sensation seekers, which is contradictory to theory. However, this isn't a significant difference, and it has a partial eta square of only .009. Thus, one can ignore the fact that the low sensation-seekers line is above that of the high sensation seekers because this difference can be attributed to random sampling error. One might argue that this difference may have occurred because we made Newtonite so valuable in Experiment 2 that even low sensation seekers were willing to take the risk of looking for it in the risky world. However, this isn't likely because we changed every value in the same proportion, i.e., the value of everything in the experiment was at least doubled. Although Newtonite was more valuable, that shouldn't have made a big difference because a probe wreck was now more risky because it costed $3000 instead of $1000. Due to the fact that the change between Phase 1 and Phase 2 and that between Phase 2 and Phase 3 of Experiment 2 was less salient than those of Experiment 1 and the participants were not even notified of this change, we decided to break the "percentage of total probes sent to the risky world" data for Experiment 2 down into 6 phases in order to more closely study changes in behavior. In other words, instead of just analyzing the three phases in their entireties, we analyzed the first half and the second half of each phase separately because, due to subtlety of the changes, we predicted that the participants would take longer to react to the changes between the phases. The trends that occurred when this was done can be viewed in Figure 3. There was not a significant difference between the phases, $F(5,125)=2.00$,$p>.05$ although the difference approached significance with an alpha level of .083.

Since sensation seeking as determined by SSS-V score did not predict risky choices, $r=.07$, we decided to see if participants who preferred the risky world in Phase 1 were differentially affected by the change in Phase 2 than those who didn't prefer the risky world. Due to a small sample size and the fact that the SSS-V did not seem to be predictive of behavior, we felt that a measure based on actual initial behavior would be a more sensitive measure. The 10 participants who chose to send probes into the risky world for more than 50% of the trials in the first half of Phase 1 were labeled as risky preferential and 17 participants who sent probes into the risky world for less than 50% of these trials were labeled as risky avoidant. As we predicted, this allowed for a more definite separation between the performances of our participants. There was a significant difference between percentage of probes sent to the risky world in the total experiment between the risky avoidant and risky preferential, $F(1,25)=19.966$, $p<.05$, with preference for or avoidance of risk accounting for 44.4% of the variability in the percentage or probes sent to the risky world. There was not a significant difference between the phases, $F(2,50)=2.668$, $p>.05$, although it approached significance and a clear trend towards a decreasing percentage of probes sent to the risky world can be seen in Figure 4. It also important to note that phase accounted for 9.6% of the variability in the dependent measure, which is a significant amount of variability. Once again, though, there was no interaction, $F(2,50)=.585$, $p>.05$. It is important to note, though, that in this particular analysis, we only had about 14% power to find a significant difference due to, once again, our small sample size.

Next, we also broke this analysis down into 6 phases and determined change scores in order to see which participants were adapting according to the phase changes. The results can be seen in Figure 5. Change 1 represents the change from the beginning to the end of Phase 1. Change 2 represents the change from the end of Phase 1 to the beginning of Phase 2. Change 3

represents the change from the beginning to the end of Phase 2, and so forth. We performed a repeated measures ANOVA on the change scores to see if there was a difference in the amount that the groups changed. The interaction between change phase and preference approached significance, $F(4,100)=2.351, p=.079$. The partial eta squared for this difference was 8.6%, which is noteworthy. The data trends regarding when the game is broken down into 6 phases can be found in Figure 5 and the results of breaking the data down into change scores can be found in Figure 6.

After deciding to separate the participants by their preference shown in Phase 1 of Experiment 2, we decided to go back and do the same thing for the data from Experiment 1. Once again, as can be seen in Figure 7, the risky preferential participants were better adaptive to the changes. When the stress phase was added, those with the initial preference for the risky world chose less from it and those with the initial preference for the non-risky world chose more from the risky world. There was a significant interaction, $F(2,100)=5.14$, $p<.05$, between risk preference and phase. There was not a significant difference between the phases, $F(2,100)=.22$, $p>.05$ but there was a significant difference for risk preference, $F(1,50)=15.80$, $p<.05$

Discussion

There was no difference between the percentages of probes that the participants sent to the risky world in different phases although a clear division or trend towards a difference can be seen. Due to the small amount of usable participants from the participant sample, it is probable that the statistical analysis did not have much power to find a difference even if there was one. On the other hand, our hypothesis that the number of probes sent to the risky world would be simultaneously affected by both level of sensation seeking and phase of the game was not

supported because of a lack of an interaction. This shows that. In this experiment, high sensation seekers were not affected by the probe phase differently than the low sensation seekers.

However, once the participants were separated by their preference for the risky world during Phase 1, some differences could be seen in adaptability. Those who had an initial preference for the non-risky world continued in this preference consistently. However, those who had an initial preference for the risky world changed their preference relatively more due to the changes between the phases. For this task, their adaptivity seemed to be somewhat advantageous, but my opinionated conjecture is that this adaptivity or inconsistency may not prove to be advantageous in other tasks nor in real life situations. Further research should be done to determine whether this sensitivity to environmental changes is advantageous or disadvantageous when generalized to other situations.

General Discussion

High sensation seekers, and thus, possibly those suffering from disorders of volition, may be suffering from a deficit in implicit learning or memory. This was somewhat substantiated by the fact that, in the first experiment, where the manipulated change intended to highlight implicit differences, high sensation seekers were affected differently than low sensation seekers. However, once again, these findings would have to be replicated in order to be better validated. In the second experiment, those who exhibit less of a preference for risk seem to more consistent in their decisions and, thus, less impulsive. Once they make a decision, they seem to stick with it and aren't much adaptive to changing environmental conditions. In order to better substantiate these findings, further research should be done in which a control group does not experience the stress phase of a replication of Experiment 1 or the sudden explicit change of a replication of Experiment 2. Also, in future experiments, explicit learners could be separated from implicit

learners further by having different conditions in which some high and low sensation seekers are explicitly told which world is the risky world and other high and low sensation seekers are not. To better gauge whether explicit learning does occur in this paradigm, participants should be directly asked how confident they felt that they knew the relationship between the worlds, risks, and gains and what exactly is this relationship. More specifically, questions like the following should be asked immediately after the participants complete the Mine Hunter task: Was there a greater chance to make more money in one world, and if so, which world was it? Was there a greater risk of probe crash in one world, and if so, which world was it? For Experiment 2, participants could have been asked whether there was a change any time during the experiment in the amount of risk present in any given world. Additionally, with a larger sample size, only really extreme scorers could be tested at Mine Hunter, which should prove to be a more sensitive, powerful design.

In order to test the extension of Damasio's results to the Mine-Hunter paradigm, in future replications, physiological measurement should be conducted using similar skin conductance equipment. This will provide a more accurate picture of whether or not any implicit or emotional learning takes place in the Mine-Hunter paradigm and whether this implicit learning played a significant role in the decisions made by participants.

Also, the probabilities and value actually used in the Mine-Hunter settings should be changed in a manner that will change the utility equations so that, under normal circumstances, it is more advantageous to choose from the non-risky world than the risky world regardless of the number of probes sent and that, as the number of probes sent into the risky world increases, the risk faced also increases.

Lastly, replications of both experiments should include a control group that doesn't experience the stress phase of Experiment 1 or sudden explicit change of Experiment 2. This should provide for a clearer picture of the effects that our manipulations during Phase 2 presented. It should also allow for a more accurate representation of the true correlation between sensation seeking and Mine Hunter performance.

References

Abrams, M., & Reber, A.S. (1988). Implicit learning: Robustness in the face of psychiatric disorders. *Journal of Psycholinguistic Research*, ***17***, 425-439.

American Psychiatric Association (1994). *Diagnostic & Statistical Manual of Mental Disorders* (4th Ed.). Washington, D.C.

Bechara, A. & Damasio, H. (2002). Decision-making and addiction (part I): Impaired activation of somatic states in substance dependent individuals when pondering decisions with negative future consequences. *Neuropsychologia*, ***40***, 1675-1689.

Bechara, A., Damasio, H., Tranel, D., & Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science*, ***275***, 1293-1295.

Channon, S., Shanks, D., Johnstone, T., Vakili, K., Chin, J., & Sinclair, E. (2002). Is implicit learning spared in amnesia? Rule abstraction and item familiarity in artificial grammar learning. *Neuropsychologia*, ***40***, 2185-2197.

Damasio, A. R. (1994). The Somatic-marker hypothesis. In *Descartes' error: Emotion, reason, and the human brain.* New York: G. P. Putnam. 165-201. [Chapter]

Davidson, R. J. (2003). Seven sins in the study of emotion: Correctives from affective neuroscience. *Brain and Cognition*, ***52***, 129-132.

Goeders, Nick E. (2002). Stress and cocaine addiction. *Journal of Pharmacology & Experimental Therapeutics*, ***301***, 785-789.

Janis, I., Defares, P., & Grossman, P. (1982). Hypervigilant reactions to threat. In H. Selye (Ed.). *Selye's guide to stress research.* New York: Van Nostrauk Reinhok. 1-42. [Chapter]

Janis, I. L. (1993). Decisionmaking under stress. In: Goldberger, Leo (Ed); Breznitz, Shlomo (Ed); 1993. *Handbook of stress: Theoretical and clinical aspects* (2nd Ed.). New York, NY, US: Free Press. pp. 56-74. [Chapter]

Johnson, M. K., Kim, J. K., & Risse, G. (1985). Do alcoholic Korsakoff's syndrome patients acquire affective reactions? *Journal of Experimental Psychology,* ***11,*** 22-36.

Johnston, J. H., Driskell, J. E., & Salas, E. (1997). Vigilant and hypervigilant decision-making. *Journal of Applied Psychology*, ***82***, 614-622.

Klein, G. (1996). The effect of acute stressors on decision-making. In J. E. Driskell & E. Salas (Eds.), *Stress and human performance* (pp.49-88). Mahwah, NJ: Lawrence Erlbaum Associates.

Koob, G. F., & Le Moal, M. (1997). Drug abuse: Hedonic homeostatic dysregulation. *Science*, ***278***, 52-58.

Loewenstein, George (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes*, ***65***, 272-292.

Seamon, J. G., Marsh, R. L., & Brody, N. (1984). Critical importance of exposure duration for affective discrimination of stimuli that are not recognized. *Journal of Experimental Psychology,* ***10,*** 465-469.

Schacter, D. L. (1990). Toward a cognitive neuropsychology of awareness: Implicit knowledge and anosognosia. *Journal of Clinical and Experimental Neuropsychology*, ***12***, 155-178.

Schunn, C.D., Lovett, M.C., & Reder, L.M. (2001). Awareness and working memory in strategy adaptivity. *Memory & Cognition*, ***29***, 254-266.

Stanley, W. B., Mathews, R. C., Buss, R. R., & Kotlercope, S. (1989). Insight without awareness: On the interaction of verbalization, instruction, and practice in a simulated process control task. *The Quarterly Journal of Experimental Psychology*, ***41***, 553-577.

Zuckerman, M (1994). *Behavioral expressions and biosocial bases of sensation seeking.* New York, NY, US: Cambridge University Press.

Table 1

Expected Outcomes of Worlds in Different Phases and When Sending Different Amounts of Probes

Risky World

	1 Probe	2 Probes	3 Probes	4 Probes	5 Probes
Phase 1	-858.75	-717.5	-576.25	-435	**-293.75**
Phase 2	-858.75	-717.5	-576.25	-435	**-293.75**
Phase 3	**-858.75**	**-717.5**	**-576.25**	**-435**	-293.75

Non-Risky World

	1 Probe	2 Probes	3 Probes	4 Probes	5 Probes
Phase 1	103	206	309	412	**515**
Phase 2	103	206	309	412	**515**
Phase 3	**103**	**206**	**309**	**412**	**515**

Table 2

Expected Outcomes of Worlds in Different Phases and When Sending Different Amounts of Probes

Risky World

	1 Probe	2 Probes	3 Probes	4 Probes	5 Probes
Phase 1	-653.45	-406.9	-106.35	86.2	**332.75**
Phase 2	386.5	773	1159	1546	**1932**
Phase 3	**-653.45**	**-406.9**	**-106.35**	**86.2**	**332.75**

Non-Risky World

	1 Probe	2 Probes	3 Probes	4 Probes	5 Probes
Phase 1	303.25	606.5	909.75	1213	**1516.25**
Phase 2	303.25	606.5	909.75	1213	**1516.25**
Phase 3	**303.25**	**606.5**	**909.75**	**1213**	**1516.25**

Figure Captions

Figure 1. Percentage of probes sent to risky world as a function of sensation seeking and stress phase (Experiment 1).

Figure 2. Percentage of times risky world chosen as a function of sensation seeking and probe phase (Experiment 2).

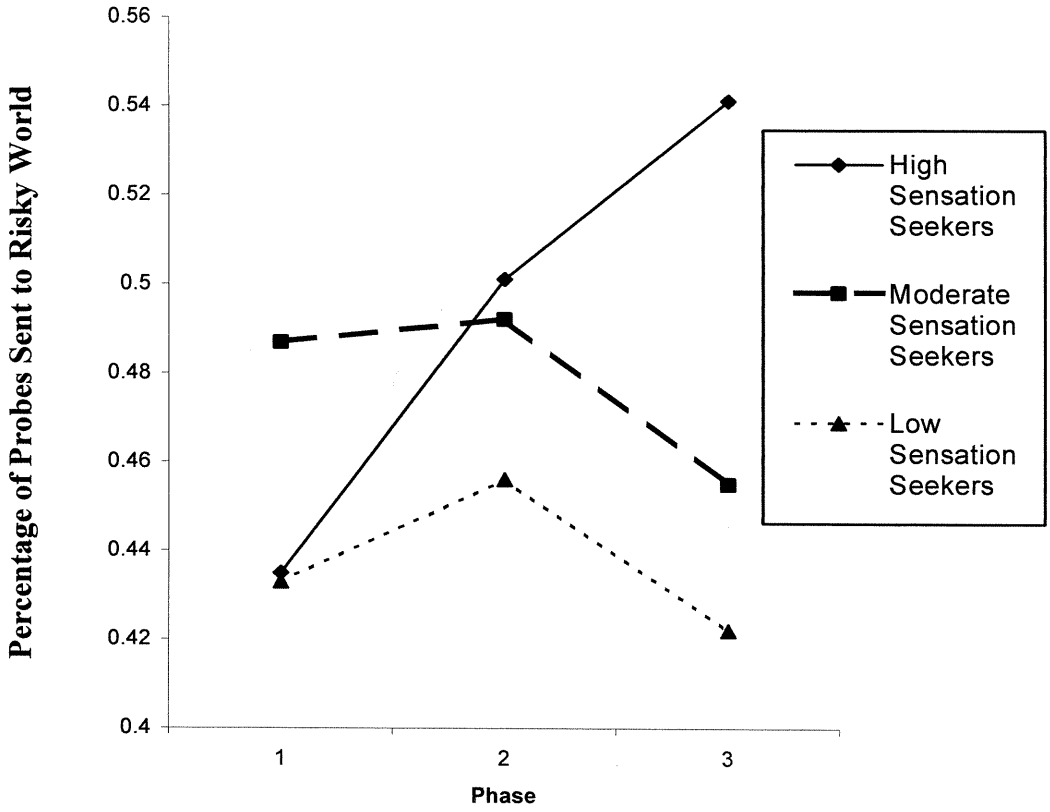
Figure 3. Percentage of probes sent to risky world as a function of sensation seeking and probe phase (Experiment 2).

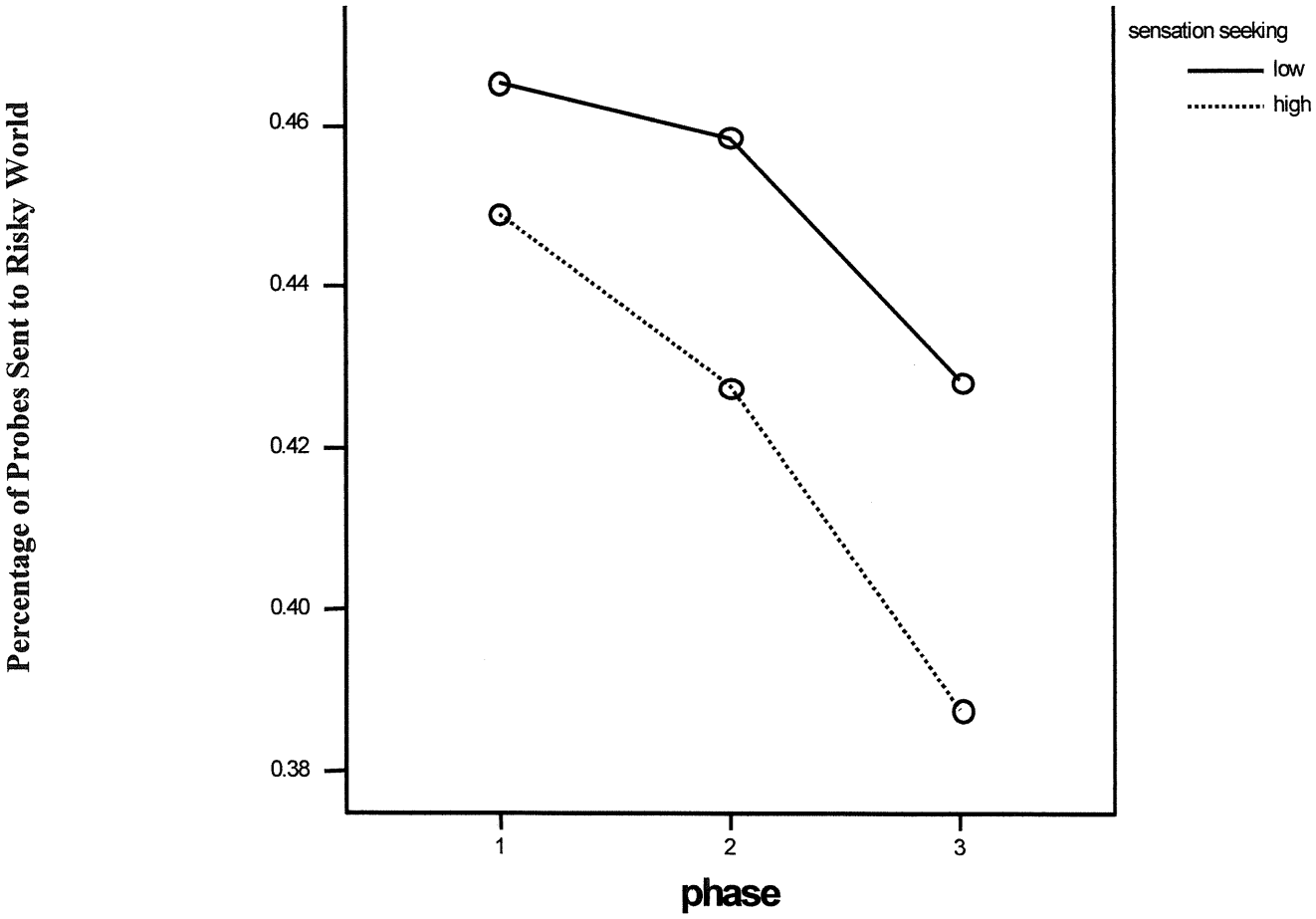
Figure 4. Percentage of probes sent to risky world as a function of risky preference during Phase 1 and current phase level (Experiment 2).

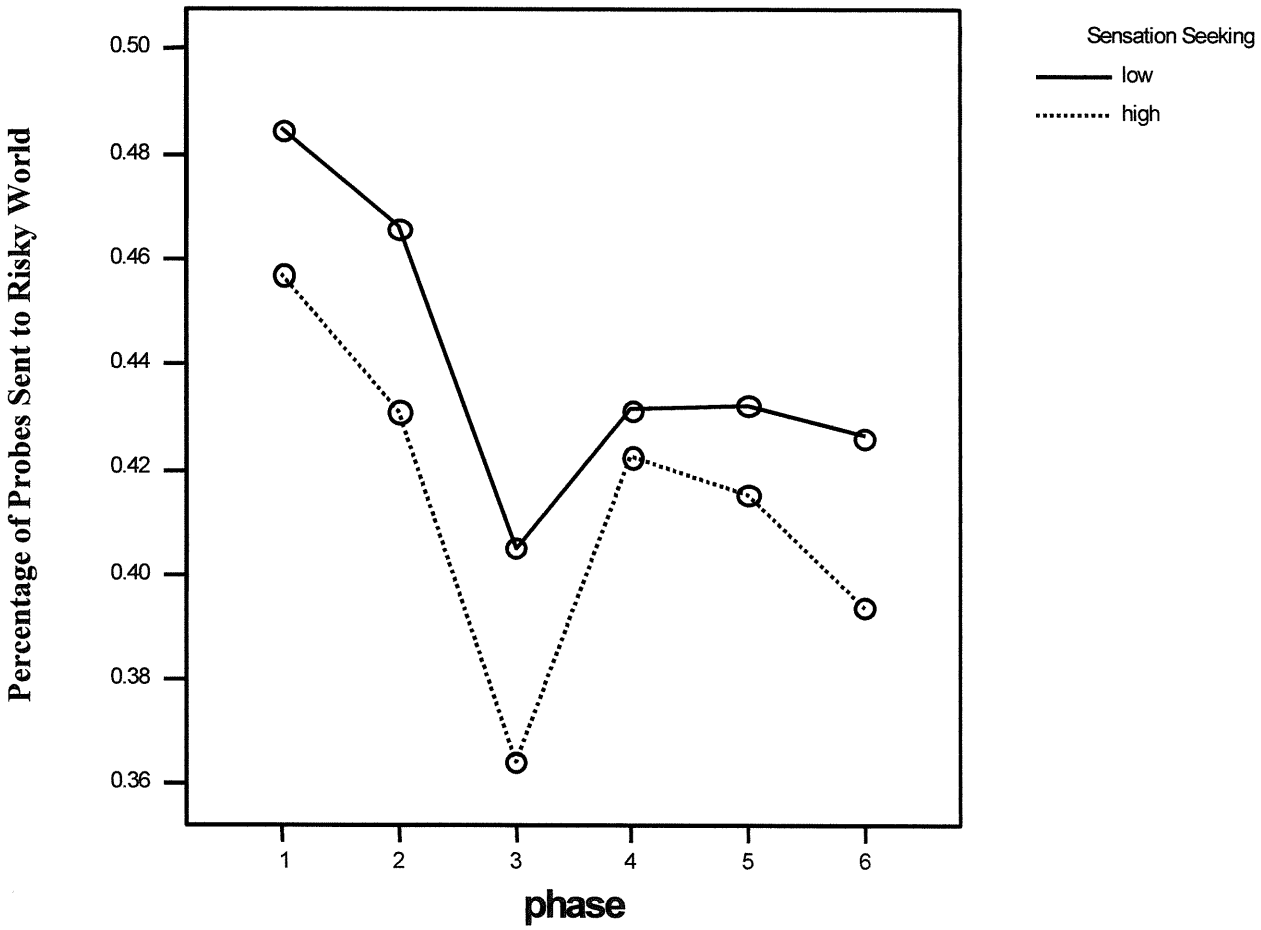
Figure 5. Percentage of probes sent to risky world as a function of risky preference during Phase 1 and phase level when broken into 6 phases (Experiment 2).

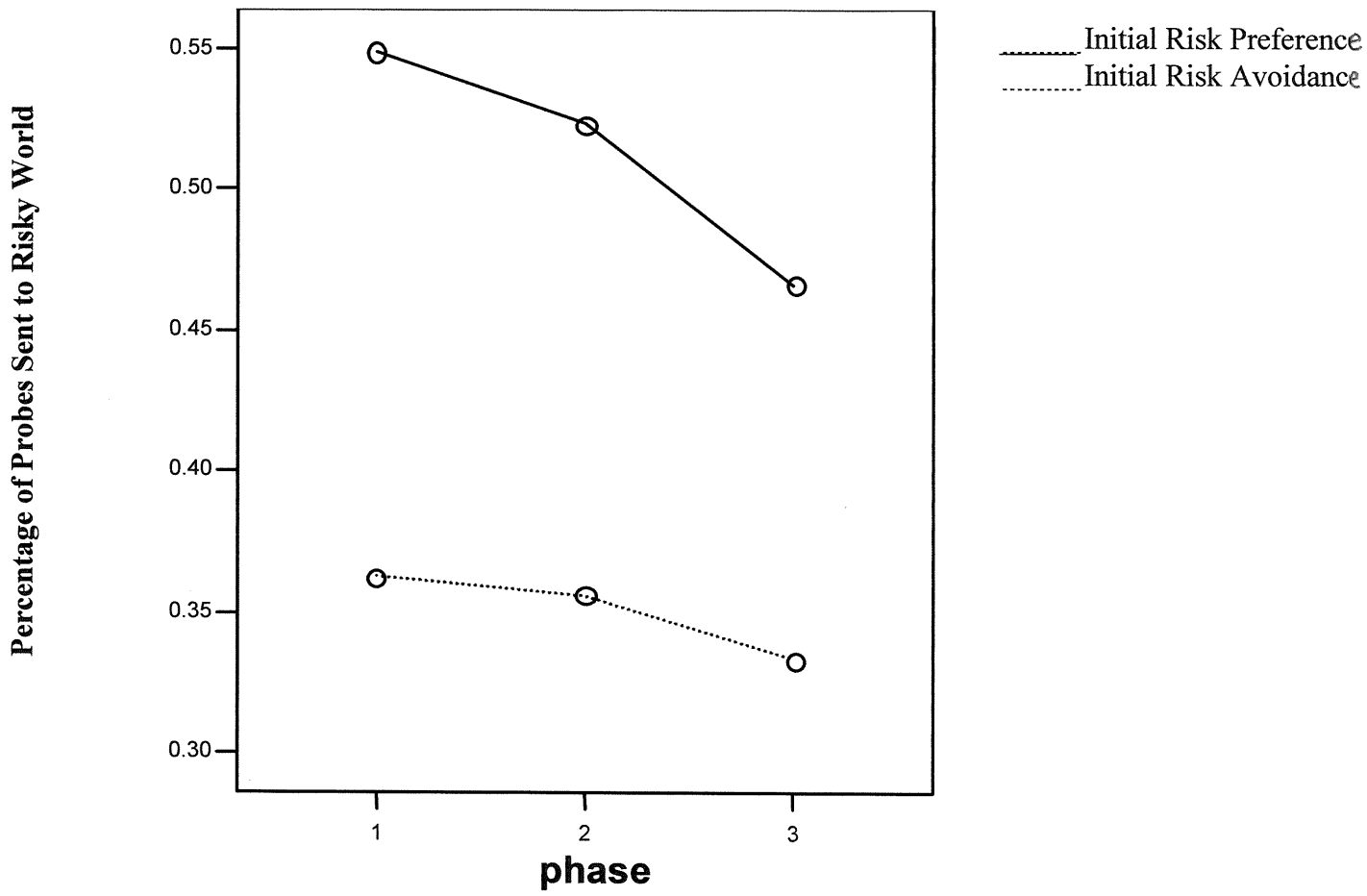
Figure 6. Change in percentage of probes sent to risky world as a function of risky preference during Phase 1 and current phase level broken down into 6 phases (Experiment 2).

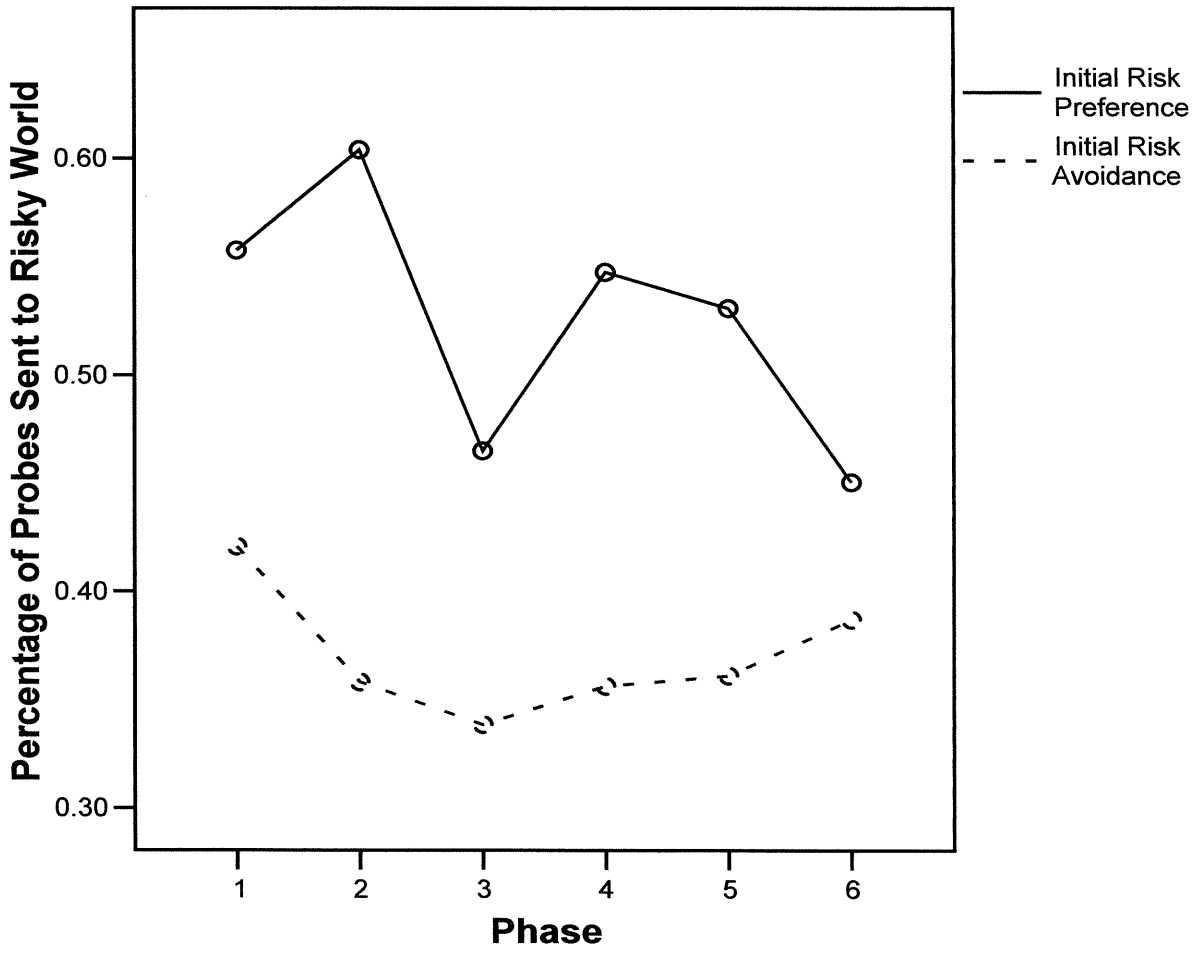
Figure 7. Percentage of probes sent to risky world as a function of risky preference during Phase 1 and current phase level (Experiment 1).

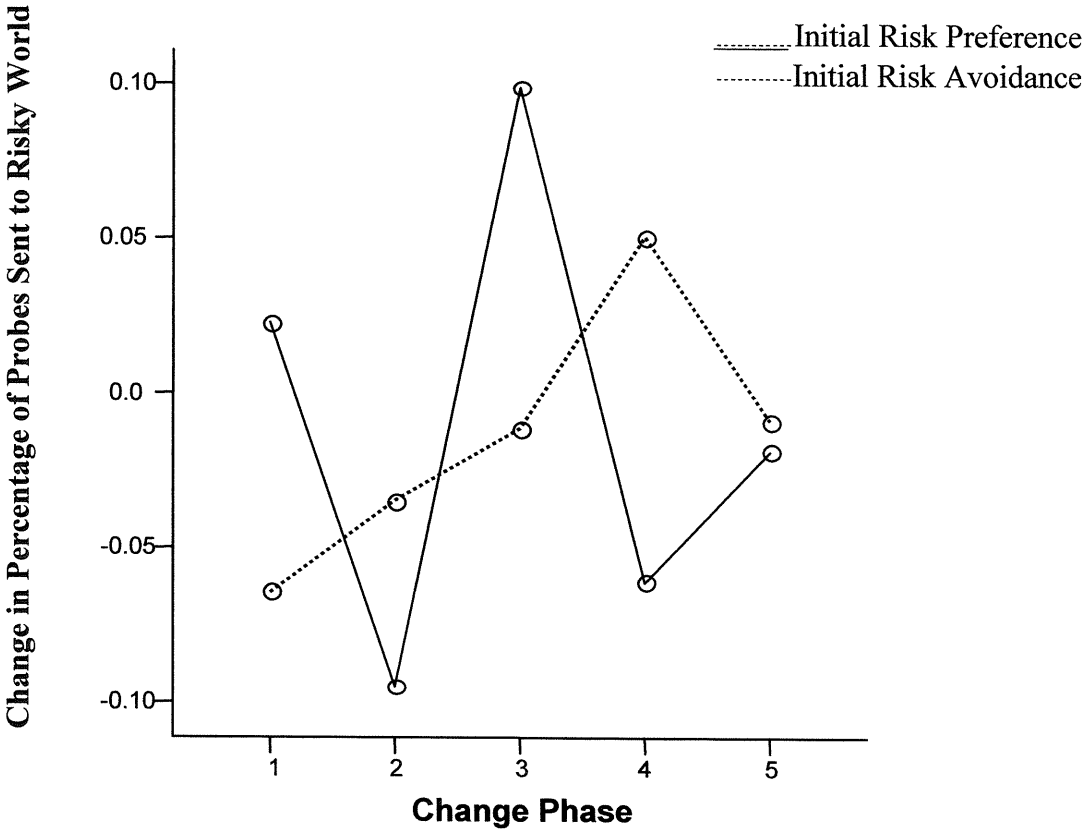

Percentage of Probes Sent to Risky World
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
1
2
3
Phase
High Sensation Seekers
Moderate Sensation Seekers
Low Sensation Seekers

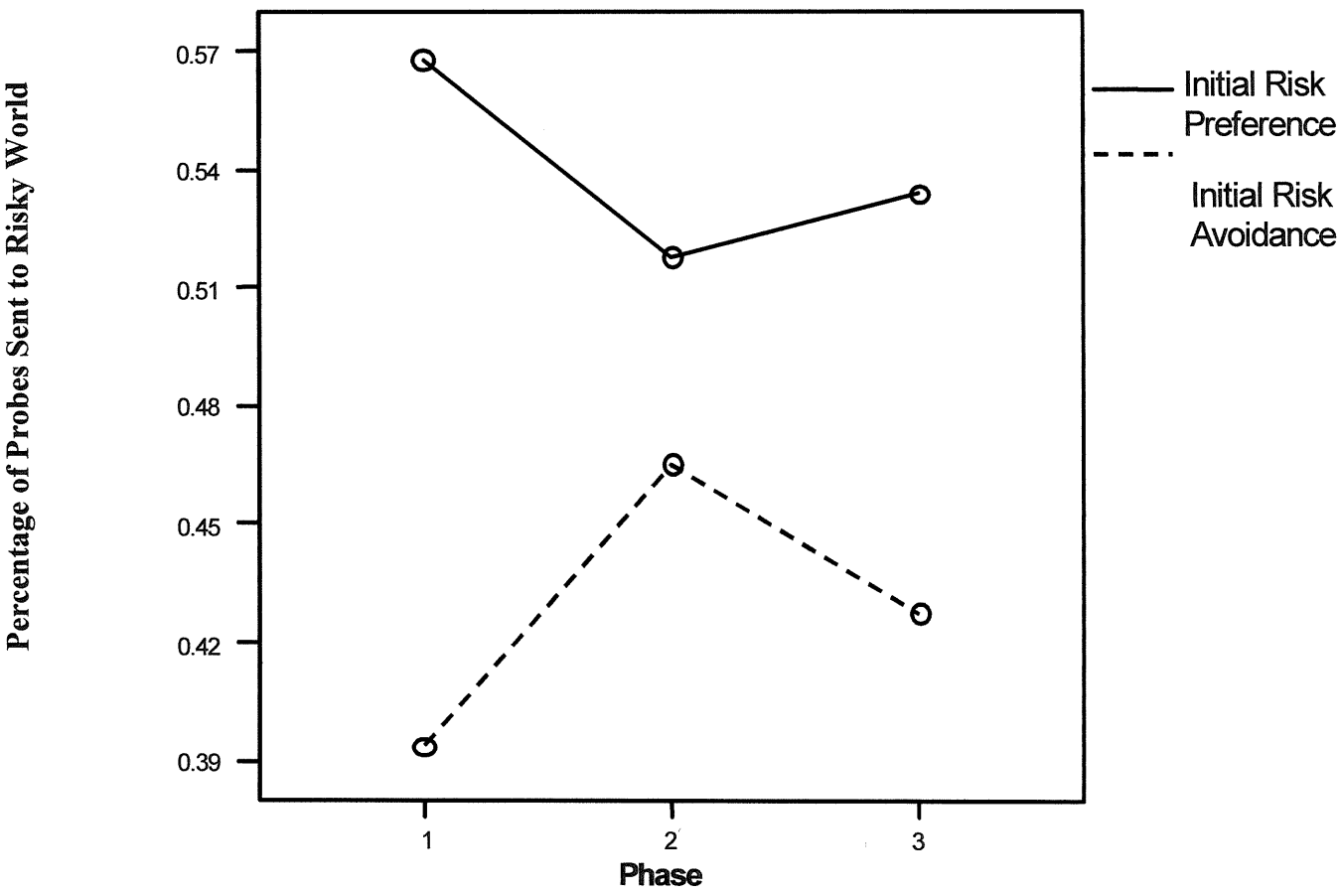

Percentage of Probes Sent to Risky World
0.46
0.44
0.42
0.40
0.38
1
2
3
phase
sensation seeking
low
high


Percentage of Probes Sent to Risky World
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
1
2
3
4
5
6
phase
Sensation Seeking
low
high


Initial Risk Preference
Initial Risk Avoidance
Percentage of Probes Sent to Risky World
0.55
0.50
0.45
0.40
0.35
0.30
1
2
3
phase


Percentage of Probes Sent to Risky World
0.60
0.50
0.40
0.30
1
2
3
4
5
6
Phase
Initial Risk Preference
Initial Risk Avoidance


Initial Risk Preference
Initial Risk Avoidance
Change in Percentage of Probes Sent to Risky World
0.10
0.05
0.0
-0.05
-0.10
1
2
3
4
5
Change Phase


Percentage of Probes Sent to Risky World
0.57
0.54
0.51
0.48
0.45
0.42
0.39
1
2
3
Phase
Initial Risk Preference
Initial Risk Avoidance

Appendix A

SSS-V: Interest and Preference Test (reprinted from Zuckerman, 1994)

Directions: Each of the items below contains two choices: A and B. Please indicate 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 choice you dislike least. **Do not leave any items blank.** It is important that you respond to all items with only one choice, A or B. We are interested only in your likes and 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 frank 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 third time.

   B. I can't stand watching a movie that I've 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 play where I can predict what will happen in advance.

   B. I don't mind watching a movie or 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 effects on me.

    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 "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 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 timetable.

    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" kinds 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 anyone 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" 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 at all).

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 with each other.

33. A. Even if I had the money, I would not care to associate with flighty rich and famous individuals.

    B. I could conceive of myself seeking pleasures around the world with the rich and famous.

34. A. I like people who are sharp and witty even if they do sometimes insult others.

    B. I dislike people who have fun at the expense of hurting the feelings of others.

35. A. There is altogether too much portrayal of sex in movies.

    B. I enjoy watching many of the "sexy" scenes in the 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 persons.

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.

Appendix B

ZKPQ (Shortened)-(taken from Zuckerman, 1994)

On this page, you will find a series of statements that persons might use to describe themselves. Read each statement and decide whether or not it describes you. Then indicate your answer on the separate answer sheet.

If you agree with a statement or decide that it describes you, answer TRUE by writing T on the answer sheet. If you disagree with a statement or feel that it is not descriptive of you, answer FALSE by writing F on the answer sheet.

In marking your answers on the answer sheet, be sure that the number of the statements you have just read is the same as the number on you answer sheet. **Answer every statement** either True (T) or False (F) even if you are not entirely sure of your answer.

1. I like to have new and exciting experiences and sensations even if they are a little frightening.
2. I like doing things just for the thrill of it.
3. I sometimes do "crazy" things just for fun.
4. I sometimes like to do things that are a little frightening.
5. I enjoy getting into new situations where you can't predict how things will turn out.
6. I'll try anything once.
7. I prefer friends who are excitingly unpredictable.
8. I like "wild" uninhibited parties.
9. I would like the kind of life where one is on the move and traveling a lot, with lots of change and excitement.
10. I am an impulsive person.

11. I like to explore a strange city or section of town by myself, even if it means getting lost.
12. I would like to take off on a trip with no preplanned or definite routes or timetables.
13. Before I begin a complicated job, I make careful plans.
14. I very seldom spend much time on the details of planning ahead.
15. I tend to begin a new job without much advance planning on how I will do it.
16. I usually think about what I am going to do before doing it.
17. I often do things on impulse.
18. I often get so carried away by new and exciting things and ideas that I never think of possible complications.
19. I tend to change interests frequently.

Appendix C

SSAST

Directions: The following statement describes various moods and feelings. Please read each statement and indicate on the 1 to 5 scale the degree to which the statement describes how you feel **NOW**, at this time. Use the following scale in answering each item.

(1) Not at all, (2) Slightly, (3) Somewhat, (4) Definitely, (5) Very much

1. ____I feel interested.
2. ____I feel afraid.
3. ____I feel thoughtful.
4. ____I feel elated.
5. ____I feel secure.
6. ____I feel desperate.
7. ____I feel adventurous.
8. ____I feel pleased.
9. ____I feel steady.
10. ____I feel lucky.
11. ____I feel upset.
12. ____I feel loving.
13. ____I feel daring.
14. ____I feel contented.
15. ____I feel nervous.
16. ____I feel enthusiastic.
17. ____I feel amused.

18. ____I feel frightened.

19. ____I feel imaginative.

20. ____I feel tense.

21. ____I feel confident.

22. ____I feel shaky.

23. ____I feel pleasant.

24. ____I feel zany.

25. ____I feel calm.

26. ____I feel curious.

27. ____I feel fearful.

28. ____I feel cooperative.

29. ____I feel cheerful.

30. ____I feel terrified.

31. ____I feel mischievous.

32. ____I feel joyful.

33. ____I feel panicky.

34. ____I feel playful.

35. ____I feel happy.

36. ____I feel worried