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DECISION MAKING UNDER UNCERTAINTY AND INFORMATION PROCESSING IN POSITIVE AND NEGATIVE MOOD STATES[1]

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Summary.—This study examines whether mood states (a) influence decision making under uncertainty and (b) affect information processing. 200 students at the Indian Institute of Technology Kharagpur participated in this study. Positive mood was induced by showing comedy movie clips to 100 participants and negative mood was induced by showing tragedy movie clips to another 100 participants. The participants were administered a questionnaire containing hypothetical situations of financial gains and losses, and a health risk problem. The participants selected a choice for each situation, and stated the reasons for their choice. Results suggested that the participants preferred cautious choices in the domain of gain and in health risk problems and risky choices in the domain of loss. Analysis of the reasons for the participants' choices suggested more fluency, originality, and flexibility of information in a negative mood compared to a positive mood. A negative (positive) mood state facilitated systematic (heuristic) information processing.

In certain cultures such as the U.S., people prefer risky choices (Brown, 1986), particularly in questions assessing attitude towards risk. In the same culture, risk aversion is found in financial gain and loss situations, assert valuation, contracts, and insurance (Weary & Jacobson, 1997). Furthermore, individuals in a positive mood state engage in heuristic information processing (Schwarz & Clore, 1996) and avoid risk in decision making (Isen & Patrick, 1983). Individuals in a negative mood state do the reverse (Schwarz, Bless, & Bohner, 1991; Yuen & Lee, 2003). Inducing positive and negative mood states and incorporating decision making in financial gains, losses, and health risk situations, this study examines whether (a) decision making and (b) information processing differ in positive and negative mood states.

In most texts, emotions and affect are synonymous. However, moods are less intense than emotions, lack a contextual stimulus, and fluctuate regularly (Clark & Isen, 1982). Emotions are aroused in people by specific events, objects, or situations. If cognitive processes and behaviors are interrupted and demand attention, then the affect can be classified as an emotion (George, 1990); otherwise it can be classified as a mood, which tends to gently redirect ongoing thinking and behavior (Clark & Isen, 1982). The Positive and Negative Affectivity Schedule (PANAS) is used

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to assess these dispositions over longer periods of time, termed as the affectivity trait, and also over a short period of time, referred to as the mood state (Watson, Clark, & Tellegen, 1988).

A number of methods have been adopted for mood induction, such as watching videos (Isen, Johnson, Mertz, & Robinson, 1985; Fredrickson & Branigan, 2005; Biss, 2008), listening to music (Rowe, Hirsh, & Anderson, 2007), writing about life experiences, viewing pictures of facial experiences or other cartoon images (Wadlinger & Isaacowitz, 2006; Srinivasan & Hanif, 2010), receiving a gift (Estrada, Isen, & Young, 1994), false feedback (Raghunathan & Trope, 2002), and talking about life experiences (Lyubomirsky, Sousa, & Dickerhoof, 2006). Watching comedy and tragedy movie clips has been widely used for positive and negative mood induction, respectively (Fredrickson & Branigan, 2005; Biss, 2008; Cohn, 2008). Following a positive (negative) mood induction, individuals can experience more happiness (sadness) than before.

There are two explanations that make different predictions on how the mood influences risk in decision making. The mood maintenance hypothesis (Isen & Patrick, 1983; Isen, 1987) posits that individuals in a negative mood state tend to make riskier decisions with a hope that favorable outcomes will improve their mood (mood repair), and individuals in a positive mood avoid risky decisions to continue their good mood (mood maintenance). Contrarily, in Forgas's (1995) affect infusion model, individuals process information congruent with their mood state. With the mood priming effect, individuals in a negative mood state apply more accurate, analytical, elaborate, and substantive processing, and individuals in a positive mood state apply less accurate, simplified, and heuristic processing. More uncertainty in decision outcomes entails more risk. Risk-prone response depends on an absence of careful and rational thought. As higher accuracy and rationality are observed in a negative than in a positive mood, individuals will avoid risk in decision making in a negative mood and seek risk in a positive mood. The two models, making opposite predictions for the effects of a negative and a positive mood state on risk in decision making, demand scrutiny.

Information can be processed in a heuristic or a systematic manner. Heuristic processing requires less effort and involves the use of shortcuts to arrive at a decision (Chaiken, Liberman, & Eagly, 1989). Heuristics are stored in memory (i.e., availability), are retrieved from memory (i.e., accessibility), and are relevant (i.e., applicability) to the decision-making task (George & Jones, 1997). Decisions formed on the basis of heuristic processing reflect easily processed heuristic cue information (e.g., source expertise) rather than particularistic information (Higgins, 1996). Contrarily, systematic processing is comprehensive, involves greater cognitive effort to

reach a decision, and results in greater comprehension and memory formation (Petty & Cacioppo, 1986). It involves an analytical scrutiny of the decision-making task and an in-depth processing of the information relevant to decisions; accordingly, such decisions are responsive to the semantic content of the information (Isen, 1987). Systematic information processing is by nature fluent, original, and flexible (Baas, De Draw, & Nijstad, 2008; Baas, Nevicka, & Ten Velden, 2014). If the information/argument supporting a choice in a decision-making task shows more fluency (production of ideas), originality (uniqueness of ideas), and flexibility (variety of ideas), inferences can be drawn about the systematic processing of information.

Positive mood states provide information indicating that all is well (Schwarz & Clore, 1983), whereas negative moods provide information indicating that the environment is problematic (Clore & Huntsinger, 2009). This affective information then alters the level at which people process information (George & Brief, 1992). In a positive mood state, when a situation is perceived as safe individuals feel confident, tend to generate and connect general ideas (Forgas, 2006), do not elaborate on the message content (Priester, Cacioppo, & Petty, 1996), do not differentiate between strong and weak messages, and are more persuaded by peripheral appeals, in contrast to individuals in a negative mood (Bless, Bohner, Schwarz, & Strack, 1990). Individuals experiencing a positive mood state prefer simple, intuitive solutions to problems, use broad categories in classification tasks (rather than specific categories), and make decisions more quickly on the basis of less information, relative to individuals in a neutral mood state (Isen & Daubman, 1984). In a negative mood state, when a situation is problematic people tend to process information more systematically because they lack confidence in their own judgments (Edwards & Weary, 1993). Individuals in negative moods tend to engage more frequently in elaborate information processing, react differentially to strong and weak arguments, and respond to central appeals.

Based on the above discussion, the mood maintenance hypothesis and the affect infusion model make different predictions for the effects of positive and negative moods on risky decision making, and individuals process information differently in positive and negative moods. A research question and hypothesis were developed.

Research Question. Will individuals' positive moods influence the decision making (in domains of gains or losses in financial situations and in health risk situations) differently compared to their negative moods?

Hypothesis. Individuals in a negative mood will process information with more fluency, originality, and flexibility than individuals in a positive mood.

Method

To address the research question and test the hypothesis, the following design was adopted (Fig. 1).

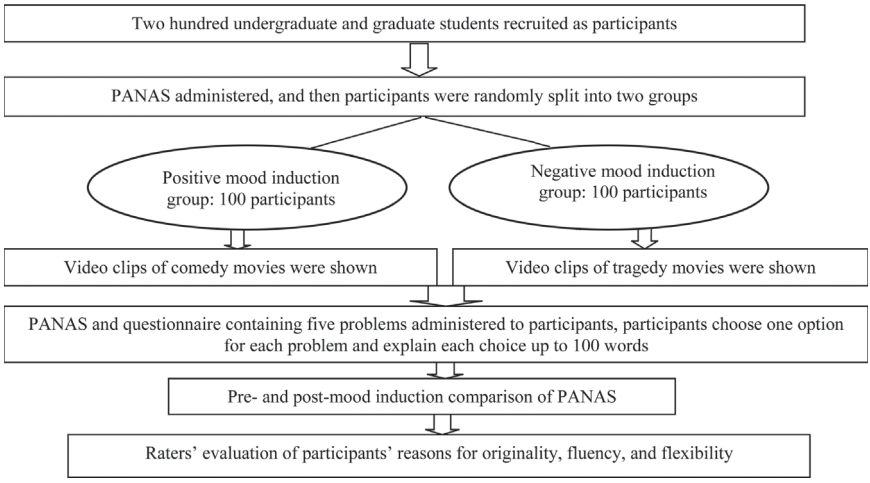

Fig. 1. Design of the experiment

Participants

With the permission of the class teacher, undergraduate and graduate engineering and management students from the Indian Institute of Technology Kharagpur, India were contacted in the classroom. The students were informed that they would be cooperating in a study of decision making. They were told they would complete different questionnaires in different phases of the study and in between they would be shown video clips. The 200 individuals who agreed to participate and who signed the informed consent form were randomly allocated to one of two groups: the positive mood-induced group ($n = 100$) and the negative mood-induced group ($n = 100$). The experiment was carried out over eight sessions. About 20 to 30 students participated in each session; each session lasted around 1 hr. and 15 min.

To compare the participants in two mood-induced groups, the sociodemographic profiles of participants in the positive and negative mood-induced groups were compared using the χ^2 test and F test. Male and female students were represented equally in two mood-induced groups [$\chi^2(1) = 0.88$, $p > .05$]; however, men were represented more than women in both groups, due to the lower numbers of female students enrolled in technical education. Each dependent variable had homogeneity of variance

and univariate ANOVA demonstrated that the age of the participants (age range: 18–32 yr.), the number of years studied in formal education (range: 16–18 yr.), job experience (range: 0–13 yr.), family size (range: 3–9 members), and per-capita family income of participants (range: Rs. 90,200–Rs. 100,000) did not differ in the two groups, two sexes, or when the interaction between group and sex was tested. The 15 F values were nonsignificant (range $F_{1, 196}=0.01$, $p=.99$ to $F_{1, 196}=2.88$, $p=.09$). Most participants were from urban areas, followed by semi-urban and rural areas. Using a $2\times3\times2$ contingency table, the χ^2 test suggested that men and women from urban, semi-urban, and rural areas were similarly distributed in the positive [χ^2 (2)$=0.06$, $p=.97$] and negative [χ^2 (2)$=3.72$, $p=.16$] mood-induced groups (Table 1). Overall, the participants in two groups were similar on socio-demographic features.

Measures

Along with socio-demographic information, data were collected from the participants in positive and negative mood-induced groups on five prospects and information supporting their choices, using a questionnaire.

Decision under uncertainty.—Five problems in the questionnaire assessed a choice under uncertainty. These questions contained two positive and one negative hypothetical prospect, and two health risk situations. Every situation had two alternatives: A and B. The participants were asked to choose one alternative in each situation (Table 1).

Reasons for choice.—For each problem, the participants were asked to describe and explain in about 100 words why they preferred that choice, using the space provided after each problem. Two raters who were blind to the purpose of the study (two doctoral students who have completed 3 years in the institute, one in communication studies and another in business management) evaluated the reasons for choices. They were explained the meaning of the terms fluency (production of ideas), originality (uniqueness of ideas), and flexibility (variety of ideas) of information. As a rating scale was used to evaluate the originality of information (Baas, *et al*., 2014, p. 6), the two raters were similarly asked to read and evaluate the participants' written explanations for each item for dimensions of fluency, originality, and flexibility on a 10-point scale, with anchors 1: Least (about 0.1%) presence and 10: Complete (about 91%) presence of the dimension. Both the experts rated the first 15 participants' written explanations to five items. The inter-rater reliability of the three dimensions ranged from .80 to .88. Each rater evaluated the written statements of 100 participants.

Affectivity.—The mood state was assessed using the Positive Affectivity and Negative Affectivity Schedule (PANAS; Watson, *et al*., 1988). The 10 items portraying positive mood states were interested, alert, attentive,

TABLE 1
EXPERIMENTAL CONDITIONS

1. Positive prospect (Kahneman & Tversky, 1979)	
A: You can win Rs. 25,000 with probability .33 Rs. 24,000 with probability .66 0 with probability .01	B: You can win Rs. 20,000 with certainty
2. Positive prospect (Kahneman & Tversky, 1979)	
A: You can win Rs. 25,000 with probability .33 0 with probability .67	B: You can win Rs. 24,000 with probabilities .34 0 with probability .66
3. Negative prospect (Kahneman & Tversky, 1979)	
A: You can lose Rs. 40,000 with probability .80 0 with probability .20	B: You can lose Rs. 30,000 with certainty
Health situation (Kahneman & Tversky, 1979)	
Consider the following two frames (survival and mortality). In each frame two alternative treatments are there. Please indicate the frame as well as treatment you would prefer.	
4. Survival frame	
A (Surgery): Of 100 people having surgery, 90 live through the post-operative period, 58 are alive at the end of the first year, and 32 are alive at the end of 5 yr.	B (Radiation Therapy): Of 100 people having radiation therapy, all live through the treatment, 77 are alive at the end of 1 yr., and 23 are alive at the end of 5 yr.
5. Mortality frame	
A (Surgery): Of 100 people having surgery, 10 die during surgery of the post-operative period, 30 die by the end of the first year, and 60 die by the end of 5 yr.	B (Radiation Therapy): Of 100 people having radiation therapy, none die during treatment, 22 die by the end of 1 yr., and 78 die by the end of 5 yr.

excited, enthusiastic, inspired, proud, determined, strong, and active; the 10 items portraying negative mood states were distressed, upset, guilty, ashamed, hostile, irritable, nervous, jittery, scared, and afraid. The response descriptions against each item were given on a five-point unidirectional scale with anchors 1: Not at all and 5: Extremely. Participants were asked to indicate their feeling on each item by encircling a response that best described their current mood. Before mood induction, Cronbach's inter-item consistency reliability was .92 for 10 Positive Affectivity items and .97 for 10 Negative Affectivity items in the positive mood-induction group. Similarly, before mood induction, the inter-item consistency reliability was .76 for 10 Positive Affectivity items and 0.81 for 10 Negative Affectivity items in the negative mood-induction group.

Procedure

The design was reviewed by a university thesis committee. There was no university requirement for other review.

On the day of the experiment, the participants were asked to sit comfortably in the classroom under conditions of normal lighting and temperature. The participants were administered the PANAS (Watson, *et al*., 1988) to assess their mood states before the experimental intervention. Then a collection of comedy video clips from top-20 comedy movies were shown, along with some clips of a laughter channel show (Shrivastav, 2009) and the nonverbal comedies of Mr. Bean (British Broadcasting Corporation, 2009). Similarly, for the induction of negative mood, video clips from top-20 tragedy YouTube movies, tragedy scenes depicting the Japanese tsunami, the Hiroshima and Nagasaki incidents, and the sufferings of children were shown. Each set of video clips were shown for 40 min. After viewing the video clips, the PANAS was administered again along with the questionnaire.

Results

Manipulation Check

To check whether experimental manipulation induced moods, paired-samples *t* tests were performed to examine the differences in the positive and negative mood states of the participants before and after watching the video clips. Also, the effect size (*ES*) was estimated ($t/\sqrt{N}$). Positive and negative moods were intensified after watching the comedy and tragedy video clips, respectively. There was an increase in the Positive Affectivity scores ($t_{99}=15.20$, $p<.001$, $ES=1.52$) and decrease in the Negative Affectivity scores ($t_{99}=8.22$, $p<.001$, $ES=0.82$) of the positive mood-induction group (Fig. 2a). Similarly, the Negative Affectivity scores increased ($t_{99}=15.48$, $p<.001$, $ES=1.55$) and the Positive Affectivity scores decreased ($t_{99}=9.13$, $p<.001$, $ES=0.91$) in the negative mood-induction group (Fig. 2b). The magnitude of mean difference in each case was large. These observations suggested that positive and negative moods were successfully induced by watching the comedy and tragedy video clips, respectively (Table 2).

Choice in Positive and Negative Mood States

The participants in the positive and negative mood-induction groups reported their choices to five problems. As shown in Table 3, of 100 participants in each group, the chi-squared test suggested that participants predominantly preferred a choice (A or B) in three problems in the positive mood-induction group, and four problems in the negative mood-induction group. Albeit insignificantly, similar patterns of responses were observed in two health risk situations in the positive mood-induction group and one health risk situation in the negative mood-induction group.

Chi-squared analysis using a 2 (choice: A, B) × 2 (moods: positive, negative) contingency table demonstrated that the patterns of responses were similar in the positive and negative mood-induction groups for the five

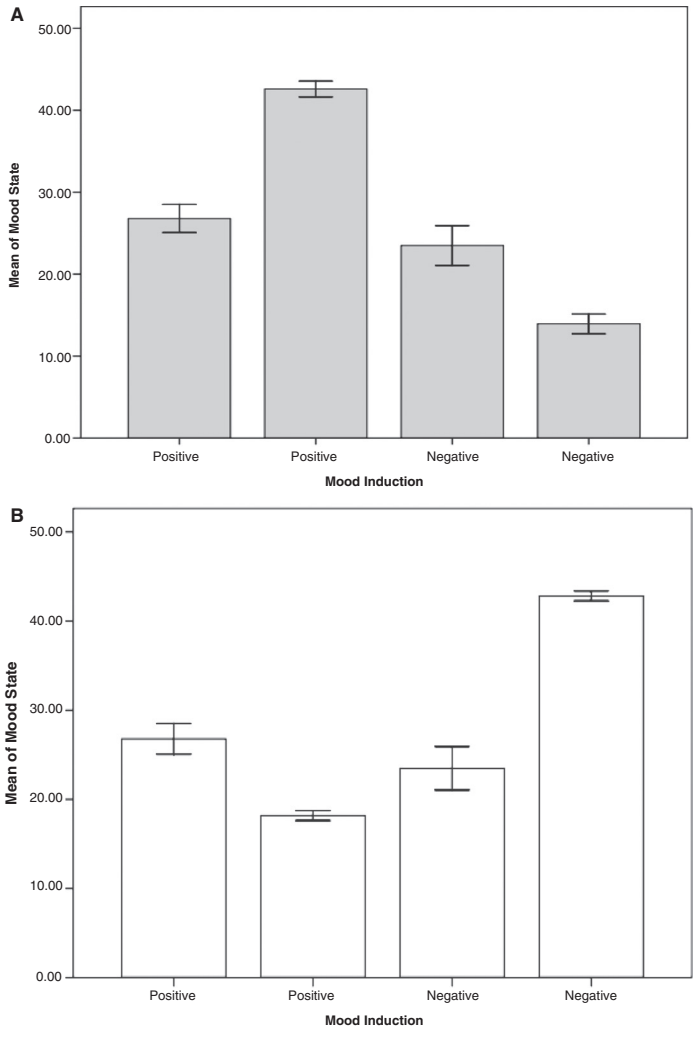

FIG. 2. Mood states before and after watching video clips of A. comedy B. tragedy. Choice A, gray bars; choice B, white bars.

problems. When faced with a domain of gain in the first financial problem, 76 participants in the positive mood-induction group and 67 participants in the negative mood-induction group selected certain gain option B. In the second financial problem regarding a domain of gain, a majority of the participants similarly in the positive and negative mood-induction groups selected uncertain gain option A. Thus, when faced with domains of gain in a financial situation, the majority of participants selected gain with cer-

TABLE 2
SAMPLE PROFILE BY POSITIVE AND NEGATIVE MOOD CONDITIONS

Characteristic	Positive Mood				Negative Mood			
	Male *n*		Female *n*		Male *n*		Female *n*	
Sex	67		33		73		27	
Birth place								
Urban	37		19		42		20	
Semi-urban	21		10		18		6	
Rural	9		4		13		1	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	23.52	3.97	23.39	3.96	22.56	3.65	24.37	3.21
Years studied	18.07	3.90	17.48	3.59	16.98	3.42	18.29	3.31
Job experience	2.67	3.61	1.95	2.26	1.60	3.00	1.74	2.50
Income (in INR)[a]	100,007	76,666	90,299	56,217	79,591	57,032	82,331	73,213
Family size	4.47	1.29	4.45	1.39	4.47	1.23	4.59	1.71

Note.—DS = Descriptive statistics; [a]INR = Indian rupees.

tainty over the option offering increased gain with uncertainty, irrespective of their mood states. On the contrary, when faced with a domain of loss in the third financial problem, 81 participants in the positive mood-induction group and 76 participants in the negative mood-induction group chose the uncertain option A, suggesting that the participants preferred the uncertain/risky choice over a certain one in the domain of loss. They do not want to lose less with certainty but want to lose more with uncertainty.

TABLE 3
CHI-SQUARED CONTINGENCY TABLE FOR CHOICES IN POSITIVE AND NEGATIVE MOOD CONDITIONS

Problem	Choice	Positive Mood		Negative Mood		$2 \times 2\ \chi^2$
		Preference	χ^2	Preference	χ^2	
1	A	24	27.04‡	33	11.56‡	1.98
	B	76		67		
2	A	67	11.56‡	72	19.36‡	0.59
	B	33		28		
3	A	81	38.44‡	76	27.04‡	0.74
	B	19		24		
4	A	41	3.24	42	2.56	0.02
	B	59		58		
5	A	42	2.56	29	17.64‡	3.69
	B	58		71		

*$p < .05$. ‡$p < .001$.

Problems four and five involved survival and mortality in situations requiring treatment with surgery or radiation therapy. Though a majority of the participants preferred the more cautious option of radiation therapy in the health risk situations irrespective of mood states, the preferred cautious option was not so distinctly different from the risky option except the option in problem five in negative moods. Notably, in answering the research question, irrespective of mood states, participants preferred the risky option in financial loss domain only, the cautious option in financial gain domain, and the cautious option in a health risk situation.

Information Processing in Positive and Negative Mood States

Ratings of fluency, originality, and flexibility derived from reasons the participants used to explain the choice for each problem in the positive mood state and in the negative mood state were compared using independent-samples *t* tests. As shown in Table 4, the 30 *t* values for two choices in five problems against the ratings of fluency, originality, and flexibility between positive and negative mood-induced groups were significantly different. The effect sizes ($t^2 / (t^2 + df)$) of difference varied from 0.51 to 0.87. It can be observed from the descriptive statistics that the participants in the negative mood-induction group consistently demonstrated more fluency,

TABLE 4
MOOD STATES INFLUENCING INFORMATION ATTRIBUTES

Problem	Induced Mood	Choice A						Choice B					
		Fluency		Originality		Flexibility		Fluency		Originality		Flexibility	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	PM	4.50	0.66	3.21	1.06	4.21	1.25	4.64	0.65	3.24	1.26	4.30	1.07
	NM	7.73	1.18	7.91	0.76	8.21	0.78	7.7	0.98	8.07	0.72	8.12	0.83
	t	13.4		18.47		13.84		22.37		28.49		24.01	
2	PM	2.79	1.02	3.45	1.14	3.27	1.48	3.30	1.42	4.00	1.41	4.09	1.37
	NM	6.78	1.43	7.03	1.39	7.19	1.50	7.00	1.56	7.04	1.62	7.25	1.50
	t	18.73		16.48		15.51		9.58		7.81		8.55	
3	PM	3.14	1.30	3.57	1.28	3.49	1.71	2.58	1.07	3.26	1.28	3.00	1.37
	NM	6.91	1.48	7.04	1.31	7.18	1.26	6.83	1.57	6.62	1.66	7.04	1.48
	t	16.85		16.76		15.44		10.69		7.26		9.14	
4	PM	3.00	1.16	2.63	1.00	3.49	1.20	3.53	1.43	3.02	1.13	3.58	1.17
	NM	6.90	1.55	6.67	1.37	6.88	1.31	7.33	1.30	6.83	1.45	7.10	1.18
	t	15.70		12.28		12.91		15.78		16.18		15.03	
5	PM	3.19	1.33	3.83	1.29	3.57	1.63	2.97	1.15	3.62	1.31	3.43	1.66
	NM	6.69	1.34	7.07	1.51	6.69	1.36	7.11	1.31	7.07	1.32	7.23	1.38
	t	10.87		9.70		8.47		18.81		14.80		14.21	

Note.—PM = Positive mood; NM = Negative mood. For all *t* values, $p < .001$.

originality, and flexibility of information in the reasons supporting their choices, compared to the positive mood-induction group.

Discussion

This study examined the effects of positive and negative moods on decision making in hypothetical positive and negative prospects and health risk situations, and also assessed the fluency, originality, and flexibility of information processing associated with choices in different mood states. Barring few exceptions, participants preferred cautious choices in the domain of financial gain and health risk situations, and risky choices in the domain of financial loss irrespective of their mood state. Participants in negative moods retrieved, elaborated, and processed information in favor of their choices with more fluency, originality, and flexibility than the participants in a positive mood, suggesting that a negative mood state facilitates systematic processing and a positive mood state promotes heuristic processing.

The participants exposed to negative mood induction reported an increase in the negative mood state and decrease in the positive mood state. Conversely, those exposed to positive mood induction reported an increase in the positive mood state and decrease in the negative mood state. The contents of the video clips induced the respective moods successfully. The mood induction procedure was also active, as the participants had to focus their attention on the video clips.

In accordance with prospect theory (Kahneman & Tversky, 1979), people generally do not weigh the utility of choices by their respective probabilities; rather, they prefer cautious choices in domains of financial gain and health risk situation, and risky choices in domains of financial loss. These tendencies of people are found to be similar in student samples in the U.S. and India. Individuals want to gain more and lose less. The patterns of choices, being similar in positive and negative moods, support neither the mood maintenance hypothesis (Isen & Patrick, 1983; Isen, 1987) nor the affect infusion model (Forgas, 1995). Evidence also suggests that individuals in a negative mood avoid risk (Yuen & Lee, 2003) as well as seek risk (Lerner & Tiedens, 2006). In the literature there is a wide variety of tasks examining risk-taking tendency (e.g., choice dilemma questionnaire, risk estimation for heath issues, gambling tasks, to name a few), and the task used in this study is not directly comparable to them. The study suggests that risk taking depends on the nature of decision-making tasks (Kahneman & Tversky, 1979) and mood states do not influence the choices in financial gains, losses, and health risk situations.

Fluency, originality, and flexibility of information describe information processing (Baron, Logan, Lilly, & Inmam, 1994). Based on the assumption that a negative mood state maximizes the involvement in the

problem (Mackie & Worth, 1989), this study indicates that individuals in a negative mood state process information in an elaborate and systematic manner compared to the heuristic processing which predominates in a positive mood state (Isen, 1987; Forgas, 1995).

These results may also have implications on decisions regarding informed consent during the treatment of patients suffering from serious ailments. For example, the negative moods of the patient's family members and their doctor are bound to process information critically and in a more elaborate manner before signing the informed consent or prescribing medicines for the patient's treatment, respectively. If accuracy is the ultimate objective, then individuals in a negative mood will rely more on thoughtful processes to achieve the goal. Similarly, in the case of financial investments in insurance plans or mutual funds, decisions made in a low negative mood state, such as mild stress, will result in systematic information processing and more accurate decisions compared to decisions made in a positive mood state.

This study has certain limitations. First, the findings from student participants may limit generalization. However, studies on decision making under uncertainty have incorporated student samples because their decisions closely resemble decisions in the real world (George & Jones, 1997). Second, only the information attributes of fluency, originality, and flexibility were used to assess the systematic or the heuristic information processing. However, other appraisal dimensions such as effort and response time can be considered for measuring information processing (Baron, Logan, Lilly, & Inmam, 1994). Third, the two raters, who were blind to the purpose of the study, evaluated the written explanation of participants. That might have decreased the ratings of fluency, originality, and flexibility of information. Fourth, it was also not examined whether the induced mood continued till the completion of the questionnaire. Last, if information is processed more systematically in a negative mood state than in a positive mood state, why the choices did not change significantly in a negative mood-induced group? Had the choices A or B for each item been measured on a Likert-type scale, results might have differed. Notwithstanding these limitations, this study suggests that mood states do not influence the choice cognitions differently in financial gain and loss prospects or in health risk situations. Furthermore, changes in mood state can influence the way the individual processes information in the attributes of fluency, originality, and flexibility.

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