Cognitive mechanisms underlying mood bias in life satisfaction judgements: Affect-as-information or affect priming?

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Abstract

There is currently a debate about whether the affect-as-information or affect priming cognitive mechanism is primarily responsible for mood bias in a wide variety of judgements, including life satisfaction. For the first time, this study tested for the prevalence of affect priming as an explanation of mood bias in life satisfaction judgements, a bias which has previously been attributed to the affect-as-information cognitive mechanism. Mood, cognitive elaboration and need for cognition were used to identify underlying cognitive mechanisms. A mixed design was employed with mood, cognitive elaboration and need for cognition as factors predicting life satisfaction. Using a PC based program, students in 1st year psychology courses were presented pleasant or unpleasant pictures and were asked about life satisfaction, ostensibly as part of two separate studies. A two way interaction in a moderated regression analysis revealed individual differences in the use of cognitive processing mechanisms such that affect-as-information was associated with low need for cognition and affect priming with high need for cognition. This finding means that researchers should not assume that one cognitive mechanism is dominant over the other since their use depends on both the judgement task and individual differences. When investigating mood bias in judgements, researchers should employ methodologies which reveal the effects of both cognitive mechanisms, rather than inferring one or the other cognitive mechanism based on theoretical predispositions.

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Introduction

Our moods have been found to bias a wide variety of judgments and lead to suboptimal decisions (for reviews, see Clark & Williamson, 1989; Clore, Schwarz, & Conway, 1994; Forgas, 1995, 2002a; Mayer, 1986; Mayer, Gaschke, Braverman, & Evans, 1992). For example, mood bias has been found in persuasion (Petty, Schumann, Richman, & Strathman, 1993), stereotyping (Roesch, 1999), self-conceptions (Sedikides, 1995), risk judgments (Schwarz & Clore, 1983) and life satisfaction judgments (Abele & Gendolla, 1999; Schwarz & Clore, 1983; Schwarz & Strack, 1999; Schwarz, Strack, Kommer, & Wagner, 1987). Presently, there is disagreement over which cognitive mechanism is primarily responsible for mood bias in such judgments. It is important to determine which cognitive mechanisms underlie mood bias since different cognitive mechanisms suggest different and even contradictory ways of reducing mood bias. Accordingly, this thesis examines the issue of whether one of two cognitive mechanisms, affect-as-information or affect priming, is primarily responsible for mood bias in life satisfaction.

It is useful at the outset to distinguish between affect, moods and emotions since these terms are commonly used interchangeably with varying definitions in the literature. In this study, affect is defined as a general term that includes both moods and emotions, and which has positive and negative dimensions (Forgas, 1995; Watson, Clark, & Tellegen, 1988). Moods are also defined as general affective states with positive and negative dimensions, but which are often not associated with any particular event or target (e.g., I feel depressed generally), while emotions refer to specific affective states which are usually associated with particular events or targets (e.g., I felt inspired when … or I felt angry at …) (Forgas, 2002b; Haidt, 2002; Lerner & Keltner, 2000). In this study, the focus is on moods rather than emotions.

There are several types of mood bias. The type of mood bias most often studied, and the type investigated in this study, is where positive affect is associated with more favourable judgments and negative affect is associated with less favourable judgments (e.g., Abele & Gendolla, 1999; Chaiken & Maheswaran, 1994; Forgas, 1994, Petty et al., 1993; Maheswaran & Chaiken, 1991; Schwarz et al., 1987; Sedikides, 1995). This type of mood bias has been called various names such as the mood congruent effect (Maheswaran & Chaiken, 1991), concurrent assimilation (Abele & Gendolla, 1999) and affect infusion (Forgas, 1995). To avoid advocating any particular theoretical perspective, I simply use the general term mood bias from now on to refer to this type of mood bias.

However, there is another type of mood bias that needs to be taken into account in the context of life satisfaction judgments called mood incongruency or contrast effects. This is where negative mood inducing stimuli are associated with more favourable judgments, and vice versa (e.g., Schwarz & Clore, 1983, Experiment 2). In these cases, the same stimuli that causes a positive or negative mood also serves as a standard of comparison. For example, if we see a bomb blast victim on television, we may feel sad but judge ourselves lucky in comparison. It seems as if these contrast effects involve making comparisons with others (Abele & Gendolla, 1999). Therefore care is needed in selecting stimuli to produce mood bias rather than contrast effects. This type of mood bias is referred to from now on as contrast effects.

Other types of mood bias which are not subject to investigation in this thesis relate to motivated processing where individuals process information with an aim of attaining (or retaining) a positive affective state (e.g., Baumgardner & Arkin, 1988); cognitive interference from happy thoughts which are either intrusive or exciting, and which subsequently lead to more mood bias in positive mood conditions (e.g., Bodenhausen, Kramer, & Suesser, 1994), and effects of specific emotions on specific judgments such as the effect of fear on risk judgments (e.g., Lerner & Keltner, 2000).

Cognitive Mechanisms, Processing Strategies and Theories

There are a number of theoretical perspectives associated with mood bias with similar aspects but important differences. To help explain these theoretical perspectives more clearly, I have adopted a terminology which distinguishes between cognitive mechanisms, processing strategies and theories.

Essentially, cognitive mechanisms are the fundamental cognitive processes that lead to mood bias. Different cognitive mechanisms are used in different processing strategies, and theories explain the use of different processing strategies, usually on the basis of such things as motivation, cognitive ability and task complexity (e.g., Forgas, 1995; Schwarz & Strack, 1999). These relationships are explained in more detail below, though in this study most focus is placed on the basic cognitive mechanisms because these are most closely associated with mood bias.

Cognitive mechanisms. The "affect-as-information" cognitive mechanism is one of two main cognitive mechanisms thought to underlie mood bias. With this approach, information about whether something is good or bad is conveyed to us by feelings we have toward it, and this information helps us evaluate things either favourably or unfavourably (Clore & Tamir, 2002). The affect-as-information cognitive mechanism can lead to mood bias for two reasons. First, if mood is used as a heuristic (or rule of thumb) to simplify a judgment, then the importance of mood may be overweighted. For example, when asked about life satisfaction, we may simply ask ourselves how we feel in response to that question and use this information as the main basis for our response (Schwarz & Strack, 1999). A second reason that affect-as-information can give rise to mood bias is because current affective states can be *mis*attributed as a response to the judgment target. This is exemplified in a study by Schwarz and Clore (1983, Experiment 2) where attributions were manipulated by interviewing participants about their happiness with life on either sunny or cloudy days. In one condition, the participant's attention was subtly drawn to the weather as a plausible cause for their current mood, in the other condition no mention was made of the weather. Mood bias was found in the later condition but not the former condition. The argument is when mood can be attributed to another cause, no mood bias results. However, when mood is not attributed to another cause (e.g., the weather) it may be misattributed as a response to the judgment target (e.g., life satisfaction). In both cases - using mood as a heuristic and misattributing mood – our affect is being used as information.

Affect priming is the other main cognitive mechanism thought to underlie mood bias. With this cognitive mechanism, positive moods facilitate retrieval of positive information from memory and negative moods facilitate retrieval of negative information from memory (Blaney, 1986; Bower, 1981; Clark & Isen, 1983). In the network model put forward by Bower (1981), memories of life events have affective associations, and as a consequence, memories of life events are connected to particular emotion nodes in the brain. When an emotion node is activated (e.g., by being in a positive or negative affective state), an associated memory structure is also activated (or primed) which then makes these memories more accessible or likely to be recalled. For example, if someone was asked about their life satisfaction when in a happy mood, then this network model predicts that they are more likely to remember happy events in their life and arrive at a favourably biased judgment.

Processing Strategies. There are two main processing strategies associated with the affect-as-information and affect priming cognitive mechanisms: the heuristic and systematic processing strategies. There are other processing strategies such as motivated processing and direct processing (Forgas, 1995). However, these are not focussed on in this study because they are not directly related to the cognitive mechanisms under investigation.

The heuristic processing strategy, which is closely associated with the affect-as-information cognitive mechanism, is a strategy where there is limited information processing and where a cue or heuristic is used as a rule of thumb to arrive at a relatively quick and effortless judgment (Maheswaran & Chaiken, 1991). The underlying assumption is that people are cognitive misers and have a preference to save cognitive energy unless motivated to do otherwise. Thus, the heuristics – or rules of thumb - are used to save cognitive energy in situations say when a judgment is very complex or not considered important.

With regard to life satisfaction judgments, our mood can be used as a heuristic to arrive at a simplified judgment. As mentioned, someone may consult how they feel when asked about their life satisfaction and use this as a basis for their judgment (Clore & Parrott, 1991; Schwarz & Clore, 1988; Schwarz & Strack, 1999). This processing strategy is likely to be used in situations of low motivation, limited time, insufficient cognitive resources, or when the judgment is very complex (Schwarz, 2002).

Although, the affect-as-information cognitive mechanism underlies the heuristic processing strategy, a distinction can be drawn between them because affect can serve as information without necessarily being used as a heuristic. That is, affect can serve as one source of information together with other sources of information upon which a considered judgment is made (Clore & Tamir, 2002).

The systematic processing strategy is often contrasted with the heuristic processing strategy. A systematic processing strategy is characterised by information seeking and analytical thought in an endeavour to make a sound judgment (Chaiken & Maheswaran, 1994; Maheswaran & Chaiken, 1991; Shafir & LeBoeuf, 2002; Trumbo, 1999). It assumes that people are motivated to expend cognitive effort, and have sufficient cognitive capacity and the enough time to adopt a systematic processing strategy. Accordingly, it is associated with more thoughts and longer response times (Forgas, 1995, 2002b).

Even though applying a systematic processing strategy is motivated by a desire to make a sound judgment, mood bias can still be expected via affect priming. Systematic processing strategy involves information seeking and people use information from their memories as part of arriving at a judgment. If someone thinks about their life when in a negative mood, they may recall many more negative life events then they otherwise would. Thus, mood bias can be expected even when a systematic processing strategy is being employed (Forgas, 1995).

Theories. A number of theories draw on the ideas of heuristic and systematic processing: the elaboration likelihood model (ELM) (Petty & Cacioppo, 1986), the heuristic-systematic model (HSM) (Chaiken, 1980; Chaiken, Liberman, & Eagly, 1989), the judgment model of subjective well-being (JM-SWB) (Schwarz & Strack, 1999) and the affect infusion model (AIM) (Forgas, 1995). These dual process theories share the conception that when someone lacks the motivation or capacity to think carefully and thoroughly about a judgment, they will rely on simplifying cues or heuristics to inform their judgment (i.e., heuristic processing). However, when they do have the motivation and capacity to use cognitive effort in making sound judgments, they will seek information, think carefully and systematically, and think for longer periods of time (i.e., systematic processing). However, these theories differ in important respects too.

In the elaboration likelihood model (ELM), heuristic processing is referred to as peripheral route processing and systematic processing is referred to as central route processing. The most distinguishing feature of this model is the emphasis on the potential for ones own thoughts (or cognitive elaborations) to provide additional information when undertaking central route processing. In this model, mood biases are hypothesised in peripheral route processing when mood is used as a heuristic (or peripheral cue). In central route processing, ELM predicts that the effects of peripheral cues will diminish as other more relevant information is brought to mind during cognitive elaboration.

However, the biasing influence of mood has been found in both routes (Petty et al., 1993). Mood directly influenced persuasion under low cognitive elaboration, and it also indirectly influenced persuasion under high cognitive elaboration, mediated by number of thoughts in the high cognitive elaboration condition. The effect sizes for mood bias were approximately the same in the low and high cognitive elaboration conditions. The authors explained these findings within the ELM framework by incorporating the notion of affect priming during cognitive elaboration. However, the notion of affect priming is not normally included in ELM and this appeared to be an ad hoc addition to explain a finding which does not fit well within the ELM framework. Normally, ELM predicts that a bias decreases with cognitive elaboration.

One strength of ELM is that it incorporates individual differences in need for cognition (NFC) (Cacioppo & Petty, 1982) such that those higher in NFC are more likely to engage cognitive elaboration and central route processing (Cacioppo, Petty, Kao, & Rodriguez, 1986). For example, those high in NFC are more likely to be persuaded by argument quality and less likely to be persuaded by peripheral information such as source credibility (Chaiken & Maheswaran, 1994).

The heuristic-systematic model (HSM)(Chaiken, 1980; Chaiken et al., 1989) is similar to ELM. However, it focuses on a need for accuracy as the mechanism underlying the switch from heuristic to systematic processing. In this model, heuristic processing occurs when one is not motivated to be accurate, and systematic processing starts when someone is motivated to form an accurate judgment. Systematic processing continues until one has attained a desired level of confidence in the accuracy of one's judgment (Trumbo, 1999). This model does not include the notion of affect priming and would thus predict mood bias under heuristic processing but not under systematic processing.

The judgment model of subjective well-being (JM-SWB)(Schwarz & Strack, 1999) relates specifically to the influence of mood on judgments of subjective well-being. This model was partly developed to explain the findings that mood bias was commonly found in "global" judgments about overall life satisfaction but often not in "domain specific" judgments such as health, neighbourhood or job satisfaction (Schwarz & Strack, 1999; Schwarz et al., 1987). In this model, global judgments are argued to be more complex because they contain many more dimensions than domain specific judgments. This additional complexity is said to promote a heuristic processing strategy to simplify the judgment, and thus mood is used as information in making global life satisfaction judgments. A distinguishing feature of this model is that mood is only predicted to be used as information if the affective state is informative. If the affective state can be attributed to something other than the judgment target, mood will not be used as information. In this case, more systematic processing is predicted with no accompanying mood bias.

Finally, the affect infusion model (AIM)(Forgas, 1995) is a meta-theory which integrates a variety of findings and theoretical perspectives relating to the influence of mood on judgments. This meta-theory covers four information processing strategies employed in making judgments, and predicts which processing strategy will be employed based on features of the situation, the judgment target and the judge. Mood bias (or affect infusion) is associated with both heuristic processing and systematic processing (called substantive processing). Little or no mood bias is associated with the other two processing strategies (direct access and motivated processing). With the direct access processing strategy, people are assumed to quickly access well known prior judgments with little additional thought. And with the motivated processing strategy, a desired outcome is assumed to drive the judgment process.

In AIM, the affect-as-information cognitive mechanism is hypothesised to underlie mood bias in heuristic processing, while the affect priming cognitive mechanism underlies mood bias in systematic processing. However, systematic processing is seen as the most common processing strategy, and affect-priming is seen as the main cognitive mechanism underlying mood bias (Forgas, 1995, 2002b).

However, the JM-SWB assumes affect-as-information is the cognitive mechanism underlying mood bias in subjective well being (Schwarz & Strack, 1999). Forgas agrees that this is mostly likely the case and categorises mood bias in these judgments as an example of heuristic processing. However, Schwarz goes further by championing the affect-as-information cognitive mechanism as causing mood bias in a wide variety of judgments (Schwarz, 2002). This has given rise to a debate about which cognitive mechanism is the main cognitive mechanism underlying mood bias. And apart from any academic interest in resolving this debate, determining underlying cognitive mechanisms has implications for reducing mood bias. For example, mood bias from affect priming may be reduced by thinking less about a judgment, while mood bias from affect-as-information may be reduced by thinking more about a judgment.

The Debate

Forgas (1995; 2002a; 2002b) suggests the affect-as-information cognitive mechanism is limited to heuristic processing and thus limited to situations in which respondents have little motivation or time to engage in elaborative processing. At the same time, he suggests that most judgments require more extensive and elaborative processing which involves affect priming.

Schwarz (2002) on the other hand argues that affect informs a wide variety of judgments which may become biased if mood is misattributed to the judgment target.

Schwarz (2002) believes that part of the problem is that AIM is theoretically over-determined because the affect-as-information cognitive mechanism and affect priming cognitive mechanism both predict mood bias, and as such, either can be inferred from mood bias. For example, in complex life satisfaction judgments, affect-as-information processing can be inferred from mood bias by arguing that people use their mood as a heuristic to avoid cognitive effort. However, affect priming can also be inferred from mood bias in life satisfaction judgments by arguing that the mood bias is a result of biased memory recall. This problem arises because these cognitive mechanisms can only be inferred, not measured directly.

Evidence for each cognitive mechanism has been put forth by one and discounted by the other. Forgas (2002a; 2002b) believes a wide range of evidence supports the prevalence of affect priming. In these two articles, Forgas puts forth evidence from many studies that show higher mood bias in more complex judgments is associated with longer response times, better recall of target features, and more thoughts listed. He argues that this evidence supports the view that affect priming is primarily responsible for mood bias. Schwarz argues that these findings in no way necessitate affect priming. An equally plausible explanation is that people think more and longer with complex judgments, but eventually rely on an affect- as-information to form the basis of their judgment because of the judgment complexity (Schwarz, 2002).

Schwarz believes that misattribution studies provide the "acid test", and that they show that affect-as-information is the primary cognitive mechanism underlying mood bias. In misattribution studies, mood bias disappears when people attributable their mood to something other than the judgment target (e.g., Clore et al., 1994; Schwarz & Clore, 1983, Experiment 2; Sinclair, Mark, & Clore, 1994). Schwarz argues that people see their mood as information, but can discount this information when they have reason to believe that their mood is caused by something other than their response to the judgment target. However, Forgas says "I strongly disagree. Manipulations that call attention to the source of people's moods can of course reverse mood congruent effects, *howsoever* mood congruency was initially caused" (Forgas, 2002b, p. 97, emphasis added). To support his claim, Forgas (2002b) cites some recent work by Berkowitz (2000) which shows mood bias disappears when people simply focus on their mood, and Forgas argues that this shows that misattributions are not necessary for the mood bias to disappear. He believes that mood bias disappears because of a post judgment adjustment, which occurs regardless of the underlying cognitive mechanism. Thus both Schwarz and Forgas discount the evidence of the other when supporting their claims.

Of course, neither Schwarz nor Forgas suggest that affect-as-information and affect priming cognitive mechanisms are mutually exclusive, even though they are often presented as alternative mechanisms. For example, Chaiken and Maheswaran (1994) found that heuristic processing can bias systematic processing when information is ambiguous, and Petty and Schumann (1993) found that mood can bias both heuristic and systematic processing. Additionally, Clore and Tamir (2002) hypothesise that output from one processing strategy can act as input for another. Notwithstanding some evidence that heuristic and systematically processing strategies are not mutually exclusive, there is still exists a debate as to which cognitive mechanism - affect-as-information or affect priming - is primarily responsible for mood bias in judgments. This study aims to inform this debate.

A New Approach

This study takes an innovative and new approach to identifying the main cognitive mechanism underlying mood bias. There is a dispute between the proponents of affect-as-information and affect priming over their methodologies, and a different methodology is required which is as yet undisputed and which can reveal both cognitive mechanisms. However, having such a methodology is not sufficient to show that one or the other cognitive mechanism is the "main" cognitive mechanism. For example, only weak evidence would be found for the wide spread prevalence of a particular cognitive mechanism if evidence for that cognitive mechanism was found in a situation where it was expected to dominate. A much stronger test for the wide spread prevalence of that cognitive mechanism is to test for its prevalence in a situation and judgment where that cognitive mechanism is not expected to dominate. Carrying out this stronger test with an undisputed methodology is the novel approach taken in this study

Sedekides (1995, Experiment 4) used a methodology which is as yet undisputed and which has the potential to reveal both affect-as-information and affect priming. In this experiment, affect priming was demonstrated by manipulating mood and cognitive elaboration. In the low cognitive elaboration condition, response times were limited to 5 seconds. And in the high cognitive elaboration condition, response times unlimited, but more importantly cognitive elaboration was forced via a series of thought provoking and self-reflective questions before making several self-evaluative judgments. Mood bias was found to be significantly higher in the high elaboration condition, and since the quantity of thoughts was directly manipulated, affect priming was inferred.

In this case, it is difficult to argue that the affect-as-information cognitive mechanism was responsible for the increase in mood bias from the low to the high cognitive elaboration condition. This would mean postulating that affect became more important as a source of information with cognitive elaboration which is difficult to justify. In fact, quite the opposite would be expected with affect-as-information. If mood bias had decreased with cognitive elaboration, affect-as-information could have been inferred by arguing that affect was used as a heuristic in low cognitive elaboration due to time pressure, but not in high cognitive elaboration when there was no time pressure. If this happened to be the case, then affect priming could not have been inferred. Therefore, we have a methodology that can safely infer both affect-as-information and affect priming cognitive mechanisms.

Next, a judgment and situation is needed where one cognitive mechanism is expected to dominate over the other. The affect-as-information cognitive mechanism can be expected to dominate in surveys of life satisfaction. There are a number of reasons for this. Affective states are seen as relevant information for judgments about life satisfaction. For example, in the Australian population, asking how satisfied someone is with their life is often synonymous with asking someone how happy someone is with their life (Headey & Wearing, 1992). Also, life satisfaction, positive affect and negative affect are closely related since these three constructs have been empirically validated as three underlying dimensions of subjective well-being (e.g., see Diener, Suh, Lucas, & Smith, 1999; Vitterso & Nilsen, 2002). And finally, completing a survey is a relatively low motivating task, and this favours heuristic processing (Chaiken, 1980; Maheswaran & Chaiken, 1991) and the affect-as-information cognitive mechanism.

Perhaps most importantly, both Schwarz and Forgas have hypothesised that the mood bias in life satisfaction judgments is associated with heuristic processing, which relies on the affect-as-information cognitive mechanism (Forgas, 1995; Schwarz & Clore, 1983; Schwarz & Strack, 1999; Schwarz et al., 1987). Notwithstanding this, Forgas (2002b) has recently suggested that affect priming could also explain mood bias in life satisfaction judgments. For example, since life has many aspects, people may experience affect priming when thinking about the various aspects of their lives in forming a life satisfaction judgment.

In summary, the *general* research question investigated in this thesis is whether there is a main cognitive mechanism underlying mood bias in judgments. This question is the subject of current debate, and a novel approach is taken to assist in answering this question (i.e., selecting a judgment and situation where one cognitive mechanism is expected to dominate and testing for the prevalence of the other). The rationale for this approach is that for one cognitive mechanism to be considered the "main cognitive mechanism", it should be present even where the other cognitive mechanism is expected to dominate. In this study, life satisfaction was chosen as a judgment because the affect-as-information cognitive mechanism was expected to dominate, and the prevalence of affect priming was tested. In other words, the proposition that affect priming is a main cognitive mechanism is being tested. This study uses a methodology where mood and cognitive elaboration are manipulated because this methodology can reveal both the affect-as-information and the affect priming cognitive mechanisms. The *specific* research question in this study is whether affect priming is prevalent in life satisfaction judgments. Thus, the hypotheses below reflect affect priming in life satisfaction judgments.

The Current Study

The current study manipulated both mood (negative/positive) and cognitive elaboration (low/high) to show mood bias and the underlying cognitive mechanisms associated with life satisfaction judgments. Mood was manipulated as a between groups factor and cognitive elaboration as a within subjects factor using a mixed design. Ideally, a fully factorial between groups design would have been employed to avoid any order effects. However, results from power analyses suggested that the required sample size to achieve power equal to 80 percent in a such a design would be too large for an honours project. (see Appendix A). Thus, due to time and sample size constraints associated with an honours project, a mixed design was adopted and cognitive elaboration was chosen as the within subjects factor.

Mood was chosen as the between groups factor to minimise the chance of respondents becoming aware that mood was being manipulated, and thereby minimising the chance that life satisfaction ratings would be adjusted in response. Misattribution studies have shown that people adjust life satisfaction ratings in response to awareness that their mood is being influenced by irrelevant stimuli (e.g., Abele & Gendolla, 1999; Schwarz & Clore, 1983).

Choosing cognitive elaboration as the within subjects factor meant that the order of the conditions needed to be fixed: low cognitive elaboration followed by high cognitive elaboration. The order could not be counter-balanced because after a respondent has thought for some time about a judgment (high cognitive elaboration), they can not subsequently make a judgment where they have thought little about the same judgment (low cognitive elaboration).

However, fixing the order of these cognitive elaboration conditions introduces the possibility of order effects. One possible order effect is that the effect of the mood manipulation may weaken over the course of the experiment and the strength of mood may be less in the second cognitive elaboration condition. To counter this, the mood manipulation was conducted twice in this experiment, once before the low cognitive elaboration condition and once before the high cognitive elaboration condition.

Using this repeated mood manipulation approach is novel . In support of this approach, Hernandez, Vander Wal, and Spring (2003) tested to see whether repeated administrations of mood induction procedures on the same participants also weakens the strength of that mood induction over time. Their study did not find this. They held 6 trials on separate days over two weeks where each trial involved two mood induction methods: music and autobiographical memory. Similarly, in another study by Bradley, Cuthbert and Lang (1996), participants did not habituate to repeated exposure of pictures of the same affective valence.

However, because there have been relatively few studies using repeated mood manipulations, a statistical control measure was also included. Mood was measured after each mood induction activity so that any differences in effects between the first and second induction could be controlled statistically.

Another possible order effect is that participants may remember their responses in the low elaboration condition and use this information when responding in the high elaboration condition. Placing an additional mood manipulation before the high cognitive elaboration condition also serves to minimise this carry over effect by engaging the participants in another activity. Any remaining carry over effects from remembering past responses would have a conservative impact on the hypotheses in this study by working against finding affect priming in life satisfaction judgments.

The Hypotheses

First, it was hypothesised that there would be mood bias in life satisfaction judgments (H1). More specifically, that there would be a main effect of mood such that life satisfaction would be higher in the positive mood condition than the negative mood condition (see Figure 1). Second, affect priming in life satisfaction judgments was hypothesised (H2). That is, it was expected that the mood bias in life satisfaction judgments would be greater under high cognitive elaboration than under low cognitive elaboration. In other words, a two way interaction between mood and cognitive elaboration was hypothesised such that with cognitive elaboration, life satisfaction would increase for those in the positive mood condition and decrease for those in the negative mood condition (see Figure 2).

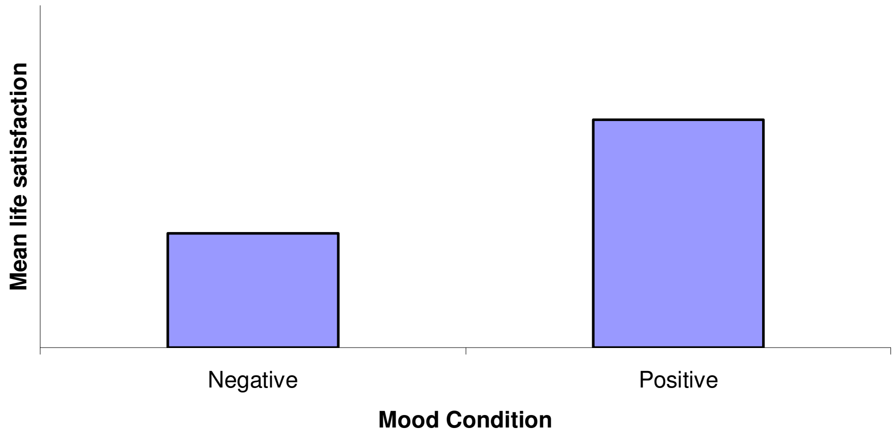

Figure 1. Hypothesised mood bias in life satisfaction judgments (H1)

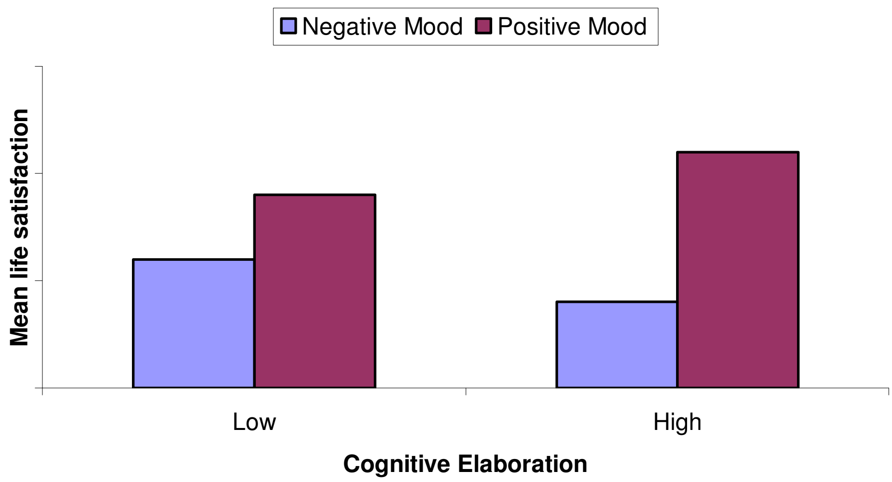

Figure 2. Hypothesised affect priming in life satisfaction judgments (H2)

The third hypothesis related to individual differences. As mentioned, one strength of the elaboration likelihood model is that it incorporates individual differences in need for cognition

(NFC) and it has been found that individuals high in NFC are more likely to engage in cognitive elaboration than those low in NFC (Cacioppo et al., 1986). Therefore, it was expected that the cognitive elaboration manipulation would induce more thoughts in those with high NFC than in those with low NFC. Accordingly, it was hypothesised that there would be more affect priming in those with high NFC than in those with low NFC (H3). In other words, a three way interaction was expected between mood, cognitive elaboration and NFC such that with cognitive elaboration, life satisfaction would increase for those in the positive mood condition and decrease for those in the negative mood condition, but that this effect would be greater for those high in NFC (see Figure 3 & 4).

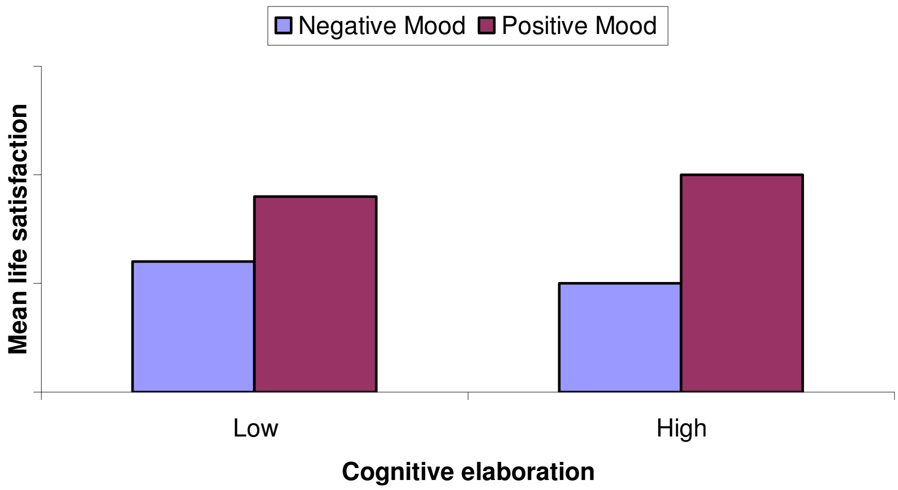

Figure 3. Hypothesised lower affect priming with low need for cognition (H3a)

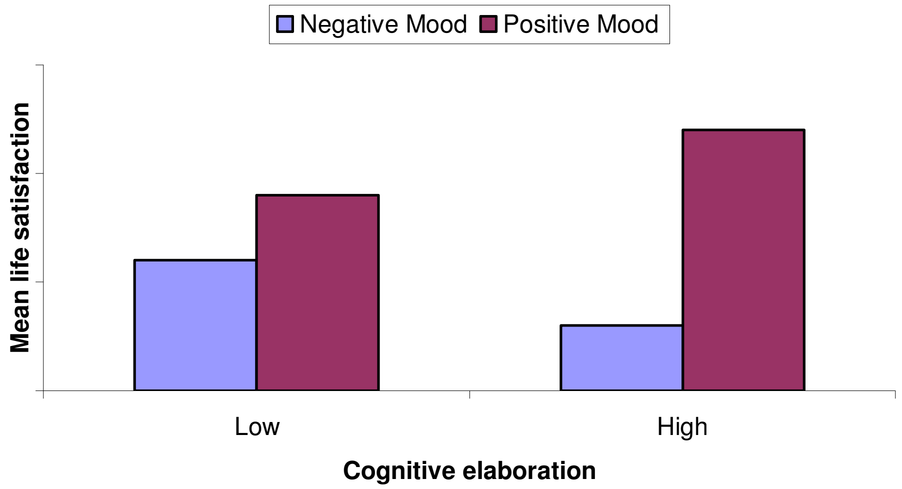

Figure 4. Hypothesised greater affect priming with high need for cognition (H3b)

Method

Participants

There were 86 participants (26 males and 60 females), all of who were first year psychology students at an Australian university participating for course credit. Their ages ranged from 16 to 42 (mean = 19.98, SD = .47) with over 90 percent of participants being 25 years of age or less. These participants were randomly allocated to either the positive or negative mood condition.

Design

The design was a 2 x 2 mixed design with mood (negative/positive) as the between groups factor and cognitive elaboration (low/high) as the within subjects factor. The dependent variable was life satisfaction.

Materials

Life satisfaction. Respondents were asked "How would you describe your satisfaction with your life as a whole" and they responded on six rating scales such as very poor/very good, exceptional/ordinary (reverse coded), and completely dissatisfied/completely satisfied. Each scale ranged from one to seven and was anchored at each end with one word from a word pair. The responses on the six scales were averaged to form a life satisfaction measure, with higher scores reflecting higher life satisfaction.

The scale was developed for this study because existing scales of life satisfaction were unsuitable for this experiment. Single item measures of life satisfaction have only moderate levels of reliability and validity (Diener, 1984); multi-item measures either included questions on affective state (which would confound the mood manipulation) or related to geriatric populations;

and measures including questions on satisfaction in various life domains facilitated cognitive elaboration (which would weaken the cognitive elaboration manipulation). See Diener (1984) for a review of 16 subjective well-being scales.

The life satisfaction measure developed for this study was pre-tested as part of a pilot study where a short survey was given to a convenience sample of 40 persons at a university refectory. The life satisfaction question was followed by a question asking them to list any thoughts they had while answering the life satisfaction question (see Appendix E). The wording and scoring for the thought listing question followed the protocol outlined in Cacioppo and Petty (1981). The life satisfaction measure had high internal reliability (α=.88) and there was evidence for convergent and divergent validity by being positively correlated with the number of positive thoughts about life (r = .35, $p < .05$), negatively correlated with the number of negative thoughts about life (r = .35, $p < .05$) and not correlated with the number of unrelated thoughts about life (r = .06, *ns*).

In the main study, the life satisfaction also had high internal consistency at time 1 and time 2 (α=.92 and α=.96 respectively) and good test-retest reliability between time 1 and time 2 (r = .79), especially considering these measures at time 1 and time 2 were taken under different cognitive elaboration conditions.

International Affective Picture System: digitized photographs. (IAPS; Lang, Bradley, & Cuthbert, 1999): Pictures from the IAPS were used to manipulate participants mood by viewing either 60 pleasant or 60 unpleasant pictures. The IAPS consists of over 700 photographs which have all been rated on three dimensions of affect (valence, arousal and dominance) using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The SAM consists of a facial scale ranging from 1 to 9 for each dimension. For example, ratings of pictures on the valence dimension were from 1 (a frowning unhappy face) to 9 (a smiling happy face).

The IAPS has very good psychometric properties. The split-half reliabilities for the valence and arousal dimensions are very high for both paper and computer administrations of the SAM, all *r*'s over .92 (Lang et al., 1999). Also, the ratings of IAPS pictures using the SAM are highly correlated with ratings of the same pictures using semantic differential scales (Bradley & Lang, 1994), as well as being highly correlated with a range of physiological measures of emotional response (Greenwald, Cook, & Lang, 1989). In addition, presentation of a series of IAPS pictures with the same affective valence does not lead to habituation (Bradley et al., 1996).

Using the IAPS to manipulate mood has a number of advantages. First, it is a standard mood manipulation procedure which can be easily replicated in future research, compared with the many ad hoc mood manipulations used previously in life satisfaction research. Second, administering the manipulation is relatively simple by using a PC to display each picture for a set length of time, as compared with more elaborate manipulations such as setting up pleasant and unpleasant rooms for participants (Schwarz et al., 1987) or contacting participants on sunny and rainy days (Schwarz & Clore, 1983, Experiment 2). And third, pictures can be selected to minimise any contrast effects.

As mentioned in the introduction, contrast effects in life satisfaction judgments occur when negative mood inducing stimuli are associated with *more* favourable judgments (and visa versa) because the stimuli serves as a standard of comparison (e.g., Abele & Gendolla, 1999; Schwarz & Strack, 1999; Schwarz et al., 1987, Experiment 2). For example, while a picture of a burnt *animal* in a bush fire may make people feel sad and cause negative bias in life satisfaction judgments, a picture of a burnt *person* in a bush fire may make a people feel sad but cause a positive bias in life satisfaction judgments because people consider themselves lucky in comparison. To avoid any pictures that may evoke such comparisons, any pictures with people in them were excluded, as were any pictures seen to be related to any of the most commonly studied life satisfaction domains (for a list of these domains, see Lance & Sloan, 1993; Michalos, 1985). This involved excluding pictures such as beautiful and dreary homes (housing domain), cigarette butts (health domain), and money (standard of living domain). Fortunately, this picture selection process also served to exclude a range of pictures that may have been less ethical to show (e.g., bodily mutilations, rape scenes, death from gross violence, and erotica).

The final sets of pictures used in this study were obtained by ranking the remaining pictures by their valence score and selecting the top 60 and bottom 60 pictures, and these pictures provided the stimuli for the positive mood and negative mood conditions respectively. Those in the positive condition included pictures such as cute animals, beautiful flowers and landscapes, and delicious food. And those in the negative condition included pictures such as dangerous, sick and dead animals, spoiled food, traffic, pollution and garbage. See Appendix B for a full list of the pictures used in this study. Each picture has a published average score on each of three dimensions: valence, arousal and dominance (Lang et al., 1999). Table 1 shows descriptive statistics for pictures used in the positive and negative mood conditions on the three dimensions, as rated on the 9 point SAM scales. The average valence score for pictures in the positive condition was significantly higher, or more pleasant, than the average valence score for pictures in the negative condition, t (118) = 11.75, $p < .05$. There was no significant difference in average arousal scores for the two sets of pictures, t (118) = 1.46, *ns*. However, pictures in the negative condition were rated as more dominating than pictures in the positive condition, t (118) = 3.62, $p < .05$.

Table 1

Descriptive statistics for pictures in the mood manipulation

Mood condition	Valence Mean (SD)	Arousal Mean (SD)	Dominance Mean (SD)
Positive	7.33 (1.59)	5.03 (2.13)	4.58 (2.21)
Negative	3.80 (1.70)	4.43 (2.37)	6.03 (2.17)

Positive and Negative Affect Scale. (PANAS; Watson, Clark and Tellegen., 1988): The PANAS measures affect on two dimensions: positive affect (PA) and negative affect (NA). The brief "moment" measure was used which has 10 items on each dimension, each item relating to different emotions (e.g., distressed and irritable for NA; proud and inspired for PA). The respondents were asked to what extent they feel this way at right now (i.e., at the present moment) and answered on a scale from 1 (very slightly or not at all) to 5 (extremely).

A study by Watson et al. (1988) showed that both PA and NA were reliable and valid. For the moment measure, PA and NA were both internally reliable, with coefficient alphas of .89 and .85, respectively. However, the test-retest reliabilities after eight weeks for the "moment" measure were much lower (r = .54 and .45, respectively) which is understandable for a state measure. NA showed convergent validity by being positively correlated with various versions of the Hopkins Symptom Checklist (HSCL), The Beck Depression Inventory (BDI), and the State Anxiety Scale (A-State), the correlations ranging from .51 to .74. PA showed discriminant validity by negatively correlating with these same measures, ranging from -.19 to -.36. The study also showed that the PA and NA dimensions are relatively independent, being correlated around .20 on average.

Cognitive elaboration questions. Seven questions taken from Michalos (1985) were used to encourage thought about one's life, and formed the basis of the high cognitive elaboration manipulation. For example, "How does your satisfaction with life measure up to your general aspirations or what you want?" and "How does it measure up to the average for most people your own age (i.e., your peers)" (Appendix C).

These questions were based on Multiple Discrepancies Theory (Michalos, 1985) which hypotheses that satisfaction judgments involve making comparative evaluations between one's own life and one's peers, what one deserves, what one needs, what one expected to have, what one expects to have in the future, the best one has had, what one wants. In support of using these questions to induce cognitive elaboration in life satisfaction judgments, responses to these questions have been shown to effectively predict life satisfaction judgments (e.g., Cohen, 2000; Lance, Mallard, & Michalos, 1995; Michalos, 1985).

In the low elaboration condition, participants were not given these cognitive elaboration questions to induce additional thoughts about life satisfaction. Instead, they were limited to a 5 second response time to rate their life satisfaction on each of six life satisfaction rating scales. If a participant had not entered an answer on a rating scale within 5 seconds, the PC displayed the message "Please answer as best you can NOW".

Need for Cognition Scale. (NCS; Cacioppo & Petty, 1984): The NCS is a single scale measure of a person's tendency to enjoy and engage in cognitive effort. The short form was used which comprised of 18 items where participant responded to statements on a 7 point scale from disagree strongly to agree strongly. Higher NCS scores indicate higher need for cognition (NFC).

In a review of over 100 studies using the NCS (Cacioppo, Petty, Feinstein, & Jarvis, 1996), the Cronbach alphas were typically over .85, and many examples were provided of convergent and divergent validity. For example, NCS is positively correlated with openness to ideas, information oriented identity style, and attributional complexity (all *r*s over .35), and is negatively correlated with the closed mindedness, diffuse-avoidant-oriented identity style, and causal uncertainty (all *r*s over -.34).

Procedure

Participants were read a cover story (see Appendix D) where they were told that they were participating in two studies. The mood manipulation was portrayed as a memory study which involved looking at pictures and later remembering whether they had seen the pictures before (i.e., the mood manipulations at time 1 and time 2). The surveys were portrayed as pre-testing a short and long version of a quality of life survey (i.e., the life satisfaction judgments under low and high cognitive elaboration conditions).

First, participants were shown pictures associated with their mood condition, each being displayed consecutively on a PC screen for three seconds each. Second, they completed the "short version of the quality of life survey" (low cognitive elaboration), which included the PANAS and the life satisfaction measure, but did not include the cognitive elaboration questions. Answers to these life satisfaction questions were limited to 5 seconds. These first two phases constituted time 1.

Next, they viewed the exact same pictures again for three seconds each, though this time they also pressed either a "yes" or "no" button with the mouse to indicate whether they thought they had seen the picture before. These buttons were part of the cover story for the "memory study" and had no other function. Then they completed the "long version of the quality of life survey", which included the cognitive elaboration questions, and they were explicitly told that there were no time limits on their responses. These last two phases constituted time 2.

This order for the experiment enabled the second mood manipulation to act as an intervening task between the two surveys to reduce carry over effects, and allowed the mood manipulation to be administered prior to both the low and high cognitive elaboration conditions. However, the cover story simply stated that this order was followed so that both studies could act as intervening tasks for the other (see Appendix D).

At the end of the session, participants were asked to answer “yes” or “no” to the following question. “We would like your feedback on combining the memory study and the quality of life studies together. Do you think that these had any significant impact on each other, besides acting as intervening tasks for each other?”. The cover story was deemed to have worked for those answering “no”. Those answering “yes” were asked to provide further comment. Of these, two were thought to be aware that mood was being manipulated and were excluded from any analysis, leaving an effective sample size of 84. Finally, the participants were debriefed, thanked, and those in the negative mood condition were invited to view the positive mood inducing pictures before leaving.

Contributions

This research project was chosen by myself in an area outside the normal research area of my supervisor. As such, I played the lead role in this project with my supervisor, Len Dalgleish, playing a supporting and advisory role in all phases of the research.

I was primarily responsible for reviewing the literature, developing the research question and hypotheses, and formulating the rationale behind the novel approach to investigating the research question. I was also primarily responsible for the following tasks: designing the cognitive elaboration manipulation and the mood manipulation, developing the life satisfaction measure, developing and conducting a pilot survey to validate the cognitive elaboration manipulation and the life satisfaction measure, incorporating design features to minimise carry over effects for life satisfaction judgments and to maintain manipulated mood (Len advised on statistically controlling for any changes in mood), specifying the PC program, inventing the cover story, and data collection. I conducted most of the data analysis (with substantial input from Len), and the thoughts in the general discussion section on the implications for theory, study limitations and future areas of research are my own.

Len Dalgleish provided valuable support and advice, in particular, with guidance on the power analysis, simple slopes analysis, generally talking through the results and suggesting further analyses, with advice on writing up the results section, and also with valuable suggestions on structuring the thesis and presenting the material with the reader in mind.

Results and Discussion

Manipulation Checks

Cognitive elaboration manipulation. Since the cognitive elaboration manipulation was new, it was tested in the pilot study which used a convenience sample of 40 persons at a university refectory, and randomly allocated persons to low and high cognitive elaboration conditions. Those in the low cognitive elaboration condition completed a survey which included the life satisfaction measure (with an instruction not to spend any more than 5 seconds on each rating scale), followed by a question asking them to list any thoughts they had while answering the life satisfaction question (see Appendix E). As mentioned, the wording and scoring for the thought listing question followed Cacioppo and Petty (1981). The total number of thoughts about life was the sum of positive and negative thoughts about life. Those in the high cognitive elaboration condition completed a similar survey which included the cognitive elaboration questions to induce more thoughts about life, the life satisfaction measure (with no instructions about time limits), and the thought listing question. Both surveys finished with the need for cognition measure (NFC), which was included to test whether the cognitive elaboration manipulation had a greater effect on those with high NFC compared to those with low NFC.

The distribution of the number of thoughts about life was significantly positively skewed, $Z = 2.70$, $p<.05$ and a square root transformation was performed so that skewness was not significant, $t(38) = -.61$, ns. However, since the substantive interpretations of the analysis were the same using the original and transformed variables, results using the original variable are reported.

A moderated regression was used to test the cognitive elaboration manipulation with the number of thoughts about life as the criterion, and with cognitive elaboration (low/high) and NFC as the predictors. The cognitive elaboration manipulation was successful. There was a main effect of cognitive elaboration on the number of thoughts about life such that there were significantly more thoughts about life in the high cognitive elaboration condition than the low cognitive elaboration condition, $b = 2.53$, $t(36) = 2.65$, $p<.05$. This main effect uniquely explained 16 percent of the variance in the number of thoughts about life ($sr^2=.16$). There was no main effect of NFC, $b = -.01$, $t(36) = -.10$, ns , nor a significant two-way interaction between cognitive elaboration and NFC, $b = .12$, $t(36) = 1.97$, ns. However, the two-way interaction approached significance (p=.06, $sr^2 = 8.88\%$). This implies a tendency for those with high NFC to have more thoughts than those with low NFC in the high cognitive elaboration condition. For illustrative purposes, this tendency is shown in Figure 5 using group means and a mean split for NFC.

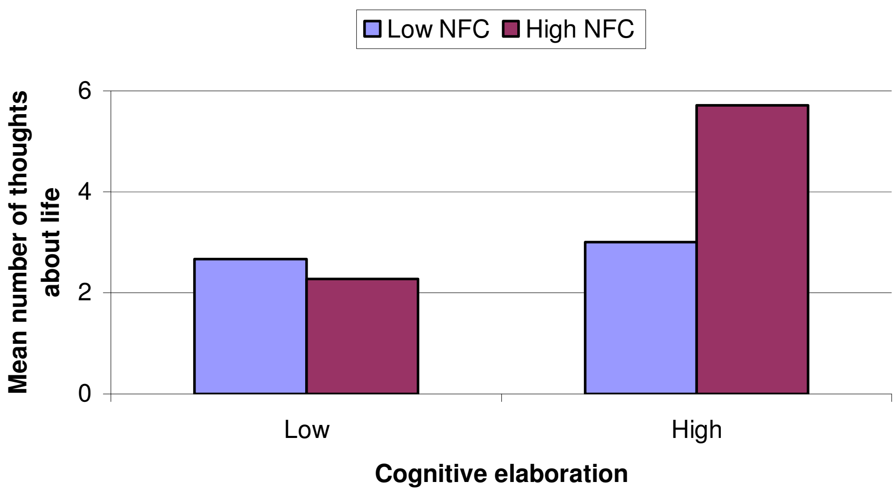

Figure 5. Thoughts about life by cognitive elaboration and need for cognition.

Mood manipulation. The mood manipulation check was conducted on the sample data (N = 84) using the Negative Affect (NA) and Positive Affect (PA) measures as dependent variables. The distribution of PA for both time 1 and 2 were normal, though NA was positively skewed at time 1 and time 2, *Z* = 5.90, *p*<.05 and *Z* = 10.89, *p*<.05, respectively. However, the substantive interpretations of the analysis did not change using transformed measures of NA, and thus, the results are reported using the original variable.

Independent group t-tests were conducted to test for differences in affect between the positive and negative mood conditions. As expected, Table 2 shows that the means for NA were higher for those in the negative mood condition than for those in the positive mood condition, while the means for PA were higher for those in the positive mood condition than those in the negative mood condition. These differences were significant for NA at time 1 and time 2, *t*(82) = 3.74, *p*<.05 and , *t*(82) = 3.75, *p*<.05, respectively. However, they were not significant for PA at time 1 and time 2, *t*(82) = -.64, ns and *t*(82) = -1.30, ns, respectively. Therefore, there was only partial support was found for an effective mood manipulation. While the differences between means were in the expected directions, these differences were only significant for NA. They were not significant for PA.

Table 2

Means and (standard deviations) for negative affect and positive affect in the negative and positive mood conditions

	Negative affect		Positive affect	
Mood condition	Time 1	Time 2	Time 1	Time 2
Negative	1.93 (0.75)	1.81 (0.91)	4.10 (1.13)	3.77 (1.38)
Positive	1.41 (0.50)	1.25 (0.36)	4.26 (1.18)	4.16 (1.43)

Because the study was conducted over 30-40 minutes, checks were also conducted for a possible weakening of the mood manipulation over time. Repeated measures t-tests were conducted to test for differences between time 1 and time 2 in both PA and NA for each of the mood conditions. PA at time 1 (M = 4.18) was significantly higher than PA at time 2 (M = 3.96), $t(83) = 3.34$, $p<.05$. Similarly, NA at time 1 (M = 1.68) was significantly higher than NA at time 2 (M = 1.54), $t(83) = 3.43$, $p<.05$. Thus, even though the mood manipulation was repeated half way through the experiment, average levels of PA and NA declined a small but significant amount over the course of the experiment.

Therefore, in the following analyses, changes in PA and NA between time 1 and 2 were controlled for statistically. The control variables used were PA at time 1 less PA at time 2 (padiff) and NA at time 1 less NA at time 2 (nadiff). Both of these difference scores were normally distributed.

Mood Bias and Life Satisfaction

ANCOVA with mood. To test all three hypotheses simultaneously, a 2x2x2 split-plot ANCOVA was conducted where the dependent variable was life satisfaction, the within subjects factor was cognitive elaboration (low/high), the between groups factors were mood (positive/negative) and also need for cognition (NFC) using a median split (low/high), and where the covariates were padiff and nadiff. H1 was that there would be mood bias (i.e., a main effect of mood on life satisfaction), H2 was that there would be affect priming (i.e., a two-way interaction between mood and cognitive elaboration on life satisfaction), and H3 was that there would be a individual differences in affect priming (i.e., a three-way interaction between mood, cognitive elaboration and need for cognition).

The distribution of the life satisfaction measure was found to be positively skewed at time 2, $Z = -4.18$, $p < .05$. However, the substantive interpretations of the following analyses did not change when using transformed measures of life satisfaction. Therefore, the results for the original measure are reported.

The 2x2x2 split-plot ANCOVA showed no main effect of mood on life satisfaction, $F < 1$; no two-way interaction between mood and cognitive elaboration on life satisfaction, $F < 1$; and no three-way interaction between mood, cognitive elaboration and NFC on life satisfaction, $F < 1$. Therefore, the analysis did not provide any support for mood bias in life satisfaction judgments (H1), nor affect priming (H2) nor individual differences in affect priming (H3) (see Appendix F for SPSS output).

It was surprising that even H1 was not supported since a number of previous studies have found mood bias in life satisfaction judgments (Abele & Gendolla, 1999; Schwarz & Clore, 1983; Schwarz et al., 1987). One possible explanation is that the mood manipulation was not strong enough. An associated explanation is that even though the mood manipulation resulted in significant differences in NA, life satisfaction judgments are much more related to PA. Evidence supporting the second explanation can be found in Table 3 where life satisfaction correlates significantly with PA but not NA, and also from two other studies which have found much higher correlations of life satisfaction judgments with PA than NA (Heller, Judge, & Watson, 2002; Vitterso, 2001). Overall, this suggests that the mood manipulation in this study was not effective for inducing mood bias in life satisfaction judgments because PA was not effectively manipulated.

Despite a seemingly ineffective mood manipulation, there was support for a relationship between affect and life satisfaction as shown by the correlations in Table 3, especially between positive affect and life satisfaction. So while the *manipulated* mood may not have been useful in testing the hypotheses, the hypotheses were tested again using *measured* positive and negative affect.

Table 3

Correlations of life satisfaction, negative affect and positive affect

	Life satisfaction	
	Time 1	Time 2
Negative affect		
Time 1	-0.19	-0.14
Time 2	-0.14	-0.15
Positive affect		
Time 1	0.39**	0.32**
Time 2	0.32**	0.29**

Notes: ** denotes significant at the .01 level

With hindsight, the mood manipulation should have been pre-tested in another pilot study. However, this was not done due to time constraints and because of good reliability and validity evidence supporting the International Affective Picture System (IAPS). In addition, a study by Patrick and Lavoro (1997) using 60 IAPS pictures showed that pleasant slides were significantly different from unpleasant slides when rated on both NA and PA. It seems as if the particular slides used in the current study did not manipulate PA. In the study by Patrick and Lavoro (1997), the pictures producing the highest levels of PA were those of opposite sex nudes. However, in the current study, all pictures with people in them were excluded to avoid any possible contrast effects. For example, while positive affective responses are associated with viewing a nude of the *opposite* sex, negative affective responses are associated with viewing nudes of the *same* sex (Lang et al., 1999). However, it may have been possible to include opposite sex nudes if the PC program presenting the pictures were written so as to take into account the sex of the participant. By excluding all pictures with people in them, perhaps the mood manipulation in this current study was “too pure” and not effective in manipulating PA.

ANCOVA with measured affect. As mentioned, further analyses were undertaken using measured affect instead of manipulated mood since it seemed that the mood manipulation was not effective in regard to manipulating PA. Thus, the hypotheses about the effects on life satisfaction were tested again using PA and NA as independent variables. Separate analyses were run with PA and NA because it seemed that life satisfaction had a different relationship with PA than NA. Also, PA and NA are theorised as independent dimensions of affect. A split-plot ANCOVA analysis was re-run to test H1, H2 and H3. This required using median splits for PA, NA and need for cognition (NFC) with some associated loss in power.

A 2x2x2 split-plot ANCOVA was conducted where life satisfaction was the dependent variable, cognitive elaboration (low/high) was the within subjects factor, and where PA (low/high), and NFC (low/high) were between groups factors. PA was taken at time 2 because it was prior to cognitive elaboration, and differences in PA between time 1 and time 2 were controlled using padiff as the covariate. The analysis showed a main effect of PA on life satisfaction, F (1,79) = 9.12, $p < .05$, $\omega^2 = .10$. Those high in PA had higher life satisfaction (M = 5.72) than those low in PA (M = 4.92). This provided some support for mood bias in life satisfaction judgments (H1), though affect was measured rather than manipulated. The analysis showed no other significant effects. The analysis did not show a significant two-way interaction between PA and cognitive elaboration, F (1,79) = 1.15, *ns*. Thus, there was no support for affect priming in life satisfaction judgments (H2). There was also no significant three-way interaction between PA, cognitive elaboration and NFC, F (1,79) = 2.30, *ns*. Therefore, there was no support for individual differences in affect priming associated with need for cognition (H3). There was support for H1, but not H2 or H3 using positive affect as a measure of mood (see Appendix G for SPSS output).

The same analysis was conducted using NA at time 2 (low/high) and controlling for nadiff. The split-plot ANCOVA predicting life satisfaction with NA, cognitive elaboration and NFC did not find any significant effects. There was no main effect for NA on life satisfaction, F (1,79) = 2.95, *ns*. Neither was there a two-way interaction between NA and cognitive elaboration, $F < 1$; nor a three-way interaction between NA, cognitive elaboration and need for cognition, F (1,79) = 2.30, *ns*. Therefore, there was no support for mood bias (H1), affect priming (H2) or individual differences in affect priming (H3) using negative affect as a measure of mood (see Appendix H for SPSS output).

In summary, the ANCOVA analyses using affect measures provided some support for mood bias in life satisfaction judgments (H1), but only for positive affect. There was no support for affect priming (H2) or individual differences in affect priming (H3) in life satisfaction judgments.

Before concluding that no affect priming exists in life satisfaction judgments, another alternative explanation was checked. It is possible that affect priming was present though was not found because of a loss of power associated with dichotomising the positive affect, negative affect and need for cognition measures. To test for this possibility, a moderated regression analysis was undertaken using continuous measures for positive affect, negative affect and need for cognition.

Moderated regression analysis with measured affect. Moderated regression does not easily handle within subjects factors. To take into account cognitive elaboration as a within subjects factor, a difference score was created (lifediff) which was defined as life satisfaction in the high cognitive elaboration condition less life satisfaction in the low cognitive elaboration condition. This difference variable is the effect of cognitive elaboration on life satisfaction. Positive values for lifediff represent increased life satisfaction after elaboration, while negative values for lifediff represent decreased life satisfaction after elaboration. This measure was negatively skewed, $Z = 3.34$, $p < .05$. However, since the substantive interpretations were the same using the original and transformed measures, results using the original measure were reported.

Once again, separate analyses were conducted for positive affect and negative affect. However, only H2 and H3 could be tested using this analysis. Main effects of affect on life satisfaction relating to H1 could not be tested because the criterion variable lifediff was a combination of both life satisfaction and cognitive elaboration. This also means that the main effects and interactions in the moderated regression analysis are interpreted differently.

Main effects with lifediff are in fact interactions with cognitive elaboration on life satisfaction. Thus, a main effect of affect on lifediff reflects a two-way interaction between affect and cognitive elaboration on life satisfaction. This main effect relates to affect priming (H2). Similarly, a two-way interaction between affect and need for cognition on lifediff reflects a three-way interaction between affect, need for cognition and cognitive elaboration on life satisfaction. This interaction relates to individual differences in affect priming (H3). To illustrate this, Figure 6 represents a possible interaction between PA and NFC that would support H2 and H3. In this figure, the positive slopes represent affect priming (H2). That is, after cognitive elaboration, life satisfaction judgments increase for those high in PA and decrease for those low in PA. However, the effect of affect priming is greater for those high in need for cognition (H3) (i.e., the slope for those high in NFC is greater).

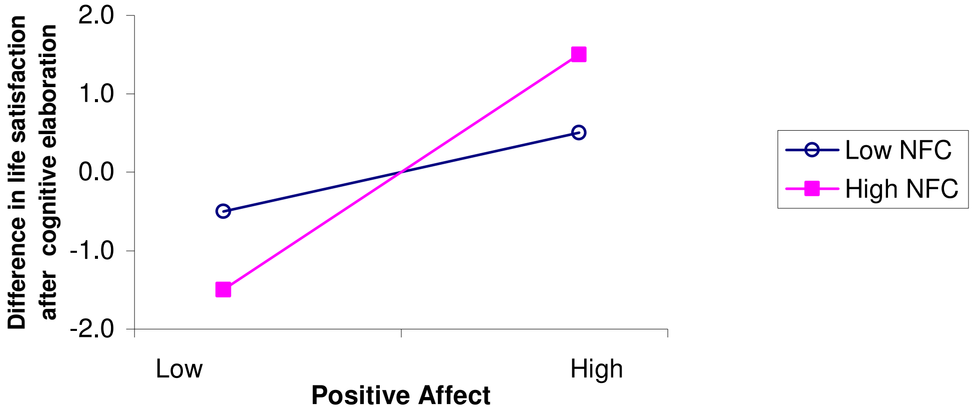

Figure 6. Example of an interaction which supports H2 and H3

Moderated regression with positive affect. Before conducting the moderated regression analysis with positive affect, data checks were conducted. This revealed no implausible values, missing values, multicollinearity problems or univariate outliers. After running the moderated regression analysis, further diagnostic checks were made. No multivariate outliers were found using Cook's distances; however, one multivariate outlier was found using Mahalanobis's distances ($p<.001$). A normal P-P plot of residual z-scores indicated that residuals were normally distributed with data points closely following the 45 degree diagonal; and a scatterplot of the z-scores for the predicted values and the residuals indicated homoscedasticity, with an oval pattern of data points reasonably equally distributed between the found quarters centred on the origin. In summary, the data checks only revealed only one concern with a multivariate outlier, which was excluded from the analysis, reducing the number of cases to 83.

This outlier affected the significance level of an interaction presented below such that the probability of a Type I error was over .05 (p = .07) when using a transformed lifediff variable and under .05 when using the original lifediff variable (p = .04). When the outlier was excluded from the analyses, the probabilities for a Type I error were under .05 for both the transformed lifediff (p = .04) and original lifediff (p = .03). The substantive interpretation of the interaction was the same with either the original and transformed measures of lifediff, so results for the original measure were reported. The multivariate outlier was excluded on the grounds that it was not considered part of the population reflected in the interaction, and this increased the variance explained by the interaction from 4.4 to 5.7 percent (sr^2 = .04 and sr^2 = .06, respectively).

Two moderated multiple regressions were performed, one using positive affect and one using negative affect. The first multiple regression used life satisfaction after cognitive elaboration (lifediff) as the criterion, and used positive affect (PA), need for cognition (NFC), and the interaction (PAxNFC) as predictors. PA and NFC were centred on the mean, and PA at time 2 was used. At the first step, the differences in PA between time 1 and time 2 were controlled by entering padiff. The predictors PA and NA were then added at step 2. Affect priming (H2) would be reflected with a significant positive regression co-efficient for PA. At step 3, interaction term was entered (PAxNFC). Support for H3 would be associated with a significant two-way interaction such as in Figure 6.

While the overall moderated regression model did not explain a significant amount of variation in lifediff, R = .27, R^2 = .07, adj R^2 = .02, F(4,78) = 1.49, p = .22, there was a significant interaction between PA and NFC, β = .24, t(78) = 2.18, p <.05. This two-way interaction explained an additional 6 percent of the variation in lifediff at the step 3, sr^2 = .06, R^2ch = .06,

$F(1,78) = 4.74$, $p < .05$. The focus in this analysis was on testing for specific interactions which use a single degree of freedom test rather than the overall model which uses 4 degrees of freedom in an omnibus test. In support this approach, Judd, McClelland, and Culhane (1995) argue that omnibus tests are not appropriate when testing for a particular effects within a model. So while most of the β coefficients in the model were not significant (see Table 4) and the omnibus test on the overall model was not significant, it was important for follow up the significant two-way interaction.

Table 4

Summary statistics from the moderated regression using positive affect

Predictors	β	*t* value	*p* value	sr^2
Step 1				
PAdiff	-0.16	-1.18	0.24	0.02
Step 2				
PA	-0.01	0.06	0.95	0.00
NFC	-0.04	-0.33	0.74	0.00
Step 3				
PAxNFC	0.24	2.18	0.03	0.06

Note: see Appendix I for SPSS output

As shown in Table 4, there was no main effect of PA, suggesting there was no affect priming in life satisfaction judgments (H2). However, the significant interaction between PA and NFC on lifediff was investigated further with a simple slope analysis to test for individual differences in affect priming (H3). The interaction is shown graphically in Figure 7. Even though the individual slopes for high and low need for cognition were not significantly different from zero, $b = .15$, $t(78) = 1.64$, *ns*, and $b = -.13$, $t(78) = -1.64$, *ns*, respectively, the overall interaction was significant which means that the slopes of the two lines were significantly different from each other

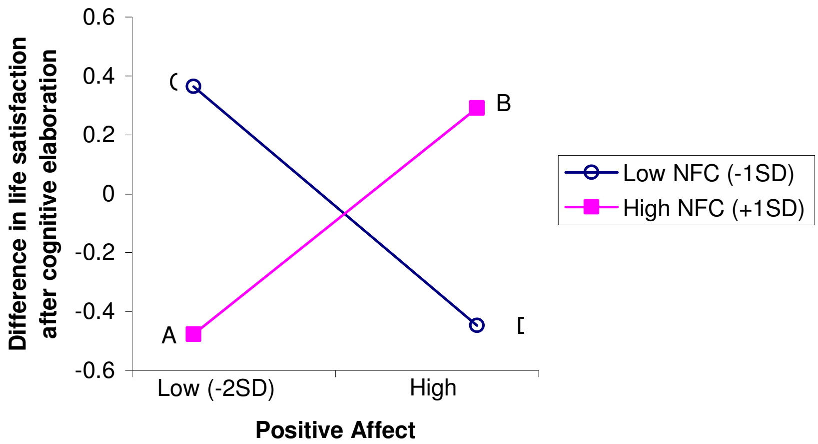

Figure 7. The interaction PA and NFC on the difference in life satisfaction after cognitive elaboration.

In Figure 7, the positive slope of AB supports affect priming for those high in NFC while the negative slope of CD supports affect-as-information for those low in need for cognition. Point A implies affect priming because life satisfaction decreased after cognition elaboration for those low in positive affect. Similarly, point B implies affect priming because after cognitive elaboration, life satisfaction increased for those high in positive affect. This is consistent with the affect priming account. That is, respondents with low positive affect experienced biased memory recall favouring negative life events when thinking more about their lives, while those high in positive affect experience biased recall favouring positive life events. Points C and D imply affect-as-information. Point C implies affect-as-information because life satisfaction increases for those low in positive affect after thinking more about their lives. Similarly, point D implies affect-as-information because life satisfaction decreases for those high in positive affect after thinking more about their lives. This is consistent with the affect-as-information account because with cognitive elaboration, the relative influence of PA as a heuristic (affect-as-information) is expected to decline as other relevant information to the judgment is considered.

Thus, this moderated regression analysis did provide qualified support for H2 and H3. There is evidence of affect priming in life satisfaction judgments (H2), but only for those high in need for cognition. There is also evidence that those high in need for cognition experience more affect priming than those low in need for cognition (H3). However, it appears that those low in need for cognition to not experience any affect priming. Rather, they appear to experience affect-as-information.

This interaction can be more easily viewed in the context of life satisfaction (rather than with differences in life satisfaction after cognitive elaboration). For illustrative purposes, the same interaction is represented in Figure 8 using life satisfaction. The estimates for life satisfaction *before* cognitive elaboration were from predictions of a moderated regression with life satisfaction at time 1 as the criterion and with PA at time 1, need for cognition (NFC) and the interaction (PAxNFC) as predictors. Estimates for life satisfaction *after* cognitive elaboration were calculated by taking the estimates before cognitive elaboration plus the difference scores in the interaction shown in Figure 7 (i.e., the difference in life satisfaction after cognitive elaboration). In Figure 8, the effect of cognitive elaboration is more easily visualised (i.e., increasing mood bias for those high in need for cognition and decreasing mood bias for those low in need for cognition).

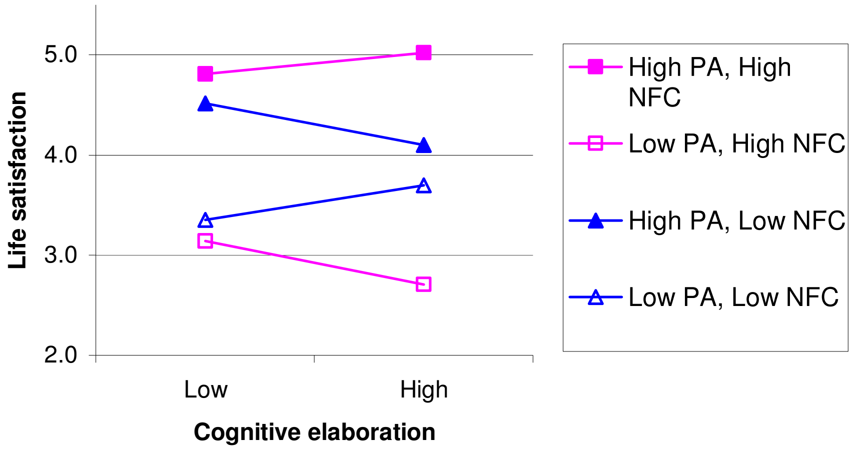

Figure 8. The interaction of cognitive elaboration, positive affect (PA) and need for cognition (NFC) on life satisfaction.

In Figure 8, the square markers represent those high in need for cognition while the triangle markers represent those low in need for cognition, and the filled markers represent those high in positive affect and unfilled markers represent those low in positive affect. For those low in need for cognition (the triangle markers), the affect-as-information cognitive mechanism is suggested because mood bias decreases with cognitive processing (i.e., the distance between the high and low positive affect markers decreases). Presumably, the influence of positive affect as a heuristic decreases after thinking more about their lives. For those high in need for cognition (the square markers) the affect priming mechanism is suggested because mood bias increases with cognition elaboration (the distance between the high and low positive affect markers increases) such that those low in positive affect have lower life satisfaction judgments after thinking more about their lives while those high in positive affect have higher life satisfaction judgments. Presumably, memory recall of past life events was biased by their affective state.

There are difficulties inferring mood “bias” when using *measured* PA rather than *manipulated* mood. For example, in Figure 8, life satisfaction is higher for those with high positive affect than for those with low positive affect, but the actual *level* of mood bias associated with this difference is unknown. However, *changes* in mood bias were able to be inferred from changes in life satisfaction between the low and high cognitive elaboration conditions. Thus mood bias was able to be inferred in the results.

Moderated regression with negative affect. Before conducting the moderated regression analysis with negative affect, data checks were conducted. Again, this revealed no implausible values, missing values, or multicollinearity problems. However, several multivariate outliers were found using Mahalanobis’s distances ($p<.001$) after running the analysis . The substantive interpretations of the analysis were the same when these outliers were excluded, so the results are reported with the outliers included.

The model specification was the same as for positive affect. The criterion was life satisfaction after cognitive elaboration (lifediff), and the predictors were negative affect at time 2 (NA), need for cognition (NFC), and the interaction (NAxNFC) as predictors. All predictors were centred on the mean, and differences in NA between time 1 and time 2 were controlled by entering padiff at the first step. The NA and NFC were then added at step 2, and the interaction term (NAxNFC) was entered at the third step. The overall model did not explain a significant amount of variation in lifediff, $R = .28$, $R^2 = .08$, adj $R^2 = .03$, $F(4,78) = 1.66$, $p = .17$, and there were no other significant effects (see Table 5).

Table 5

Summary statistics from the moderated regression using negative affect

Predictors	*β*	*t* value	*p* value	sr^2
Step 1				
NAdiff	0.12	1.02	0.31	0.01
Step 2				
NA	-0.07	-0.57	0.57	0.00
NFC	-0.07	-0.59	0.55	0.00
Step 3				
NAxNFC	0.19	1.18	0.11	0.03

Note: see Appendix J for SPSS output

As with previous analyses, negative affect was not associated with mood bias in life satisfaction judgments. This may be because of less variation in negative affect than positive affect. The standard deviations for positive and negative affect were 1.15 and .69, respectively at time 1; and 1.41 and .74, respectively at time 2. However, given that negative affect was successfully manipulated by the mood induction procedure and no effects for mood were found, it seems more likely that negative affect is not closely related to life satisfaction judgments. Previous research in life satisfaction judgments has not distinguished between positive and negative affect when investigating mood bias in life satisfaction judgments. Therefore, it is the first time that it has been suggested that mood bias in life satisfaction judgments relates to more to positive affect than negative affect. The findings even suggest that negative affect is not a cause mood bias in life satisfaction judgments.

Summary and General Discussion

Summary

This thesis examined the question of which main cognitive mechanism underlay mood bias (i.e., affect-as-information or affect priming). The novel approach taken to answer this question was to select a judgment and situation where one cognitive mechanism was expected to dominate and test for the prevalence of the other. The rationale was that for one cognitive mechanism to be considered the "main cognitive mechanism", it should be present even where the other cognitive mechanism is expected to dominate. This was a strong test which was needed for a strong claim. In this study, life satisfaction judgments and a low motivational environment were selected to test for affect priming because the affect-as-information cognitive mechanism was expected to dominate.

Initially, an ANCOVA using manipulated mood did not show support for any of the hypotheses. There was no mood bias on life satisfaction (H1), no affect priming (H2), and no individual differences in affect priming (H3). However, because there were doubts about the effectiveness of the mood manipulation, the same analyses was conducted again but with median splits on positive and negative affect. There was a main effect of positive affect on life satisfaction providing some support for (H1), but again, there was no evidence of affect priming (H2), nor individual differences in affect priming (H3). Finally, a moderated regression analysis was performed on the difference in life satisfaction after cognitive elaboration. This allowed for continuous measures to be used and for increased power to be applied to investigating whether affect priming existed in life satisfaction judgments. A two way interaction revealed individual differences in affect priming using the positive affect measure. There was evidence of affect priming for those high in need for cognition, and evidence for affect-as-information for those low in need for cognition. This provided qualified support for affect priming existing in life satisfaction judgments (H2), and support for individual differences in affect priming such that higher affect priming was associated with higher need for cognition (H3). The interaction also provided some support for H1 in that some mood bias in life satisfaction judgments was demonstrated. Overall, the results showed that life satisfaction was more related to positive affect than negative affect, and that the use of different cognitive mechanisms underlying mood bias in life satisfaction judgments depended on individual differences in need for cognition.

General Discussion

Mood bias is a pervasive phenomenon found in a wide variety of judgment domains such as persuasion, stereotyping, self-conceptions, risk judgments and life satisfaction judgments. The approach taken and the findings from this current study shed light on the *general* research question about which main cognitive mechanism underlies mood bias in judgments generally, as well as the *specific* research question about whether affect priming exists in life satisfaction judgments.

With regard to the general research question, there is no evidence of a “main” cognitive mechanism in surveys of life satisfaction where you would expect the affect-as-information cognitive mechanism to dominate. In this study, evidence was found for both cognitive mechanisms (affect-as-information and affect priming), depending on individual differences in need for cognition. Notwithstanding the small effect size of this interaction, it highlights the importance of individual differences in determining which cognitive mechanism is used. These findings suggest a change in approach from asking the research question about “which cognitive mechanism" is primarily responsible for mood bias, to asking the research question under "which circumstances" and for "which individuals" is each cognitive mechanism likely to be used.

With regard to the specific research question on mood bias in life satisfaction judgments, the findings were important because, for the first time, affect priming was tested for and found in life satisfaction judgments. Both cognitive mechanisms were found to be important in explaining life satisfaction judgments. Previously, affect-as-information was assumed to underlie life satisfaction judgments because of the low situational demand in surveys of life satisfaction. Low situational demands are associated with the affect-as-information cognitive mechanism and the heuristic processing strategy because of low cognitive motivation (Forgas, 1995). As Cacioppo et al. (1996) have said, cognitive motivation has been typically viewed as a situational variable rather than an individual difference variable, and there is a need to approach cognitive motivation as including both situational and individual factors.

Also for the first time, there is evidence that negative affect does not cause mood bias in life satisfaction judgments. The mood manipulation in this study successfully manipulated negative affect; however, there were no effects for mood or negative affect on life satisfaction judgments. It seems as if mood bias in life satisfaction judgments is related to positive affect only. New approaches to investigating mood in life satisfaction judgments bias need to focus on sub-dimensions of mood such as positive and negative affect.

Theoretical implications. The dual processing theories generally do not account well for mood bias in life satisfaction judgments because either the concept of affect priming is inconsistent with their main thrust of hypothesising decreasing bias with systematic processing or because they do not include need for cognition as an important individual difference variable underlying cognitive mechanisms and processing strategies. Affect priming is not consistent with the main thrust of the heuristic-systematic model (HSM), the judgment model of subjective well being (SWB) and the likelihood elaboration model (ELM), while need for cognition is not included in the Affect Infusion Model (AIM) as an important individual difference variable influencing use of cognitive mechanisms and processing strategies.

However, AIM was designed to include both affect priming and affect-as-information, and this model does hypothesise that individual difference variables influence the use of different processing strategies. This would therefore seem the most appropriate model for investigating mood bias (or affect infusion) in judgments. As mentioned, AIM is a meta-theory with the main purpose of explaining mood bias. The theory endeavours to predict which of four processing strategies will be used depending on features of the situation, the judgment target and the judge. Both heuristic and systematic (called substantive) processing strategies are associated with high mood bias, while direct and motivated processing strategies are associated with low mood bias.

Findings from this study suggest that AIM should explicitly include the influence of individual differences in need for cognition in determining which cognitive mechanisms is underlying mood bias. AIM does include the concept of “motivation for accuracy”, and this motivation is hypothesised to influence whether a heuristic or systematic processing strategy is employed. However, while motivation for accuracy may be thought to be similar to need for cognition, motivation for accuracy is conceptualised as arising from situational features, rather than features of the judge reflecting individual differences. Thus, the findings from this study suggest that the concept of motivation for accuracy should be expanded to include features of both the situation and the judge, and explicitly include need for cognition as an important individual difference variable in predicting whether a heuristic or systematic strategy is employed.

Including need for cognition in AIM is also important because it answers a criticism made of AIM by Schwarz (2002). Schwarz criticises AIM for being overdetermined because both the heuristic and systematic processing strategies predict mood bias. Thus he asks "where are the unique predictions" for these two processing strategies (Schwarz, 2002, p. 87). One response is that with cognitive elaboration, mood bias is expected to decrease for those low in need cognition (reflecting a heuristic processing strategy and the affect-as-information cognitive mechanism) and increase for those high in need for cognition (reflecting a systematic processing strategy and the affect priming mechanism). That is, changes in mood bias associated with cognitive elaboration are different under the two processing strategies, depending on individual differences in need for cognition.

Another theoretical implication arises from the finding that positive affect was more related to mood bias in life satisfaction judgments than negative affect. Previous studies have found more mood bias in positive mood conditions, and this is hypothesised to be due to cognitive interference from intrusive or exciting happy thoughts (e.g., Bodenhausen et al., 1994). This may explain why mood bias was found with positive affect and not negative affect in life satisfaction; however, a positive mood condition is different to positive affect because participants can have scores on positive affect regardless of which mood condition they are in. Therefore, further investigation is needed, and at present none of the main theories covered in this study incorporate different mood bias effects for either positive and negative affect or positive and negative mood conditions.

Limitations. This study had a number of limitations. The first main limitation is that the generalisability of these results depend on the extent to which these the findings apply to populations outside these first year psychology students from an Australian university. For example, Suh and Diener (1998) have recently found that people in Asian cultures do not use affect to inform their life satisfaction judgments.

Regarding the research design employed in this study, using a within subjects design for the cognitive elaboration manipulation was associated with a small decline in levels of positive and negative affect over the course of the experiment, presumably because the mood manipulation at time 2 was less effective than the same manipulation at time 1. While differences in affect were controlled for statistically, a between groups factorial design for manipulating cognitive elaboration and mood could have eliminated this problem. However, the larger sample size needed to achieve the necessary power in such a design was not practical for this study.

Also, the mood manipulation procedure using pictures from the International Affective Picture System (IAPS) was not effective in manipulating positive affect. An implication for the results is that that even though mood bias could still be inferred from the cognitive elaboration manipulation, the effect sizes for the interaction found may have been larger if positive affect had been effectively manipulated.

The IAPS was chosen because it enabled stimuli to be selected to minimise contrast effects, and to introduce a standard mood manipulation procedure to the research of mood bias in life satisfaction judgments. However, this study revealed doubts about using this particular mood manipulation for studying mood bias in life satisfaction because it manipulated negative affect more than positive affect when in fact life satisfaction was more related to positive affect then negative affect. Thus, despite the good psychometric properties of the IAPS, mood manipulations using pictures from the IAPS should be pre-tested, given sufficient time and resources.

Future research. Research is needed to examine the different roles of positive and negative affect in life satisfaction judgments. A study including manipulations for both positive and negative affect may confirm a hypothesis suggested by the findings in this study that mood bias in life satisfaction judgments is caused by positive affect rather than negative affect. This also raises the question as to whether mood bias in life satisfaction judgments is related more to some positive emotions than others. In future exploring this, the effects of specific emotions (such as love, desire, and hope) in biasing judgments may be examined, as suggested by Keltner, Anderson and Gonzaga (2002) and Roesch (1999).

Any future research into mood bias in life satisfaction judgments, and into mood bias generally, should include a cognitive elaboration manipulation, as well as a mood manipulation, to test for both affect-as-priming or affect-as-information cognitive mechanisms underlying mood bias rather than adopting any theoretical predispositions favouring one cognitive mechanism or the other. In doing this, between groups factorial designs are recommended.

In particular, another study needs to be conducted to investigate the opposite situation examined in this study. That is, to test for the prevalence of the affect-as-information mechanism where affect priming is expected to dominate. If it were found again that no cognitive mechanism was to dominate and that the use of a cognitive mechanism depended on individual differences in need for cognition, this would provide very strong evidence confirming the importance of individual differences in determining the use of different cognitive mechanisms.

In conclusion, this study did not find support for a main cognitive mechanism underlying mood bias. Rather, it was found that the cognitive mechanism employed in life satisfaction judgments depended on individual differences in need for cognition. This suggests that rather than focussing on finding a main mechanism, a better approach may be to focus on finding the different individual and situational factors that promote the use of different cognitive mechanisms. Thus, future studies on mood bias should be designed to detect both cognitive mechanisms. Researchers can not assume that one or the other cognitive mechanism is responsible for mood bias in any particular situation or individual. This study has shown that both affect-as-information and affect priming cognitive mechanisms operate in life satisfaction judgments, depending on individual differences in need for cognition.

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Appendix A. Power Analyses

Summary of Power Analyses

The three power analyses on the following pages were conducted on two studies (Abele & Gendolla, 1999; Sedikides, 1995, experiment 4). The first analysis suggested a sample size of 60 was required for a 2x2 between groups design for this study, which is manageable for an honours project. However, the second and third power analyses suggested sample sizes of over 300 for the same design, which is not manageable for an honours project. Therefore, a mixed design was employed in this study.

The study by Sedikides (1995, Experiment 4) had a comparable design to the current study. Mood and cognitive elaboration were also manipulated, and although the judgment was not life satisfaction, it did involve self-evaluative judgments (self evaluation on various positive and negative traits). The following power analyses examined both positive and negative trait judgments in the low elaboration condition since mood bias in this condition was lower than that for the high elaboration condition. The power analyses suggest that the required number for each cell in a 2x2 between groups design be between 15 and 81.

The study by Abele and Gendolla (1999) used a mood manipulation to investigate mood bias on life satisfaction judgments in specific non-social domains such as housing and financial situations. This power analysis suggested a minimum cell size of 175 for a 2x2 between groups design. This is a very large cell size and reflects the fact that mood bias is often not found in specific life satisfaction domains (Schwarz & Strack, 1999).

Power Analysis 1

Detecting mood bias in positive trait judgments under low elaboration. This power analysis was conducted on Sedikides (1995, Experiment 4)

$$s_{\bar{X}_1-\bar{X}_2} = \frac{\bar{X}_1-\bar{X}_2}{t}$$

$$s_{\bar{X}_1-\bar{X}_2} = \frac{6.17-5.27}{3.31}$$

$$s_{\bar{X}_1-\bar{X}_2} = .27$$

$$s_{\bar{X}_1-\bar{X}_2} = \sqrt{\frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}}$$

$$.27^2 = \frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}$$

$$.27^2 = \frac{s_1^2}{20}+\frac{s_2^2}{20}$$

$$s_1^2 + s_2^2 = .27^2.20$$

$$s_1^2 + s_2^2 = 1.48$$

$$s^2 = \frac{1.48}{2} \text{ (assuming } s_1^2 = s_2^2\text{)}$$

$$s^2 = .74$$

$$s = .86$$

$$d = \frac{\mu_1-\mu_0}{\sigma}$$

$$d = \frac{6.17-5.27}{.86}$$

$$d = 1.05$$

$$\delta = d\sqrt{\frac{N}{2}}$$

$$\delta = 1.05\sqrt{\frac{20}{2}}$$

$$\delta = 3.31$$

Power = .91 (from Power tables)

Desired power = .8, $\delta = 2.8$

$$N = 2.\left(\frac{\delta}{d}\right)^2$$

$$N = 2.\left(\frac{2.8}{1.05}\right)^2$$

$$N = 15$$

Power Analysis 2

Detecting mood bias in negative trait judgments under low elaboration. This power analysis was also conducted on Sedikides (1995, Experiment 4). These means for negative trait evaluation in the positive and negative mood conditions reflected mood bias, but were not significant. Unfortunately, the article only provided the means and not the standard deviations. Therefore, the analysis below uses an estimate of .27 for the standard deviation of the distribution of differences between means, based on the previous analysis for positive traits.

$$s_{\bar{X}_1-\bar{X}_2} = .27$$

$$s_{\bar{X}_1-\bar{X}_2} = \sqrt{\frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}}$$

$$.27^2 = \frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}$$

$$.27^2 = \frac{s_1^2}{20}+\frac{s_2^2}{20}$$

$$s_1^2+s_2^2 = .27^2.20$$

$$s_1^2+s_2^2 = 1.48$$

$$s^2 = \frac{1.48}{2} \text{ (assuming } s_1^2 = s_2^2\text{)}$$

$$s^2 = .74$$

$$s = .86$$

$$d = \frac{\mu_1-\mu_0}{\sigma}$$

$$d = \frac{5.55-5.17}{.86}$$

$$d = .44$$

$$\delta = d\sqrt{\frac{N}{2}}$$

$$\delta = .44\sqrt{\frac{20}{2}}$$

$$\delta = 1.40$$

Power = .29 (from Power tables)

Desired power = .8, $\delta = 2.8$

$$N = 2.\left(\frac{\delta}{d}\right)^2$$

$$N = 2.\left(\frac{2.8}{.44}\right)^2$$

$$N = 81$$

Power Analysis 3

Detecting mood bias in life satisfaction judgments for non-social domains. This power analysis was conducted on Abele and Gendolla (1999).

$$s_{\bar{X}_1-\bar{X}_2} = \frac{\bar{X}_1-\bar{X}_2}{t}$$

$$s_{\bar{X}_1-\bar{X}_2} = \frac{.15-(-.16)}{1.77}$$

$$s_{\bar{X}_1-\bar{X}_2} = .18$$

$$s_{\bar{X}_1-\bar{X}_2} = \sqrt{\frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}}$$

$$.18^2 = \frac{s_1^2}{N_1}+\frac{s_2^2}{N_2}$$

$$.18^2 = \frac{s_1^2}{70}+\frac{s_2^2}{70}$$

$$s_1^2 + s_2^2 = .18^2.70$$

$$s_1^2 + s_2^2 = 2.15$$

$$s^2 = \frac{2.15}{2} \text{ (assuming } s_1^2 = s_2^2\text{)}$$

$$s^2 = 1.07$$

$$s = 1.04$$

$$d = \frac{\mu_1-\mu_0}{\sigma}$$

$$d = \frac{.15-(-.16)}{1.04}$$

$$d = .30$$

$$\delta = d\sqrt{\frac{N}{2}}$$

$$\delta = .30\sqrt{\frac{70}{2}}$$

$$\delta = 1.77$$

Power = .43 (from Power tables)

Desired power = .8, $\delta = 2.8$

$$N = 2.\left(\frac{\delta}{d}\right)^2$$

$$N = 2.\left(\frac{2.8}{.30}\right)^2$$

$$N = 175$$

Appendix B. Images used in the mood manipulation

Negative condition

Image Name	Image No.
Snake	1019
Snake	1022
Snake	1030
Snake	1040
Snake	1050
Snake	1051
Snake	1052
Snake	1070
Snake	1080
Snake	1090
Snake	1101
Snake	1110
Snakes	1111
Snake	1113
Snake	1120
Spider	1200
Spider	1220
Spider	1230
Spider	1240
Roach	1270
Roaches	1274
Roaches	1275
Rat	1280
Pit Bull	1300
Dog	1301
Dog	1302
Leopard	1310
Bear	1321
Bees	1390
Shark	1930
Shark	1931
Turtle	1945
Pine needles	5120
Rocks	5130
Stilllife	5535
Stool	7025
Hammer	7110
Truck	7130
NeonBuilding	7180
AbstractArt	7186
File cabinets	7224
FliesOnPie	7360
RoachOnPizza	7380

Image Name	Image No.
Traffic	7590
Cabinet	7705
CarCrash	7920
Needle	9008
Wires	9080
Exhaust	9090
Puddle	9110
Cow	9140
Seal	9180
Dead cows	9181
Horses	9182
Smoke	9280
Garbage	9290
Garbage	9340
Porpoises	9500
Duck in oil	9560
Sick kitty	9561

Positive condition

Image Name	Image No.
Seal	1440
Kitten	1460
Kittens	1463
Dog	1500
Dog	1510
Cat	1540
Horse	1590
Horse	1590
Horse	1600
Butterfly	1603
Butterfly	1604
Rabbit	1610
Rabbit	1610
Sprgbok	1620
Cow	1670
Puppies	1710
Lion	1720

Image Name	Image No.
Lion	1721
Jaguars	1722
Owl	1740
Bunnies	1750
Monkies	1811
Elephants	1812
Porpoise	1920
Flower	5000
Sunflower	5001
Flower	5010
Flowers	5200
Nature	5201
Nature	5220
Waterfall	5260
Nature	5270
Galaxy	5300
Fireworks	5480
Sky	5594
Mountains	5600
Mountains	5660
Mountains	5700
Nature	5760
Nature	5780
Mountains	5820
Clouds	5891
Fireworks	5910
Sky	5982
Skyline	5994
Brownie	7200
Pastry	7220
Turkey	7230
Torte	7260
IceCream	7270
Ice cream	7330
Pizza	7350
Ice cream	7390
Candy	7410
Candy	7430
Pancakes	7470
Pasta	7480
Ocean	7545
Skyline	7570
Desert	7580

Appendix C. Questions asked to induce high cognitive elaboration

(a) How does it measure up to your general aspirations or what you want:

1 = far below average
4 = half as well as what you want
7 = matches or is better than what you want

(b) How does it measure up to the average for most people your own age (i.e., peers):

1 = far below average
4 = average
7 = far above average

(c) How does it measure up to what you think you deserve:

1 = far below what is deserved
4 = matches exactly what is deserved
7 = far above what is deserved

(d) How does it measure up to what you think you need:

1 = far below what is needed
4 = matches exactly what is needed
7 = far above what is needed

(e) How does it measure up to what you expected to have 3 years ago at this point in your life:

1 = extremely less
4 = about what you expected
7 = extremely more

(f) How does it measure up to what you expect to have 5 years from now:

1 = extremely less
4 = about the same
7 = extremely more

(g) How does it measure up to the best in your previous experience:

1 = far below the previous best
4 = matches the previous best
7 = far above the previous best

Appendix D. Information sheet and cover story

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Psychology

Session Outline

We are running two different studies in the hour because they are both short, and they both need intervening tasks. Each study will be used as an intervening task for the other by running the following program:

Study 1 Part 1
Study 2 Part 1
Study 1 Part 2
Study 2 Part 2

Study 1 is a memory task. It looks at the relationship between visual memory and arousal. In part 1 you will be shown a series of photographs which will vary in their arousal level. Then you will do an intervening task (study 2, part 1). Then you will do the second part of study 1, where you will be shown another series of photographs, most or all of which you will have seen before. Your task in part 2 will be to identify those pictures NOT seen in part 1, if any. The number of photographs not seen before could vary between 0 and 20.

Study 2 is pilot testing a short and a long version of a quality of life survey. You will answer the same survey twice; though, one will have some extra questions and the question order will vary. To reduce any carry over effects, you will do an intervening task between the surveys (i.e., the memory task in study 1, part 2).

Potentially offensive stimuli

[Two versions of the information sheet, one for those in the negative condition and one for those in the positive condition, will be created by inserting the relevant paragraph below.]

[Negative mood condition] - The pictures vary in arousal and some pictures may offend some participants. The pictures include dangerous, sick and dead animals, spoiled food, traffic, pollution and garbage.

[Positive mood condition] - The experiment description advised that some pictures may offend some participants. However, not all participants see the same pictures, and you will not be exposed to any pictures considered offensive. The pictures include cute animals, beautiful flowers and landscapes, and delicious food.

Right to withdraw

Participation in this experiment is voluntary and you have the right to withdraw fully or from any aspect of any study, at any time, without any detrimental consequences. If you wish to withdraw from any part of any study, or withdraw from the session fully, please advise the researcher.

Ethical Guidelines

This study has been cleared in accordance with the ethical review processes of the University of Queensland and within the guidelines of the National Health and Medical Research Council. You are, of course, free to discuss your participation with project staff (contactable on 3365 7435). If you would like to speak to an officer of the University not involved in the study, you may contact the School of Psychology Ethics Review Officer directly on 3365 6394 (message on 3365 6230), or contact the University of Queensland Ethics Officer on 3365 3924.

This session is part of a 4th year research project being conducted by Rod McCrea (3365 7435), under the supervision of Dr Len Dalgleish (3365 6805).

Appendix E. Thought listing question in pilot survey

We are now interested in what you were thinking about while answering the questions on the previous pages. In the space below, write down all the thoughts you can remember while answering the previous questions.

- list only those thoughts occurring while answering the questions, do not list any additional or subsequent thoughts.
- list one thought per line.
- be as concise as possible
- ignore spelling grammar and punctuation

We have deliberately provided more space than we think most people will need to insure that everyone would have plenty of room. So don't worry if you don't fill every space. Simply list any thoughts you can remember that occurred while answering the questions.

[lines inserted for responses]

Mark each thought with a '+', '-', or '0', where

'+' = a positive thought about your life

'-' = a negative thought about your life

'0' = an irrelevant thought (i.e., not a thought about your life

Appendix F. SPSS output: ANCOVA with mood

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
COGELAB	Sphericity Assumed	.233	1	.233	.978	.326
	Greenhouse-Geisser	.233	1.000	.233	.978	.326
	Huynh-Feldt	.233	1.000	.233	.978	.326
	Lower-bound	.233	1.000	.233	.978	.326
COGELAB * PADIFF	Sphericity Assumed	.272	1	.272	1.139	.289
	Greenhouse-Geisser	.272	1.000	.272	1.139	.289
	Huynh-Feldt	.272	1.000	.272	1.139	.289
	Lower-bound	.272	1.000	.272	1.139	.289
COGELAB * NADIFF	Sphericity Assumed	.788	1	.788	3.302	.073
	Greenhouse-Geisser	.788	1.000	.788	3.302	.073
	Huynh-Feldt	.788	1.000	.788	3.302	.073
	Lower-bound	.788	1.000	.788	3.302	.073
COGELAB * MOOD	Sphericity Assumed	.090	1	.090	.379	.540
	Greenhouse-Geisser	.090	1.000	.090	.379	.540
	Huynh-Feldt	.090	1.000	.090	.379	.540
	Lower-bound	.090	1.000	.090	.379	.540
COGELAB * NFCR1	Sphericity Assumed	.118	1	.118	.493	.485
	Greenhouse-Geisser	.118	1.000	.118	.493	.485
	Huynh-Feldt	.118	1.000	.118	.493	.485
	Lower-bound	.118	1.000	.118	.493	.485
COGELAB * MOOD * NFCR1	Sphericity Assumed	.081	1	.081	.338	.563
	Greenhouse-Geisser	.081	1.000	.081	.338	.563
	Huynh-Feldt	.081	1.000	.081	.338	.563
	Lower-bound	.081	1.000	.081	.338	.563
Error(COGELAB)	Sphericity Assumed	18.614	78	.239		
	Greenhouse-Geisser	18.614	78.000	.239		
	Huynh-Feldt	18.614	78.000	.239		
	Lower-bound	18.614	78.000	.239		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	3694.673	1	3694.673	1925.667	.000
PADIFF	.227	1	.227	.118	.732
NADIFF	1.598	1	1.598	.833	.364
MOOD	.309	1	.309	.161	.689
NFCR1	1.089	1	1.089	.568	.453
MOOD * NFCR1	1.224	1	1.224	.638	.427
Error	149.654	78	1.919		

Appendix G. SPSS output: ANCOVA with positive affect

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
COGELAB	Sphericity Assumed	.256	1	.256	1.073	.303	.013
	Greenhouse-Geisser	.256	1.000	.256	1.073	.303	.013
	Huynh-Feldt	.256	1.000	.256	1.073	.303	.013
	Lower-bound	.256	1.000	.256	1.073	.303	.013
COGELAB * PADIFF	Sphericity Assumed	.000	1	.000	.001	.971	.000
	Greenhouse-Geisser	.000	1.000	.000	.001	.971	.000
	Huynh-Feldt	.000	1.000	.000	.001	.971	.000
	Lower-bound	.000	1.000	.000	.001	.971	.000
COGELAB * PABR	Sphericity Assumed	.274	1	.274	1.150	.287	.014
	Greenhouse-Geisser	.274	1.000	.274	1.150	.287	.014
	Huynh-Feldt	.274	1.000	.274	1.150	.287	.014
	Lower-bound	.274	1.000	.274	1.150	.287	.014
COGELAB * NFCR1	Sphericity Assumed	.043	1	.043	.180	.672	.002
	Greenhouse-Geisser	.043	1.000	.043	.180	.672	.002
	Huynh-Feldt	.043	1.000	.043	.180	.672	.002
	Lower-bound	.043	1.000	.043	.180	.672	.002
COGELAB * PABR * NFCR1	Sphericity Assumed	.548	1	.548	2.299	.133	.028
	Greenhouse-Geisser	.548	1.000	.548	2.299	.133	.028
	Huynh-Feldt	.548	1.000	.548	2.299	.133	.028
	Lower-bound	.548	1.000	.548	2.299	.133	.028
Error(COGELAB)	Sphericity Assumed	18.834	79	.238			
	Greenhouse-Geisser	18.834	79.000	.238			
	Huynh-Feldt	18.834	79.000	.238			
	Lower-bound	18.834	79.000	.238			

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	3587.808	1	3587.808	2076.090	.000	.963
PADIFF	4.515	1	4.515	2.612	.110	.032
PABR	15.752	1	15.752	9.115	.003	.103
NFCR1	.303	1	.303	.175	.676	.002
PABR * NFCR1	.815	1	.815	.472	.494	.006
Error	136.524	79	1.728			

2. Postive Affect (Form B) recoded

Measure: MEASURE_1

Postive Affect (Form B) recoded	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Low	4.918[a]	.172	4.577	5.260
High	5.716[a]	.163	5.391	6.041

a. Covariates appearing in the model are evaluated at the following values: Difference score for Positive Affect (paa-pab) = .2190.

Appendix H. SPSS output: ANCOVA with negative affect

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
COGELAB	Sphericity Assumed	.517	1	.517	2.157	.146	.027
	Greenhouse-Geisser	.517	1.000	.517	2.157	.146	.027
	Huynh-Feldt	.517	1.000	.517	2.157	.146	.027
	Lower-bound	.517	1.000	.517	2.157	.146	.027
COGELAB * NADIFF	Sphericity Assumed	.819	1	.819	3.419	.068	.041
	Greenhouse-Geisser	.819	1.000	.819	3.419	.068	.041
	Huynh-Feldt	.819	1.000	.819	3.419	.068	.041
	Lower-bound	.819	1.000	.819	3.419	.068	.041
COGELAB * NABR	Sphericity Assumed	.008	1	.008	.035	.851	.000
	Greenhouse-Geisser	.008	1.000	.008	.035	.851	.000
	Huynh-Feldt	.008	1.000	.008	.035	.851	.000
	Lower-bound	.008	1.000	.008	.035	.851	.000
COGELAB * NFCR1	Sphericity Assumed	.142	1	.142	.592	.444	.007
	Greenhouse-Geisser	.142	1.000	.142	.592	.444	.007
	Huynh-Feldt	.142	1.000	.142	.592	.444	.007
	Lower-bound	.142	1.000	.142	.592	.444	.007
COGELAB * NABR * NFCR1	Sphericity Assumed	.094	1	.094	.393	.533	.005
	Greenhouse-Geisser	.094	1.000	.094	.393	.533	.005
	Huynh-Feldt	.094	1.000	.094	.393	.533	.005
	Lower-bound	.094	1.000	.094	.393	.533	.005
Error(COGELAB)	Sphericity Assumed	18.924	79	.240			
	Greenhouse-Geisser	18.924	79.000	.240			
	Huynh-Feldt	18.924	79.000	.240			
	Lower-bound	18.924	79.000	.240			

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	4147.153	1	4147.153	2307.040	.000	.967
NADIFF	.876	1	.876	.487	.487	.006
NABR	5.302	1	5.302	2.949	.090	.036
NFCR1	1.318	1	1.318	.733	.394	.009
NABR * NFCR1	4.570	1	4.570	2.542	.115	.031
Error	142.011	79	1.798			

Appendix I. SPSS output for moderated regression using positive affect

Model Summary[d]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.110[a]	.012	.000	.69710	.012	.983	1	81	.324
2	.120[b]	.014	-.023	.70502	.002	.095	2	79	.909
3	.266[c]	.071	.023	.68892	.056	4.736	1	78	.033

a. Predictors: (Constant), Difference score for Positive Affect (paa-pab)

b. Predictors: (Constant), Difference score for Positive Affect (paa-pab), NFCCEN, PABCEN

c. Predictors: (Constant), Difference score for Positive Affect (paa-pab), NFCCEN, PABCEN, Interaction term for Positive Affect (Form B) and NFC

d. Dependent Variable: lifeb less lifea

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.478	1	.478	.983	.324[a]
	Residual	39.362	81	.486		
	Total	39.840	82			
2	Regression	.573	3	.191	.384	.765[b]
	Residual	39.267	79	.497		
	Total	39.840	82			
3	Regression	2.820	4	.705	1.486	.215[c]
	Residual	37.020	78	.475		
	Total	39.840	82			

a. Predictors: (Constant), Difference score for Positive Affect (paa-pab)

b. Predictors: (Constant), Difference score for Positive Affect (paa-pab), NFCCEN, PABCEN

c. Predictors: (Constant), Difference score for Positive Affect (paa-pab), NFCCEN, PABCEN, Interaction term for Positive Affect (Form B) and NFC

d. Dependent Variable: lifeb less lifea

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			Correlations		
Model		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
1	(Constant)	-.041	.082		-.504	.615			
	Difference score for Positive Affect (paa-pab)	-.127	.128	-.110	-.992	.324	-.110	-.110	-.110
2	(Constant)	-.036	.085		-.425	.672			
	Difference score for Positive Affect (paa-pab)	-.154	.162	-.133	-.951	.344	-.110	-.106	-.106
	PABCEN	-.012	.069	-.023	-.167	.868	.046	-.019	-.019
	NFCCEN	-.002	.006	-.044	-.387	.700	-.020	-.043	-.043
3	(Constant)	-.068	.085		-.801	.426			
	Difference score for Positive Affect (paa-pab)	-.187	.159	-.161	-1.175	.243	-.110	-.132	-.128
	PABCEN	-.004	.068	-.008	-.057	.954	.046	-.006	-.006
	NFCCEN	-.002	.006	-.037	-.330	.742	-.020	-.037	-.036
	Interaction term for Positive Affect (Form B) and NFC	.011	.005	.241	2.176	.033	.219	.239	.238

a. Dependent Variable: lifeb less lifea

Appendix J. SPSS output for moderated regression using negative affect

Model Summary[d]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.195[a]	.038	.026	.68784	.038	3.205	1	81	.077
2	.218[b]	.048	.012	.69301	.010	.398	2	79	.673
3	.280[c]	.078	.031	.68615	.031	2.588	1	78	.112

a. Predictors: (Constant), Difference score for Negative Affect (naa-nab)

b. Predictors: (Constant), Difference score for Negative Affect (naa-nab), NFCCEN, NABCEN

c. Predictors: (Constant), Difference score for Negative Affect (naa-nab), NFCCEN, NABCEN, Interaction term for Negative Affect (Form B) and NFC

d. Dependent Variable: lifeb less lifea

ANOVA[d]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.516	1	1.516	3.205	.077[a]
	Residual	38.324	81	.473		
	Total	39.840	82			
2	Regression	1.899	3	.633	1.318	.274[b]
	Residual	37.941	79	.480		
	Total	39.840	82			
3	Regression	3.117	4	.779	1.655	.169[c]
	Residual	36.723	78	.471		
	Total	39.840	82			

a. Predictors: (Constant), Difference score for Negative Affect (naa-nab)

b. Predictors: (Constant), Difference score for Negative Affect (naa-nab), NFCCEN, NABCEN

c. Predictors: (Constant), Difference score for Negative Affect (naa-nab), NFCCEN, NABCEN, Interaction term for Negative Affect (Form B) and NFC

d. Dependent Variable: lifeb less lifea

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			Correlations		
Model		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
1	(Constant)	-.121	.081		-1.504	.136			
	Difference score for Negative Affect (naa-nab)	.360	.201	.195	1.790	.077	.195	.195	.195
2	(Constant)	-.110	.082		-1.330	.187			
	Difference score for Negative Affect (naa-nab)	.278	.223	.151	1.249	.215	.195	.139	.137
	NABCEN	-.100	.114	-.107	-.882	.381	-.164	-.099	-.097
	NFCCEN	-.002	.006	-.031	-.279	.781	-.020	-.031	-.031
3	(Constant)	-.089	.083		-1.076	.285			
	Difference score for Negative Affect (naa-nab)	.226	.223	.123	1.016	.313	.195	.114	.110
	NABCEN	-.065	.114	-.070	-.572	.569	-.164	-.065	-.062
	NFCCEN	-.003	.006	-.067	-.593	.555	-.020	-.067	-.064
	Interaction term for Negative Affect (Form B) and NFC	.011	.007	.188	1.609	.112	.221	.179	.175

a. Dependent Variable: lifeb less lifea