RATIO BIAS IN JUDGMENT UNDER SPECIFIC EMOTIONS

by

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Abstract

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How does specific emotion influence the ratio bias phenomenon? Previous studies suggested that a more systematic and analytical reasoning with logical rationality seemed to be stimulated by negative emotions. However other studies regarding appraisal congruency effects have demonstrated that information processing is dependent on the certainty of emotion. To explore the effect of specific emotions on numeracy and ratio bias in judgment, I conducted a 2 (positive vs. negative emotion) ×2 (certainty vs. uncertainty emotion) between-participants design, contributing to four conditions: happy (positive, certainty), hope (positive, uncertainty), disgust (negative, certainty) and fear (negative, uncertainty). Four groups of participants were induced to experience these four emotions and then completed a binary judgment task to make a choice between two urns containing white and red marbles. The results indicated that people under emotion of certainty (happy and disgust) were higher confident about their judgments and had higher accuracy than people under uncertain feelings (hope and fear).

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Chapter 1

Are We Rational?

"We are normally blind about our own blindness. We're generally overconfident in our opinions and our impressions and judgments. We exaggerate how knowable the world is." Recently, TIME had an interview with Daniel Kahneman (Luscombe, 2011). Why do people usually not make rational choices? We make irrational decisions due to many factors, such as gender difference, emotion, consequence of previous judgment, information given and so forth. In the present study, I will focus on ratio bias in judgment under specific emotions by examining the decision confidence and accuracy. The example I used was the ratio bias task, to be explained.

There are two types of emotion influencing our decision making we need to discuss here: integral emotion responses and incidental emotion states (Bodenhausen, 1993). Integral emotion responses are usually directly or indirectly related to the judgment or decision making. For instance, the affect induced by the consequence of the decision might in turn influence the decision-making in the future. In addition, the expected emotion to the outcome of the judgment is in this category as well. Experienced fear and anticipated regret when evaluating a gamble have been shown to influence how much one is willing to gamble (Larrick & Boles, 1995). The incidental emotion states which are unrelated to the judgment or decision can be elicited by current environment, individual dispositional affect or certain life events (Loewenstein & Lerner, 2003; Cohen, Pham, & Andrade, 2007). For example, bad weather might make you feel depressed and this depression might influence the decision on an investment. Although the incidental emotion states are not induced by the judgment or decision itself, they play important roles in individuals' judgment and choice (Clore, 1992; Forgas, 1995; Isen, 1993; Lerner

& Keltner, 200; Schwarz, 1990). In the current study, I will focus on the effect of incidental emotion states.

<div align="center">Three Aspects of Emotion</div>

Three aspects of emotion should be considered: intensity, valence and appraisal content (Pham, 2007).

Intensity of Emotion

High intense emotional states accompanied by high level of activation or arousal impair people's cognitive capacity such as working memory and logical inferences (Darke, 1988). For instance, a study involving high anxiety suggested that people tended to scan their alternatives in a nonsystematic fashion and had more errors in problem solving problems than did people with lower arousal of anxiety (Keinan, 1987). Also, participants with intense anxiety seemed to rely on persuasion arguments with less thorough process (Sanbonmatsu & Kardes, 1988). However, Kaufman (1999) stated in his study that emotion with low arousal such as boredom and depression would diminish the quality of decision making because insufficient energy is contributed to attention, information processing and problem solving. In those studies on risk-taking, ideas regarding the effect of emotional intensity are still controversial. Fessler, Pillsworth & Flamson's (2004) study found that people under anger which is one of the high arousal emotions exhibited more risk-seeking in gambling. People who were induced to feel anger were more willing to pay for lotteries and less willing to pay for insurance. Whereas, they also found that women under disgust, regarded as another emotion of high level of intensity, tended to have less risk-seeking in gambling. It seems that the effect of emotional intensity does not have a consistent effect on cognitive processing. It might depend on the interaction of the target we process and the emotional state and other factors (Crepaz & Marks, 2001).

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Valence of Emotion

For the other aspect of emotion, valence, previous studies suggested that it is not a good approach to only differentiate emotion by negative and positive state when exploring its impact on judgment and decision making. On one hand, negative emotion seems to have mixed effects on our process of decision making and judgment. Many findings indicated that sadness tended to increase the care with which people process substantive information in persuasion (Bless, Bohner, Schwarz, & Strack 1990; Sinclair, Mark, & Clore, 1994). This negative mood seems to trigger a more systematic, data-driven, and analytical form of reasoning consistent with logical rationality (Pham, 2007). Negative states are probably associated with vigilant thoughts which make the individual be more cautious and not tend to rely on stereotype or superficial phenomenon. However, participants induced to feel anger and disgust seem to have less depth of processing and tend to rely on stereotyping and other heuristic cues, because of the sense of certainty triggered by these two states(Bodenhausen, Sheppard, & Kramer, 1994; Tiedens & Linton, 2001). One the other hand, the effects of positive emotion are also inconsistent. The findings of Isen and Means's (1983) study showed that people with positive mood solved multiattribute decision problems more efficiently. Whereas other studies showed that people under positive emotions seem to rely on knowledge structures and internal cues and judgmental heuristics, such as ease of retrieval (Ruder & Bless, 2003). According to the study of Forgas (1998), it showed that happy participants were more likely to demonstrate a correspondence bias, overattributing behavior to individual characteristics rather than to situational influences. Therefore, a more integral approach needs to be proposed to explore the complexity of emotion on decision making and judgment.

Appraisal Content

Study of emotion-appraisal associations showed that regardless of valence of emotion, experiences of specific emotions are associated with specific sets of appraisals (Tiedens & Linton, 2001). In this study, they induced four types of emotions including disgust (negative, certainty), fear (negative, uncertainty), happiness (positive, certainty) and hope (positive, uncertainty) and asked the participants to rate their confidence of the judgment. They found that people under emotions associated with certainty felt more certain about their judgment than people under uncertain feelings. In addition, in order to examine whether there was different information processing triggered by certainty appraisal, participants under each emotional condition were asked to rate their attitudes towards different source of information. The results showed that valence of the emotion state had no effect, instead, in contrast to the emotions associated with uncertainty, emotions associated with certainty led to greater reliance on the expertise of a source of a persuasive message (a student versus a professor). It suggested that emotions associated with certainty resulted in heuristic processing while emotions associated with uncertainty resulted in systematic processing, because participants under emotion characterized by certainty agreed more with the argument in the "expert version" than in the "student version" although the content of the two messages were identical. They processed the information heuristically by using the salient or superficial cues (distinguished professor vs. community college student). Whereas, people under the feeling of uncertainty had relatively equal agreements with the "expert version" and the "student version", in which it reflected that they paid attention on the content of the message and processed the information of the message thoroughly and objectively. Moreover, Weary and Edwards (1994) argued that people have the need to minimize their uncertainty, therefore they try to search for and process information deliberately so

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that it takes more cognitive effort in order to reduce the feeling of uncertainty. Furthermore, Edwards and Weary (1993) investigated the different impression formation between depressed participants and nondepressed participants. The finding indicated that depressed participants who felt lower certainty and control about their life tended to use elaborate trait attributes in evaluating a person, while nondepressed participants typically used less effortful categorical processing. It also suggested that people with uncertain feelings engage in more systematical analysis than people with feelings of certainty.

These findings above can be explained by Appraisal-Tendency Framework (Lerner & Keltner, 2000, 2001) which predicts that each emotion carries with it motivational properties that fuel carryover to subsequent judgments and decisions. According to the associative network mechanisms of ATF (Lerner and Tiedens, 2006), this network emphasizes on "specific emotion level rather than the global-affect level". That is, specific emotions can lead to specific appraisal-congruent judgments. Take a worried person as an example, "a low-control, low-certainty, low-coping potential network might be activated and thus low-control, low-certainty, low-coping potential events are salient" (Lerner and Tiedens, 2006). The specific appraisal content can inform people the current situation potentially (Schwarz, 2002). For instance, in a gambling game, fearful appraisal will make people realize that current situation is uncertain and less controlled. As a result, this person would evaluate this situation with lower confidence and consume more cognitive effort to censor the information carefully in order to reduce the feeling of uncertainty. The ATF summarizes the processes as "appraisal tendencies." Therefore, emotion associated with uncertainty would trigger lower confidence about their decision and more systematic information processing than those with emotion of certainty. Our study followed Tiedens and Linton's (2001) paradigm to investigate whether people under

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emotion associated with uncertainty would process information more thoroughly and then exhibit less ratio bias in judgment than those under feelings of certainty.

Ratio Bias

Even though there were various studies investigating the effect of emotion on decision making under risk, uncertainty or the judgment task similar to Tiedens and Linton's experiments that participants exhibit their attitudes towards different levels of processing on persuasive messages, there were few studies exploring how emotion influence the ratio-bias phenomenon which requires more numeracy and cognitive competence to avoid this kind of bias. This cognitive illusion phenomenon was first observed by Miller, Turnbull and McFarland (1989) and then termed as ratio bias by Denes-Raj and Epstein (1994). Ratio bias, the phenomenon whereby the same probability is experienced as larger if it comes as a ratio of two larger numbers has been called ratio bias. For example, compare to tray with 1 red jelly bean out of 10, the other tray has 8 red jelly beans out of 100. Most participants tend to choose the latter one although the ratios are actually the same in the two trays. If people more rely on the absolute number of the jelly bean rather than the actual ratio which need to systematic processing, they would make a heuristic derision which results in much faster but less accurate outcome.

Why do most people usually neglect the ratio or the background which refers to the denominator, but only focus on the absolute number of the target or the foreground which refers to the numerator (Stone, Yates & Parker, 1994)? This cognitive illusion can be accounted by different dual-process theories. One is the cognitive-experiential self-theory (CEST; Epstein, 1980, 1983, 1990) which proposes that we use two independent, parallel and interactive systems to process information: a preconscious "experiential system" and a conscious "rational system". The experiential system is emotionally driven

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in that it is more responsive than the rational system to the concrete and imagery information, whereas the rational system is more responsive to the abstract and analytical representations. The experiential system plays an important role in the ratio-bias phenomenon because the absolute number of the target (e.g. red jelly beans) or the numerator is much more concrete and imagery than the ratios. Participants in the visual-imaging group were more likely to exhibit ratio-bias phenomenon than participants in the verbal descriptive group (Epstein & Pacini, 2001). The other dual-process theory that can be used to explain the ratio-bias phenomenon is fuzzy-trace theory (Reyna & Brainerd, 1995, 2008). The basic assumption of this theory is that people tend to rely on their memories for the vague gist representation in reasoning and decision making, even when the verbatim (e.g., quantitative) details are given. However, failure to encode appropriate gist occurs in the ratio-bias phenomenon. When people are completing the ratio-bias paradigm task, even though the quantitative details are given (e.g. 1 red jelly bean out of ten), the overlapping classes interfere the process to retrieve the knowledge of ratio. Therefore, the salient gist turns out to be the absolute number of the red jelly bean but not the ratio of the target.

I believe cognitive-experiential self-theory (CEST) could better account for the ratio-bias phenomenon of people under emotion associated with different certainty appraisal. The major difference between the cognitive-experiential self-theory (CEST) and fuzzy-trace theory is that fuzzy- trace theory characterizes intuitive thinking as generally more advanced(e.g., Reyna & Ellis, 1994; Reyna & Lloyd, 2006), whereas cognitive-experiential theory treats intuition as primitive, to be censored or inhibited by more advanced rational processes. When people are under uncertain emotions, they are most likely to try to inhibit the function of experiential system in order to minimize the

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uncertain feelings. They then censor the quantitative information and notice the ratio in the problems rather than coming up with an appropriate gist.

Present Study

In the present study, I examined whether certainty appraisal of emotion rather than valence of emotion has an effect on the accuracy and decision confidence in the ratio bias phenomenon. Moreover, I followed the paradigm of Tiedens and Linton's study (2001) to induce four types of emotions and then had participants finish a binary judgment task associated with ratio bias phenomena. According to the previous studies, the effect of valence of emotion dimension seems mixed, I therefore focused on the certainty-uncertainty appraisal dimension, but valence was also included to see that valence would not have an effect and I was looking to prove that.A 2 (positive vs. negative emotion) ×2 (certainty vs. uncertainty emotion) between-participants design, contributing to four conditions: happy (positive, certainty), hope (positive, uncertainty), disgust (negative, certainty) and fear (negative, uncertainty). I also measured the intensity of emotion to see if intensity had an effect. According to the appraisal-congruency tendency effect, people under specific emotion would have specific appraisal about the situation congruent with the emotion. My first hypothesis was that emotions associated with certainty rather than valence had an effect on confidence about their judgment. People under happiness and disgust emotions would exhibit higher confidence than people under hope and fear. Previous studies suggested that emotion characterized by certainty triggered heuristic processing which is easily available and process the salient and superficial cues, whereas emotion characterized by uncertainty promotes systematic processing in order to reduce the uncertain feelings so that takes more cognitive effort. Thus, the second hypothesis was that there was effect of certainty of emotion on accuracy of ratio-bias phenomenon, in which people feeling hope and fear

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would process information more thoroughly and obtain higher accuracy than people feeling happiness and disgust. To look at how long these two effects would last, I proposed the third hypothesis that these two effects would decay across time, that is, there would be interaction effect between certainty and time, specifically, the effects would exhibit in the first block and then gradually decay from the second or third block.

Chapter 2

Methods

Participants

One hundred and forty seven college students at University of Texas at Arlington from the subject pool SONA system participated in the study (56 men and 91 women). They were told that "There are two separate studies, one is an emotional recall test and the other one is a binary judgment task". 0.75 course research credits were given for each participation.

Materials

Emotion Induction

The experiment was conducted by using the E-prime 1.1 program. Five questions adopted from Smith and Ellsworth's study (1985) and Tiedens and Linton's study (2001) were used to elicit one of the four emotions respectively. The following questions show the example of the happy mood induction (See Appendix A for other types of emotions).

Please picture this happy event and then answer the questions below one by one. Your answers for each question should be at least 3-5 lines.

1. When and what happened to make you feel happy?

2. What did you do in this situation where you were happy?

3. Why did these things make you feel happy?

4. How did you feel at the time the happy event occurred?

5. Describe any thoughts or fantasies elicited by this event that increased your happiness.

Manipulation Check

To examine if the emotion induction had effect, we used a shortened version of Smith and Ellsworth's (1985) appraisal questionnaire as a manipulation check. In addition, another two items measuring intensity of emotion were added in order to obtain more information from the results. Participants were asked to rate their feelings through the following questions:

How unpleasant was it to be in this situation you wrote about?

How enjoyable was it to be in this situation you wrote?

When you were feeling happy, how well did you understand what was happening around you in the situation you wrote about?

When you were feeling happy, how uncertain were you about what was happening in the situation you wrote about?

When you were feeling happy, how well could you predict what was going to happen in the situation you wrote about?

When you were feeling happy, how strong was the feeling?

When you were in this situation, how intense was the happiness that you felt?

The first two items were used for testing of the valence of the emotion. Items 3, 4 and 5 were used for checking the manipulation of emotion associated with certainty. Items 6 and 7 were measuring the intensity of the four emotions (These two items were only used on the latter 53 participants collected). Participants needed to rate their feelings from 1 (not at all) to 11 (extremely).

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Post-Experimental Hypotheses Guessing Questionnaire

To assess how much connection people believed between "Study 1" and "Study 2". A post-experimental hypotheses guessing questionnaire was conducted. Participants were asked to answers the following questions after the marbles computer game:

What do you think the two studies were about? What do you think was the researcher's hypothesis?

Were you trying to guess the hypothesis of the two studies when doing the experiment? Please enter a number from 1(not at all) to 5 (extremely).

When you were doing the marble computer game, did you think it has a connection with the recall test? Please enter a number from 1(not at all) to 5 (extremely).

If so, what might the connection between the recall task and the marble game be? If not, you can skip this question.

Procedure

It was a 2 (positive vs. negative emotion) ×2 (certainty vs. uncertainty emotion) between-participants design, contributing to four conditions: happy (positive, certainty), hope (positive, uncertainty), disgust (negative, certainty) and fear (negative, uncertainty). Participants were randomly assigned to each group.

Participants were told that there were two separate studies. In the "first study", they needed to recall a past situation or event where they felt happy/hopeful/disgusted/scared. They needed to picture this situation in their mind, tried and remembered as vividly as they could. Then they typed in five answers about their feelings. Manipulation check questions were completed after their recall by rating their feelings with 0-12 ratings.

In the "second study", participants would see two urns on the screen. In each urn, there were white marbles and red marbles. This binary judgment task (adapted from

Dale, Rudski, Schwarz and Smith, 2007) with 46 trials (three blocks) included four base rates, 10%, 20% 30% and 40%. That is, in the small urn Urn A, the number of red marbles was always 1, 2, 3 or 4 out of 10. In the big urn Urn B, the total number of marbles was 100; the number of red marbles in the big urn was manipulated by a parameter ϵ which could be equal to -1 or -2. That is, when the base rate was 20%, Urn A had 2 red marbles out of 10, then Urn B have 19 red marbles(20-1, ϵ = -1,) or 18 red marbles (20-2, ϵ = -2) out of 100. Their task was to decide "in which urn would you feel there is a greater chance of the red marble being selected". In the following screen, they rated the confidence level of their decision by clicking on a number from 1 (not at all) to 9 (extremely) (See Figure 1). The accuracy and the confidence for each trial were recorded.
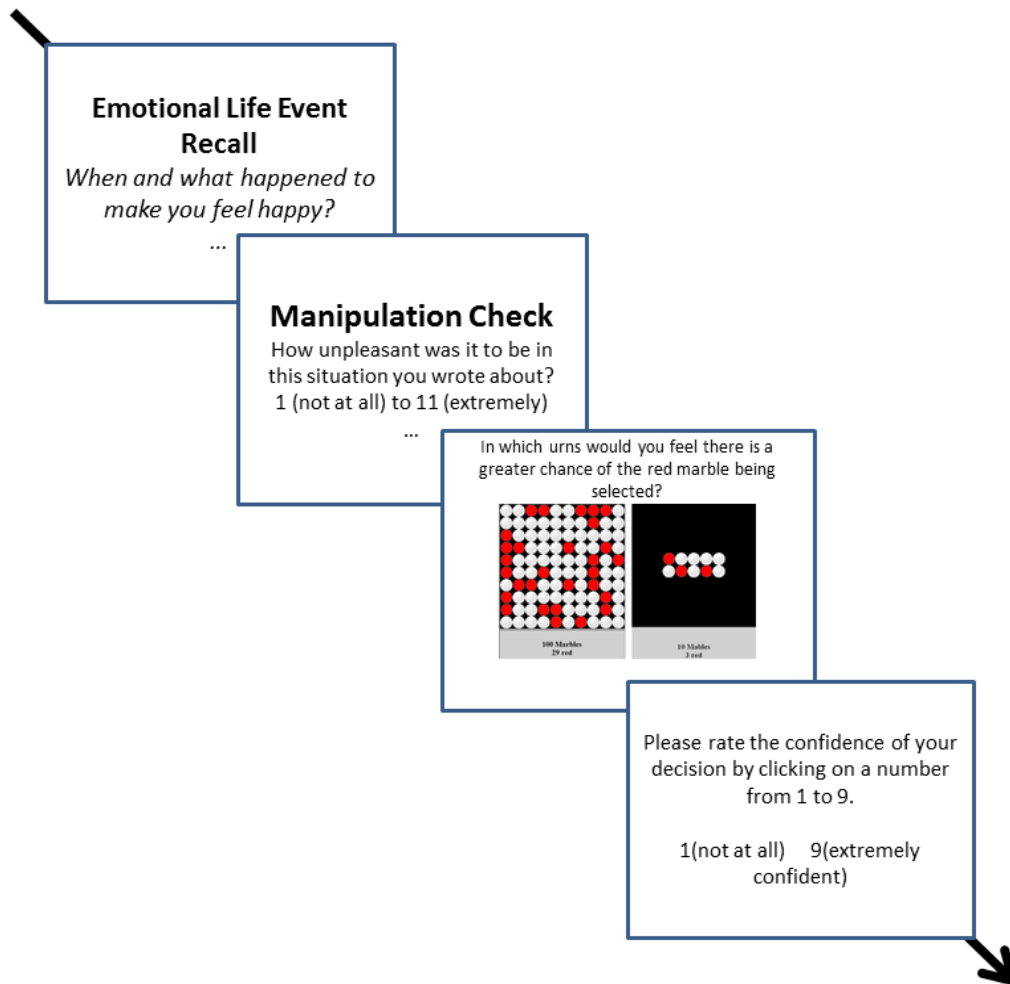
Figure 1 Emotion Induction and Binary Judgment Task.

To assess whether they perceived two studies in actuality, a 5-point Likert scale for hypotheses guessing as a post-experimental questionnaire was developed. This scale aimed to gauge how much connection between "Study 1" and "Study 2" they perceived and how many correct hypotheses they could guess. This post-experimental questionnaire was also used on the latter 53 participants as intensity questions. Finally, they were informed the actual purpose of study in a debriefing session.

Chapter 3

Results

For the results of the preliminary study, 147 participants (56 men and 91 women) were included in the data analysis. Two separate three-way ANOVAs involving gender as one of the independent variables were conducted to examine if gender had an effect on the decision confidence and accuracy. No significant main and interaction effects were found when including gender. In addition, one might be interested in the effects of base rate and the parameter (ϵ = -1 or -2) on confidence and accuracy. Two separate two-way mixed ANOVAs on confidence and accuracy were conducted. Again, no significant effects were found. Thus I excluded gender, base rate and parameter as independent variables to test the following three main hypotheses, and do not discuss them further. Before examining the hypotheses, I first conducted a manipulation check by using the self-report scores from the appraisal questionnaire to see if each specific emotion was induced as I expected.

Manipulation Checks

Since the first two items were to capture valence, item 3 to 5 were to capture certainty and the last two items were to capture intensity, a Pearson's r correlation was conducted first after transferring the reverse scored item 1 and item 4 to examine the relationship between items. Almost consistent with my expectation, Table 1 shows that pleasantness captured by Item1 (reversed) and 2, which were positively related to each other (p < .001). In addition, there was a positive correlation among item 3, 4 and 5 (p <.001) that measuring certainty appraisal. Moreover, item 6 and 7 for intensity also positively correlated to each other as expected (p< .001). However, item 3(When you were feeling happy/disgusted/scared/hopeful., how well did you understand what was

happening around you in the situation you wrote about?) seemed to be an ambiguous

item because it exhibited a positive relationship with every item except for item 7.

Table 1 Correlations between Appraisal Items across All Four Emotions

		Pleasantness1	Pleasantness2	Certainty3	Certainty4	Certainty5	Intensity6	Intensity7
Pleasantness1	r	1	.680**	.179*	0.139	0.125	-0.028	-0.017
	p		0	0.03	0.094	0.13	0.841	0.903
	N	147	147	147	147	147	53	53
Pleasantness2	r	.680**	1	.284**	-0.007	0.159	0.186	0.063
	p	0		0	0.931	0.054	0.182	0.655
	N	147	147	147	147	147	53	53
Certainty3	r	.179*	.284**	1	.394**	.444**	.299*	0.089
	p	0.03	0		0	0	0.03	0.525
	N	147	147	147	147	147	53	53
Certainty4	r	0.139	-0.007	.394**	1	.238**	0.188	0.176
	p	0.094	0.931	0		0.004	0.179	0.207
	N	147	147	147	147	147	53	53
Certainty5	r	0.125	0.159	.444**	.238**	1	0.254	0.096
	p	0.13	0.054	0	0.004		0.067	0.494
	N	147	147	147	147	147	53	53
Intensity6	r	-0.028	0.186	.299*	0.188	0.254	1	.464**
	p	0.841	0.182	0.03	0.179	0.067		0
	N	53	53	53	53	53	53	53
Intensity7	r	-0.017	0.063	0.089	0.176	0.096	.464**	1
	p	0.903	0.655	0.525	0.207	0.494	0	
	N	53	53	53	53	53	53	53

To further test whether participants had been induced the specific emotions I need, the average scores of item 1and 2, item 3 to 5, item 6 and 7 were calculated as the valence index, certainty index and also intensity index. The results suggested that the recall task of emotional life events successfully induced four types of emotions on both certainty and valence dimensions.

Pleasantness. A 2 (certainty) ×2(valence) between participants ANOVA on the valence index was performed and showed that only a main effect of valence was found, F (1, 143) = 337.267, $p < .001$, $\eta_p^2 = .702$. Participants who felt happy and hopeful had higher ratings ($M = 8.633$, $SE = .235$, 95%CI [8.169, 9.096]) on pleasantness than participants who felt disgusted and fearful ($M = 2.641$, $SE = .227$, 95%CI [2.192, 3.089]). No significant main effect of certainty and interaction effect were found on pleasantness ratings.

Certainty appraisals. A 2 (certainty) ×2(valence) between participants ANOVA on the certainty index was conducted to examine whether there were different ratings between the certain group and uncertain group. The results indicated there was a main effect of certainty, F (1, 143) = 25.096, $p < .001$, $\eta_p^2 = .149$. People under happy and disgusting feelings had higher ratings ($M = 7.981$, $SE = .249$, 95%CI [7.489, 8.473]) on certainty appraisals than people who felt hope and fear ($M = 6.186$, $SE = .258$, 95%CI [5.677, 6.695]). The main effect of certainty and interaction effect were not significant as we expected.

Intensity. Because no emotion conditions were categorized by intensity initially, the type of emotion (happy, disgust, hope and fear) was used as an independent variable in a one-way randomized ANOVA to assess if the four types of emotion had significant difference on intensity index. Intensity was only measured on 53 participants. As a result,

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no significance were found, $F(3, 49) = 2.375$, $p = .081$, $\eta_p^2 = .127$. It suggested the four types of emotion were not significantly different from each other on intensity.

<div align="center">Hypothesis Guessing Measures</div>

The post-experimental hypothesis guessing measures aimed to examine how much connection people believed between "Study 1" and "Study 2". The standards of the coding for open-ended item 1(What do you think the two studies were about? What do you think was the researcher's hypothesis?) and item 4 (If so, what might the connection between the recall task and the marble game be? If not, you can skip this question.) were below:

1= correctly guessed researcher's hypotheses. (E.g. If we reflect on a happy moment in our lives then we are more optimistic about taking chances.)

0= generally guessed the purpose of the study but not the exact hypotheses. (E.g. I guess the study was about how memorable events or feelings can affect cognitive choices.)

-1= totally didn't have a clue of the hypotheses or connection between "Study 1" and "Study 2" or gave a wrong guess. (E.g. I am not really sure how an emotional event and the marble game are connected, but it is very interesting to me why this was chosen.)

For item 1, only 4 out of 53 participants guessed the hypotheses correctly; 28 participants generally thought the purpose of the study was to look at the effect of emotion on judgment and decision making but did not know the exact hypotheses. 21 out of 53 participants know nothing about the correct hypotheses or gave a wrong guess. For item 2 (Were you trying to guess the hypothesis of the two studies when doing the experiment?) and 3 (When you were doing the marble computer game, did you think it has a connection with the recall test?), their mean scores of the 5 Likert scale were 2.000

and 2.651 each which suggested that they did not often try to guess the hypotheses and the connection between "Study 1" and "Study 2". For the last item, only 29 participants thought there was a connection between the recall test and marble computer game and then did this item. Only 4 out of 29 people gave a correct guess, 14 of them just generally believed that there would be an influence of emotion on the marble computer game but did not know what the influence was. 11 out of 29 people even gave a wrong guess although they thought there was a connection between the two tasks.

To sum up, very few participants guessed the correct hypotheses. About half people felt like there was connection between the recall test and marble computer game or believed that there was effect of emotion on judgment and decision making, however they did not know the exact hypotheses. The rest of people know nothing about the purpose of study or guessed it wrong. These indicated that my data was valid and can be used into further statistical analysis.

<div align="center">Effects of Emotion on Ratio Bias</div>

Confidence of Judgment

According to the Appraisal-Tendency Framework, the first hypothesis states that people will demonstrate appraisal-congruency tendency under specific emotions. Therefore, regardless of the valence of emotion, participants under emotion associated with certainty (happiness and disgust) will be more certain about their judgment. Namely, they would have a higher confidence level than people with uncertainty-associated emotions (hope and fear). A 2(valence) ×2(certainty) ×3(time) three-way mixed ANOVA was conducted with the average confidence of the three blocks as the dependent variable.

Not surprisingly, there was no significant effect of valence, $F(1, 143) = .128$, $p = .721$, $\eta_p^2 = .001$. The confidence of people who felt happy and hopeful was not significantly

different from those who felt disgusted and fearful. However, certainty of emotion did have an effect, $F (1, 143) = 4.266$, $p = .041$, $\eta_p^2 = .029$. Participants with happy and disgusted feelings had higher confidence levels ($M= 7.214$, $SE= .185$, 95%CI [6.850, 7.579]) than those with hopeful and fearful feelings ($M= 6.666$, $SE= .191$, 95%CI [6.288, 7.043]). Table 2 shows the confidence mean for each emotional condition through trial block. Neither the main effect for time nor other interaction effects were statistically significant. Thus, the first hypothesis was supported by the results that only certainty of the emotion had effect on the confidence level of the judgment task.

Table 2 Confidence Mean in Each Condition Through Trial Block

		Block 1		Block 2		Block 3	
		M	SE	M	SE	M	SE
Certainty	Positive(Happiness)	7.368	0.250	7.343	0.280	7.341	0.293
	Negative(Disgust)	7.160	0.243	7.024	0.273	7.050	0.286
	Average	7.264	0.247	7.184	0.277	7.196	0.290
Uncertainty	Positive(Hope)	6.710	0.261	6.540	0.292	6.623	0.306
	Negative(Fear)	6.843	0.250	6.696	0.280	6.583	0.293
	Average	6.777	0.256	6.618	0.286	6.603	0.300
Average Total		7.020	0.251	6.901	0.281	6.899	0.295

Accuracy of Judgment

According to Tiedens and Linton's (2001) findings that certainty-associated emotions trigger heuristic processing, whereas uncertainty-associated emotions result in systematic processing, the second hypothesis states that participants who were under

happy and disgusted emotions would have less accuracy than participants under hopeful and fearful emotions in the ratio bias judgment task. The accurate rate of each block was used as the dependent variable in a 2(valence) ×2(certainty) ×3(time) three-way mixed ANOVA to examine this hypothesis.

Again, valence of the emotion didn't show any significant effect on the accuracy, $F(1, 143) = .332$, $p = .565$, $\eta_p^2 = .002$. Participants under positive emotions (happiness and hope) and participants under negative emotions (disgust and fear) had similar accuracy in the ratio bias judgment task. Surprisingly, although the effect for certainty was indeed significant, $F(1, 143) = 5.667$, $p = .019$, $\eta_p^2 = .038$, it was the reverse of what we predicted (See Figure 2): people under certainty-associated emotions (happiness and disgust) had higher accuracy ($M = 84.4\%$, $SE = 3.3\%$, $95\%CI$ [77.8%, 90.9%]) than people under uncertainty-associated emotions (hope and fear) ($M = 73.0\%$, $SE = 3.4\%$, $95\%CI$ [66.2%, 79.8%]). Table 3 shows the accuracy in each emotion condition through trial block.
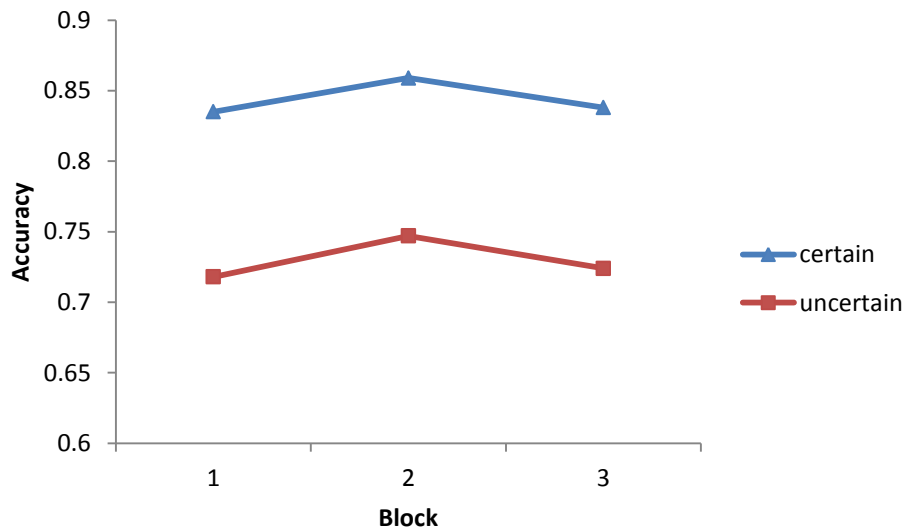

Figure 2 Average Accuracy for Levels of Certainty Over Time.

Table 3 Accuracy Mean in Each Condition Through Trial Block

		Block 1		Block 2		Block 3	
		M	SE	M	SE	M	SE
Certainty	Positive(Happiness)	89.0%	4.8%	89.9%	4.8%	88.2%	5.2%
	Negative(Disgust)	77.9%	4.6%	81.9%	4.7%	79.3%	5.1%
	Average	83.5%	4.7%	85.9%	4.8%	83.8%	5.2%
Uncertainty	Positive(Hope)	68.9%	5.0%	73.0%	5.0%	71.3%	5.5%
	Negative(Fear)	74.7%	4.8%	76.5%	4.8%	73.5%	5.2%
	Average	71.8%	4.9%	74.8%	4.9%	72.4%	5.4%
Average Total		77.6%	4.8%	80.3%	4.8%	78.1%	5.3%

Moreover, Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 17.93$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.894$).The main effect of time was marginally significant, $F(1.788, 255.675) = 2.889$, $p = .063$, $\eta_p^2 = .020$. The post-hoc test with Bonferroni adjustment showed that the difference between accuracy in block 1 and block 2 was marginally significant ($p = .057$), but there were no significant differences between block1 and block 3 and between block 2 and block 3 (See Figure 3). Furthermore, no interaction effect between valence and certainty was found (See Figure 4).
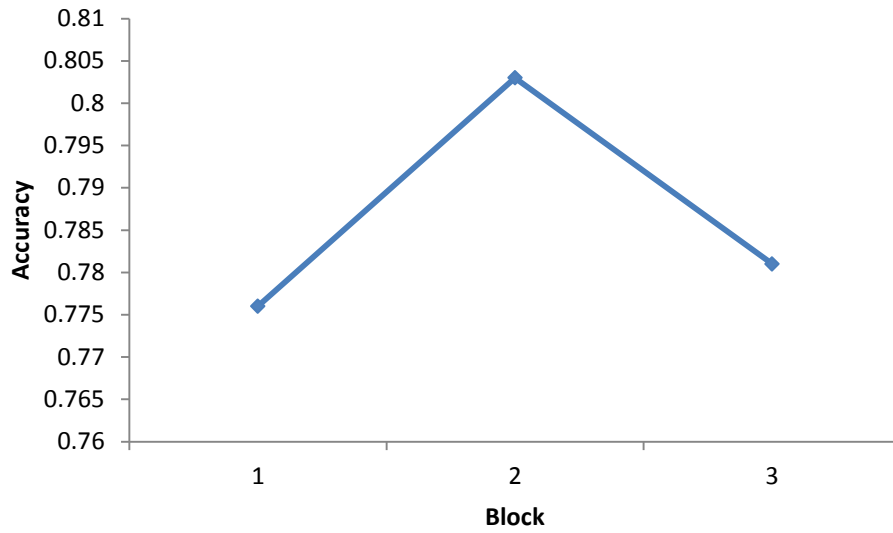
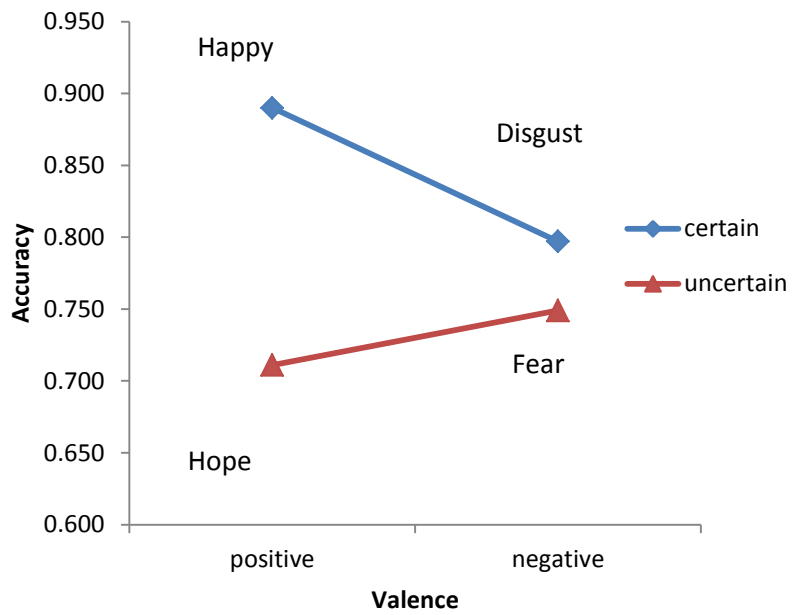Figure 3 Average Accuracy of the Judgment Task for Each Block.

Figure 4 Average Accuracy of the Judgment Task for Each Emotional Condition.

Because a reversed effect of certainty was obtained, in order to assess if this effect was a function of intensity, a Pearson's r correlation was conducted between intensity and accuracy of the three blocks. However, no significant correlations were found. The second hypothesis was partially supported in that as we predicted, valence would not influence accuracy of the marble computer game. However, the results showed a reverse effect of what we assumed that people with certainty-associated emotion would have lower accuracy then people with uncertain-associated emotion.

How Long does the Effect of Emotion Last?

The purpose of conducting three identical blocks of the judgment task across time was to examine how long the effect of emotion last. The last hypothesis stated that if only the certainty of emotion has effects on confidence and accuracy of judgment, those effects would decay across time, that is, there would be interaction effect between certainty and time, specifically, the effects would exhibit in the first block and then gradually decay from the second or third block. However, the results from the two separated three-way mixed ANOVA showed that whenever the dependent variable was confidence or accuracy, there was no interaction effect between certainty and time, $F(2, 142) = .205$, $p = .815$, $\eta_p^2 = .003$ (when confidence was the dependent variable); $F(2, 142) = .028$, $p = .972$, $\eta_p^2 < .001$ (when accuracy was the dependent variable). The results didn't support the last hypothesis that the effect of certainty would decay across blocks. The next section will discuss the explanations of this results I obtained. It indicated that the duration of the judgment task was not long enough to exhibit the decay of the effect of emotion.

Chapter 4

Discussion

In sum up, the recall task of emotional life events successfully induced four types of emotions on both certainty and valence dimensions. The first hypothesis was supported by the results that only certainty of the emotion had effect on the confidence level of the judgment task. The second hypothesis was partially supported in that we tested that there was no effect of valence on the accuracy. However, the results showed a reverse effect of what we hypothesized that people with certain emotion would have lower accuracy then people with uncertain emotion. The results didn't support the last hypothesis that the effect of certainty would decay across blocks. The next section is to discuss the explanations of the results we obtained.

At first, the four types of emotion successfully induced by the life-event recall task. The separate two-way ANOVA showed that emotion associated with certainty and uncertainty differentiated each other on certainty appraisal, so did positive and negative emotion on valence rating. We also investigated whether these emotions were different between each other on intensity. The nonsignificant effect showed that level of intensity should be a problem in the 2×2 experimental design. Moreover, considering the undesirable consequences of demand artifacts, researchers conduct post-experimental questionnaires to examine hypothesis guessing (Shimp, Hyatt and Snyder, 1991). The results of the hypotheses guessing questionnaire indicated that just a few (less than 10%) participants guessed the hypotheses correctly, the rest of them either only knew the general purpose of the study or know nothing about the study. Thus there was no demand artifacts and the data was valid to be used.

For the effect of certainty appraisal tendency on the confidence, it replicated the findings of previous studies that people under certainty-associated emotion are more

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confident about their decision than people under uncertainty-associated emotion. It demonstrated that consistent with the Appraisal-Tendency Framework (ATF), emotion with the same valence can have different impact on judgment confidence, while emotion of different valences can possess the same effect on decision making and judgment (Lerner & Keltner, 2001). The specific emotion informs people the current situation and people regard the nature of the situation as the congruent feelings with that emotion. When people are in the certain mood states, they are more likely to exhibit the appraisal-congruent tendency in which they will be certain about their judgment (Lerner and Tiedens, 2006).

As for the effect of emotion on the accuracy of the ratio-bias phenomenon task, the results partially illustrated that again the valence of emotion didn't show significant effect on the accuracy of judgment. However, contrary to the prediction, people induced the certain emotion (happiness and disgust) had higher accuracy than those with uncertain emotion (hope and fear). It seems like people with happy and disgusted feelings process information more rationally, and cautiously with thorough thinking, yet those under hope and fear mood tend to be more heuristic and automatic. This finding was also contradictory to the arguments of previous studies (Tiedens & Linton, 2001; Garg, Inman, and Mittal , 2005) in which they found emotion characterized by certainty such as anger, disgust and contentment lead to heuristic processing, whereas emotion characterized by uncertainty triggers systematic processing. It might because of the different tasks used. In one experiment of Tiedens and Linton's (2001) study, participants answered questions about their attitudes on the essay topic on educational issues. The two essays were identical expect the different source, in one condition the message came from a professor, and in the other condition from a community college student. People with certain emotion felt the message from a professor was more persuasive and

vice versa. It can be explained that certainty-associated emotion trigger heuristic processing and make people more rely on superficial information. The reversed findings in my study could be accounted for the motivational mechanisms of ATF. Lerner and Tiedens (2006) argued that the depth of processing motivated by the judgment outcomes. As I assumed before, people under uncertain emotion tend to diminish this uncomfortable feelings of uncertainty, they would use more cognitive efforts and do systematic processing to ensure more accurate answers than people under certainty-associated emotion. This explanation was also consistent with some of previous studies (Weary & Jacobson, 1997, Tiedens & Linton, 2001). However, Lerner and Tiedens (2006) stated that emotion of certainty does not always trigger deeper processing. The influence of judgment outcome is very specific. For instance, Lazarus's (1991) showed that anger was associated with appraisals of injustice. Angry people would judge unjust behaviors harsher which takes more cognitive efforts (Goldberg et al., 1999). However, if angry people in a situation in that they believe systematic processing might lead to injustice, they would in turn, process more heuristically than before. Also, recent study showed that if people under stress (uncertain emotion) treated the judgment task as a challenge rather than a threat, they took effort to keep adjusting their anchors in an anchoring task (Kassam, Koslov & Mendes, 2009). Furthermore, Inbar and Gilovich's (2011) showed that people under anger and disgust emotion did more adjustment confidently and thoroughly than people under fear and sadness. They argued that people under high-certainty emotions felt more control and certainty about their judgment and then they felt like the adjustments were under their control, so that they adjusted their anchors more frequently. Thus, ATF seems to consider each situation and emotion specifically. In my case, possible explanation could be that after a practice of the repeated trials of task, people under certainty-associated emotion felt more like they on a right track than people

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under uncertainty emotion, so they processed the ratio-bias task more thoroughly in order to keep this sense of certainty and control.

Finally, we tested whether the effect of emotion decay across time and found that although there was effect certainty, the effect did not decay across the three blocks. That is, there was still difference between certain and uncertain emotion on both confidence and accuracy across every block. It suggested that the emotion induced last longer than the judgment task which lasted about 10 minutes.

In sum, we successfully conducted the emotion induction and induced four types of emotions we need. We found that people exhibited appraisal-congruent tendency that when they were under certain emotion they were more likely to be confident about their judgment and vice versa. However, our results suggested that people with emotion characterized by certainty seem to process information more deliberately, analytically than people with emotion characterized by uncertainty. For future ideas, considering a broad range of specific emotions, researchers can explore more variety of dimensions of emotion. Also, the interaction between the goal of judgment and specific emotions is necessary to assess in order to investigate the inconsistent effect of certainty appraisal.

Appendix A

Emotion Induction Questions

"We are interested in emotions and memory. Please recall a past situation or event where you felt happy/disgusted/hopeful/scared. Picture this situation in your mind. Try and remember as vividly as you can what this past happy/disgusted/hopeful/scary situation was like. Think about when and what happened to make you feel happy/disgusted/hopeful/scared, What you did in this situation when you were happy/disgusted/hopeful/scared, why these things made you feel happy/disgusted/hopeful/scared, how you felt at the time the happy/disgusting/hopeful/scary event occurred, and whether this event had elicited thoughts or fantasies that increased your happiness/disgusted feelings/hopeful/fear. You will be asked to answer five questions about this happy/disgusting/hopeful/fearful life event. "

Please picture this happy/disgusted event and then answer the questions below one by one. Your answers for each question should be 3-5 lines.

1. When and what happened to make you feel happy/disgusted/hopeful/scared?

2. What did you do in this situation where you were happy/disgusted/hopeful/scared?

3. Why did these things make you feel happy/disgusted/hopeful/scared?

4. How did you feel at the time the happy/disgusting/hopeful/scary event occurred?

5. Describe any thoughts or fantasies elicited by this event that increased your happiness/disgusted feelings/hopefulness/fear.

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