



Effect of stress on accuracy of cognitive decisions

Dr. Surekha Jichkar , Santosh Bothe²

¹ *Professor, Jhulelal Institute of Technology , Nagpur*

² *NMIMS Deem University, Shirpur*

ABSTRACT

The effect of stress on the cognitive function is the well searched fact. (Behavioral Neuroscience: 2007, Vol. 121, No. 2, 257–263) .This study has taken the deeper & poignant look into the specific area of the decision making. Decision making involves the defining of the problem, elaboration on the available alternatives & finally then the selection of the best. The process of cognition involves the memory function while collecting the relevant data, followed by its absorption, storage & interpretation & finally the representation of the data or information. Therefore its absolutely relevant to find the relationship between the receiving, storage, interpretation of the data/information for its usage while crossing each step of the decision making. Present study focuses on the impact of stress on general cognition with special reference to the process of cognitive decision making. Stress has remarkable effect on Cognition (S.J. Lupien a,*, F. Maheu b, M. Tu c, A. Fiocco a, T.E. Schramek) as far as the accuracy part of the cognitive decision making is concerned the different factors which can cause stress are Emergency situation , Time pressure, Emotion, Risk, Lack of attention, Loss of memory, Decision making, Gambling, Psychology, Desires, Risk, Choices, Environmental constraint, Exogenous and Endogenous Factors.

INTRODUCTION

Often emergencies are time dependent which demands the correct decision at correct moment. Thus emergencies are stressful which put psychological pressure on individuals. Emergencies situations are not only time dependent but constantly demanding in terms of correct decision on changing the situation. The same decision cannot be always right for the other situation. Thus decision mostly is affected as per the need of the situation under the stress condition. Decision demanding situation often creates stress in emergencies but the stress subsides as the emergencies pass. (According to article STRESS AND COGNITION: A COGNITIVE PSYCHOLOGICAL PERSPECTIVE Lyle E. Bourne, Jr. and Rita A. Yaroush February 1, 2003).

Decision making is a cognitive process which involve the process of making a choice or course of action by a person. The decision making process require critical thinking, experience, attention, working memory and reasoning. Component of Decision making are attention and memory, reasoning, past experiences, psychology etc. (A Review of Time Critical Decision Making Models and Human Cognitive Processes Ron Azuma, Mike Daily, Chris Furmanski HRL Laboratories, LLC 3011 Malibu Canyon Rd. Malibu, CA 90265 310-317-5451, 310-317-5673)

Decision making is an outcome of process assessment and judgment which is based on the option, choice or alternative which an individual want to make. Making a choice and taking decision is involving cognition which underlie the fact of desires one have. Individual differences in values will define what constitutes an accurate or high quality decision (that is, whether or not an individual is happy/satisfied with the decision made). It is also likely that we adjust our 'quality standards' as a function of task demands (such as time pressure, complexity of the decision. The cognitive skill and their limitations are also influential in constraining choices so that choice making in reality varies from what may be seen as ideal and logical. It is evident that humans are bounded by constraints like environmental constraint and constraint of their mind like limited memory. These constrains have an impact on individual and they shape people's behavior. Research in this field is based on the approach that cognitive aspect of decision making includes emotion and 'ease of justification' for a decision. In the process of decision making emotion and other goals or desired outcomes also play important role because decision is influenced by the emotions for the highly valued things and desire for the potential outcome. Framing of a problem includes both information about the decision problem and the context of the decision problem (for example, time constraints, emotional aspects etc.). Individual differences in the way information is perceived, organized and interpreted, and differences in context, mean that the decision or choice made about the same decision problem will vary between individuals and across different contexts (Kahnemann and Tversky, 1984; Shoemaker and Russo, 2001). (According to article Understanding the Dynamics of Decision-Making and Choice: A Scoping Study of Key Psychological Theories to Inform the Design and Analysis of the Panel Study Bryony Beresford and Tricia Sloper DHP 2215 January 2008; sISBN 978-1-871713-24-4)

Cognitive psychologist have studied decision making capacity and hence deduced that, decision making process involve many areas of cognition like perceptual process (Link, 1992) to memory recognition (Ratcliff, 1978) and categorization (Nosofsky & Pal-meri, 1997). Time pressure and the choice of making a decision or not making it, is related to the probability of risk associated with that decision. It means that if time pressure increases, the frequency of making a choice if the associated risk is high will decrease, whereas the frequency of making a choice when the associated risk is low will increase.

EXPERIMENT

The risk-taking decision task used for this experiment was developed by Dror, Katona, and Mungur (1998) and is a simplified variant of the game of blackjack. In this task, the decision maker must decide whether or not to gamble by taking another card from a deck in order to maximize his or her total points without exceeding 21. This task was chosen because the information-processing demands (stimulus encoding and response production) are minimal

and identical across trials, thus enabling us to isolate the time pressure effects in the decision stage. Furthermore, this task allowed us to systematically manipulate the levels of risk by varying the probability that taking a card would “bust”. For this simple task, sequential sampling models make an a priori prediction regarding the effect of time pressure on the frequency of choosing the gamble (details are presented in the Appendix): Time pressure will increase the frequency of choosing a gamble when the risk (probability of losing) is high but will decrease the frequency of choosing the gamble when the risk (probability of losing) is low. In other words, sequential sampling models predict a crossover interaction effect between time pressure and risk level on frequency of choosing the gamble. Thus, time pressure is predicted not to have a uniform effect (of being either more conservative or more prone to take risks) but, rather, a polarization in terms of behavior: At the low risk, people turn more conservative and take fewer gambles, whereas at the high risk, they are more risky and take more gambles.

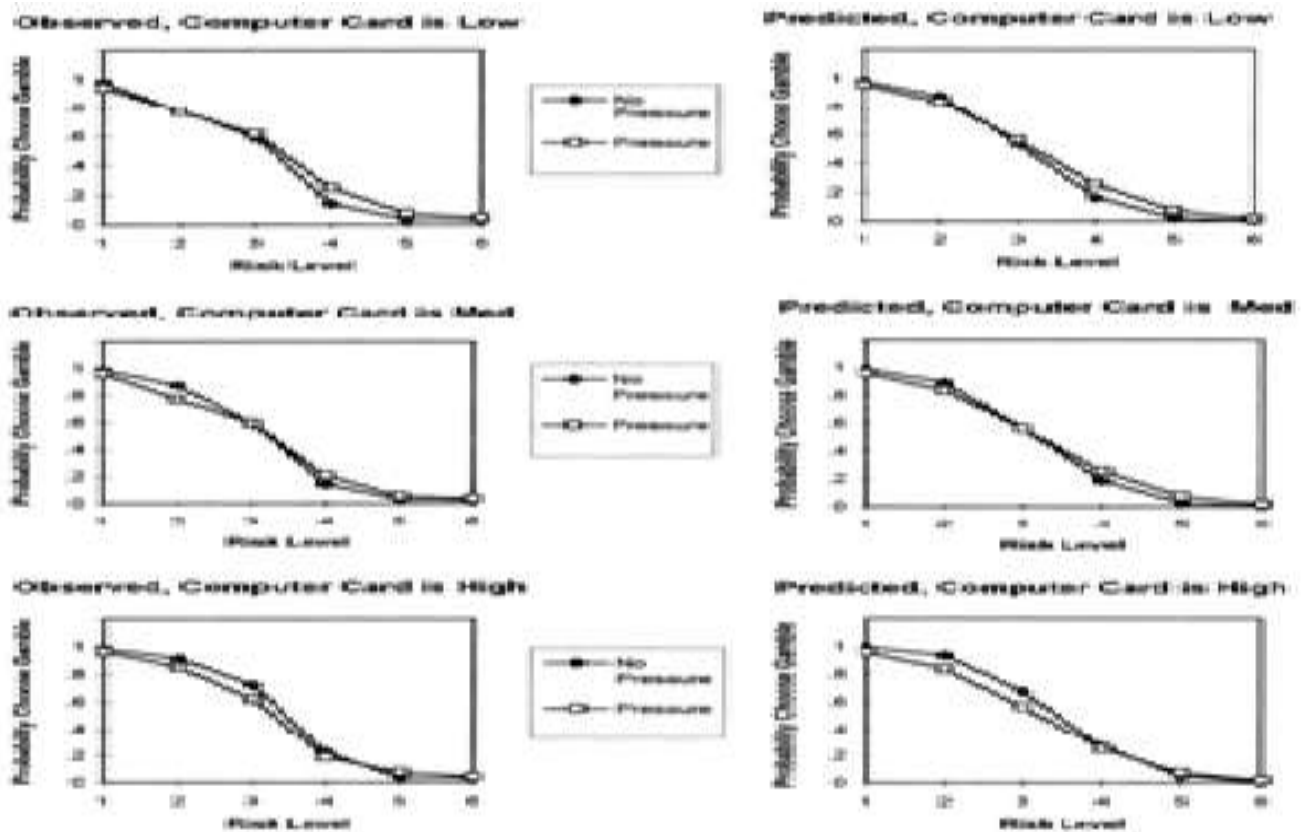


Figure 1. The left three panels show the probability of taking an additional card by the participants as a function of risk level. The top, middle, and bottom panels are for low, moderate, and high computer card levels. In all panels, there is a backward-S-shaped curve as risk level increases, and the time pressure curve is flatter than the no time pressure curve. Furthermore, there is a crossover interaction between the curves for the time pressure and no time pressure conditions in each of the panels. These effects are moderated by the computer card level, but only for the no time pressure condition. The right three panels show the predictions of the model for choice probability under the same experimental conditions. The steeper curve represents the predictions when the inhibitory threshold is set to a high criterion and the bound is increased, and the flatter curve represents the predictions when the

inhibitory threshold is set to a low criterion (under time pressure) and the bound is smaller. The precise quantitative form of the curves depends on specific parameter values estimated from the data, but the crossover interaction pattern and the effect of the computer card level is a parameter-free prediction of the model Choice probability. As is illustrated in Figure 1 (left panels), choice probability decreases as risk level increases. More important, the curve within each panel for the no time pressure condition is steeper than the corresponding curve for the time pressure condition, producing a crossover interaction between risk level and time pressure. This crossover result confirms the a priori prediction made by sequential sampling models. We observed the following results: First, the difference between the no pressure and the pressure conditions for the risk level 2 produced a positive contrast ; second, the difference between the no pressure and the pressure conditions at highest risk level produced a negative contrast.

Therefore time pressure for making a choice or decision is directly proportional to the risk associated to that particular choice or decision outcomes. One of the hypotheses suggests that the decision maker will take fast and random guess under time pressure to make a choice. (Decision making under time pressure: An independent test of sequential sampling models ITIEL E. DROR *Southampton University, Highfield Southampton, England* JEROME R. BUSEMEYER *Indiana University, Bloomington, Indiana* and BETH BASOLA *Southampton University, Highfield Southampton, England* *Memory & Cognition* 1999, 27 (4), 713-725)

Study has proved that the emotion play important role in the decision making and intrinsic emotion has beneficiary effects on decision making. Called as somatic state (Bechara, Damasio, & Damasio, 2000). Other studies also suggest that the emotion may be unrelated to the decision making task as it either existed before or developed during the course of making decision. Unrelated emotion and incidental stress often have effect on the decision making process. Incidental effects of stress on memory are complex and depends on the task, phase of memory, age and gender of the participant and even the time of day (al'Absi, Hugdahl, & Lovallo, 2002; Domes, Heinrichs, Reich-wald, & Hautzinger, 2002; Het, Ramlow, & Wolf, 2005; Kudiel-kaa, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004; Parfitt, Hardy, & Pates, 1995; Wolf, Convit, et al., 2001; Wolf, Schommer, Hellhammer, McEwen, & Kirschbaum, 2001).

EXPERIMENT

One of the experiments to see the effect of stress on decision making had been conducted on the participant and they were told that they have to deliver a public speech at the end of the experiment in the laboratory (e.g., Kudielkaa et al., 2004; Levenson, Sher, Grossman, Newman, & Newlin, 1980; Steele & Josephs, 1988). While anticipating the speech , participant performed the Iowa Gambling Task (IGT) repeatedly to rely on an intact somatic marker system which is affective and emotional in nature. When somatic marker system is triggered during the pondering of the decision they helped in providing internal information about the costs and benefit of alternative and thus demonstrated bias decision making in an advantageous direction (e.g., Bechara, Damasio, & Damasio, 2000; Bechara, Damasio, Damasio, & Lee, 1999; Bechara, Tranel, & Damasio, 2000). Because the stressor was unrelated to the decision task at hand, we hypothesized that the speech anticipation stress would impair performance by creating interference with the task-related emotion necessary

to guide advantageous choices. Although a rationale for this hypothesis based on theoretical grounds has been previously provided (Bechara & Damasio, 2005), no empirical evidence has been obtained that would support or refute such a hypothesis. This was the primary aim of this study.

RESULTS

The statistical validation of the experimental setup VS control group concluded that

1. The experimental participants had greater increase in heart rate from the speech anticipation stress.
2. In Self report experimental participant were more anxious during the test game, The State-Trait Anxiety Inventory (STAI- state)and were exhibiting less positive emotion, Positive and Negative Affect Schedule (PANAS)- positive effects than control participants. But both group had similar level of negative emotion, PANAS-Negative effects.
3. The anticipation of giving a public speech was effective as a stressor; it increased anxiety and heart rates only for participants in the anticipatory stress condition and only after the stressor was introduced. The participants in the experimental condition were slower to learn the task, meaning that it took them longer to shift toward advantageous decision making

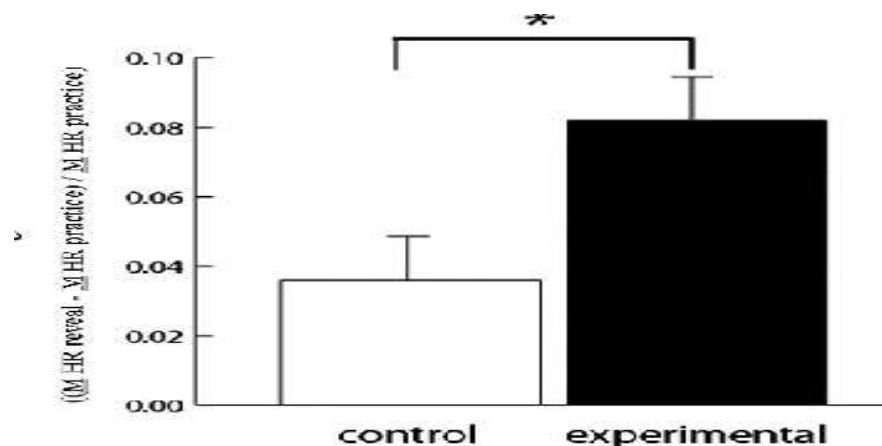


Figure 2. Experimental participants were physiologically aroused by the manipulation. Graph shows percentage change in heart rate for control and experimental participants from the baseline to the reveal period (*c*, calculated as [mean heart rate for reveal period – mean heart rate for practice game] / mean heart rate for practice game) when the experimental participants learned about the speech. Error bars show standard errors.

Because the main effect was observed in the learning phase and associated with increased arousal and anxiety and decreased positive affect (but not increased negative affect), it is likely that there is effect of anticipatory stress on decision making. The learning phase of this experiment was mediated by competition between the primary card game and the unrelated speech stressor for limited working memory resources. Indeed, evidence shows that

increased working memory load during the IGT prevents participants from developing the somatic markers associated with the contingencies of the four decks, thus impairing decision making (Hinson, Jameson, & Whitney, 2002), and that this effect is due specifically to a disruption in the executive component of working memory and not to competition for the verbal buffer (Jameson, Hinson, & Whitney, 2004)(Effects of Anticipatory Stress on Decision Making in a Gambling Task, S. D. Preston University of Michigan, R. B. Stansfield University of Michigan, T. W. Buchanan University of Iowa College of Medicine, A. Bechara University of Iowa College of Medicine and University of Southern California, Behavioral Neuroscience : 2007, Vol. 121, No. 2, 257–263)

REFERENCES

- A Review of Time Critical Decision Making Models and Human Cognitive Processes Ron Azuma, Mike Daily, Chris Furmanski HRL Laboratories, LLC 3011 Malibu Canyon Rd. Malibu, CA 90265 310-317-5451, 310-317-5673)
- Bryony Beresford and Tricia Sloper : Understanding the Dynamics of Decision-Making and Choice: A Scoping Study of Key Psychological Theories to Inform the Design and Analysis of the Panel Study DHP 2215 January 2008; ISBN 978-1-871713-24-4
- Decision making under time pressure: An independent test of sequential sampling models ITIEL E. DROR *Southampton University, Highfield Southampton, England* JEROME R. BUSEMEYER *Indiana University, Bloomington, Indiana* and BETH BASOLA *Southampton University, Highfield Southampton, England* *Memory & Cognition* 1999, 27 (4), 713-725)
- Effects of Anticipatory Stress on Decision Making in a Gambling Task, S. D. Preston University of Michigan, R. B. Stansfield University of Michigan, T. W. Buchanan University of Iowa College of Medicine, A. Bechara University of Iowa College of Medicine and University of Southern California, Behavioral Neuroscience : 2007, Vol. 121, No. 2, 257–263)
- Janet A. DiPietro Johns Hopkins University , The Role of Prenatal Maternal Stress in Child Development
- Lyle E. Bourne, Jr. and Rita A. Yaroush ; STRESS AND COGNITION: A COGNITIVE PSYCHOLOGICAL PERSPECTIVE February 1, 2003
- Mood and Anxiety Disorders Program, Emotional Development and Affective Neuroscience Branch, National Institute of Mental Health, NIH, Bethesda, MD 20892, USA, c University of British Columbia, Centre for Community Child Health Research, 480 Oak Street, L408, Vancouver, BC, Canada V6H 3V4 Accepted 21 February 2007)
- S.J. Lupien a,*, F. Maheu b, M. Tu c, A. Fiocco a, T.E. Schramek a.; The effects of stress and stress hormones on human cognition: Implications for the field of brain and cognition a Center for Studies on Human Stress, Douglas Hospital Research Center, McGill University, Montreal, Que., Canada,
- Sonia J. Lupien, Bruce S. McEwen, Megan R. Gunnar and Christine Heim ; Effects of stress throughout the lifespan on the brain, behavior and cognition,
- SUZANNE KING^{1,2} & DAVID P. LAPLANTE; The effects of prenatal maternal stress on children's cognitive development: Project Ice Storm Department of Psychiatry, McGill University, Quebec, Canada